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Towards Cleaner Industry and Improved Air Quality Monitoring in Kazakhstan

Joint Economic Research Program (JERP)

The World Bank and
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Contents

List of abbreviations

2-TP (air)	Air emissions report template to the public statistics office
API	Air Pollution Index
AQ	Air quality
As	Arsenic
BAT	Best Available Techniques
BATNEEC	Best Available Techniques Not Entailing Excessive Costs
BREF	Best Available Techniques Reference
BTX	Benzene, Toluene, Xylene
C_6H_5OH	Phenol
Cd	Cadmium
CHP	Combined Heat and Power
Cl_2	Chlorine
CO	Carbon monoxide
CO2	Carbon dioxide
CP	Cleaner Production
Cr	Chrome
CU	Copper
EC	European Commission
EEA	European Environmental Agency
EIA	Environmental Impact Assessment
EIPPCB	European Integrated Pollution and Control Bureau
ELV	Emission Limit Value
EMEWR	European Monitoring and Evaluation Program
E-PRTR	European Pollution Release and Transfer Register
EQS	Environmental Quality Standard
ETS	Emission Trading Scheme
EU	European Union
FMI	Finnish Meteorological Institute
GDP	Gross Domestic Product
GG	Green Growth
GHG	Green House Gas
GIG	Green Industrial Growth
GP	Greener Production
H_2S	Hydrogen sulfide
HCHO	Formaldehyde
HCl	Hydrogen chloride
HF	Hydrogen fluoride
Hg	Mercury
HPP	Heat and Power Plant
IED	Industrial Emission Directive
IPPC	Integrated Pollution Prevention and Control
ISO	International Standards Organization
Kazhidromet	Kazakhstan Hydrometeorological Service

KP	Kyoto Protocol
LAT	Lower assessment threshold
LCP	Large Combustion Plant
MEWR	Ministry of Environment and Water Resources of Kazakhstan
MPE	Maximum Permissible Emission
NGO	Non-Governmental Organization
NH_3	Ammonia
Ni	Nickel
Nm^3	Normal cubic meter
NMI	National Metrology Institute
NO_2	Nitrogen dioxide
NOx	Nitrogen oxide and nitrogen dioxide
N-PRTR	Norwegian Pollution Release and Transfer Register
NRL	National Reference Laboratory
O&M	Operation and maintenance
O3	Ozone
OECD	Organization for Economic Cooperation and Development
OSCE	Organization for Security and Cooperation in Europe
PAH	Polycyclic aromatic hydrocarbon
Pb	Lead
PM	Particulate Matter
PM_{10}	Particulate material of aerodynamic diameter 10 µm or less
$PM_{2.5}$	Particulate material of aerodynamic diameter 2.5 µm or less
POD	Template of initial emissions accounting
POP	Persistent Organic Pollutant
PRTR	Pollution Release and Transfer Register
QA/QC	Quality Assurance and Quality Control
SI	International System of Units
SO_2	Sulfur dioxide
SO_4^{2-}	Sulphate
SOP	Standard operation procedures sulphur
TE	Trace elements
TOC	Total Organic Carbon
TSP	Total suspended particles
UAT	Upper assessment threshold
UNECE	United Nation Economic Commission for Europe
VOC	Volatile Organic Compounds
Zn	Zinc

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Executive Summary

Kazakhstan's environmental situation is at a critical cross-road – where the pressures of economic growth without adequate environmental controls and the legacy of industrial production are beginning to take their toll on society in terms of health. In addition Kazakhstan would like to promote itself as a modern and resource-efficient economy that is worthy of top international standing. In response, a series of proactive planning has emerged through such strategic initiatives as the Green Economy Concept (2013) with its accompanying actions that aim to reduce the ecological footprint of economic activities, promote sustainable economic growth and place Kazakhstan on a cleaner and greener development path:

"*A Green Economy is defined as an economy with high living standards, careful and rational usage of natural resources in the interests of current and future generations and in accordance with the principles of the Rio Declaration, the Agenda XXI, the Johannesburg Plan and the Millennium Declaration. Transition to a Green Economy will enable Kazakhstan achieve the proclaimed goal of entering the select group of the top 30 developed countries of the world*."

Key to the success of this initiative is the necessary hard investments in modern technologies, but equally as important are the complementary soft investments to sustain objectives and foster an attitude of continual improvement.

To aid in the achievement of these overarching objectives, outlined below are the results of a recent joint study of the World Bank and the Ministry of Environment and Water Resources specifically aimed at raising awareness of one of the most pressing environmental issues - the economic and health impacts of air pollution. Currently air pollution costs society in excess of $US1.3 billion per year due to health impacts, but most of these costs are hidden and do not appear in national accounts. The stakes are very real and solutions can be easily identified. This year's joint JERP study offers pointed recommendations and actions to help modernize the state air quality management system along with the corresponding regulatory reforms necessary to increase environmental compliance by industry (one of the major contributors to air quality). Recommendations are also aligned with best international standards and approaches used in the European Union – as the Action Plan to Implement the Concept of Transition to Green Economy strives to update environmental standards to be near European Standards. Improvements as suggested below can increase Kazakhstan's industrial modernization, using green technologies and increase competitiveness.

What will it take to realize this vision? The transition to a modern environmental management system for industry will require greater utilization by authorities of sector strategies to be developed by government and the relevant industry associations. These strategies should consist of policies tailored to address the sector specific barriers to meeting regulatory requirements. This approach has been successfully applied in all EU and EU candidate countries where all interested parties comment and are consulted in detail on each new regulation before authorities finalize their regulations. The complexity and sector-

specificity of environmental issues associated with industrial production requires such consultative, if not cooperative, approach to policy making and instrument design and should be focused on reducing environmental pollution by providing incentives for industries to modernize and invest in cleaner production techniques.

Impacts of air pollution

There is significant evidence that exposure to air pollution in Kazakhstan is causing serious health and environmental impacts, particularly in urban and highly industrialized areas. Data demonstrates that ambient air quality in major cities is frequently above health standards[1] and results in significant health costs to the country. Using monitoring station data from major cities in Almaty, Karaganda, Pavlodar and Ust-Kamenogorsk Oblasts - on ambient air concentrations of total suspended solids – it was estimated that particulate matter pollution causes approximately 2,800 premature deaths and costs the economy over US$1.3 billion annually (or 0.9% of GDP) in terms of increased health care costs (see table below).

Distribution of health costs from particulate air pollution in cities among 4 selected oblasts, 2011
(US$ million and % GDP)

	Annual cost (US$ million)	**% of GDP (2010)**
Karaganda Oblast		
Karaganda City	41.6	0.03%
Temirtau town	153.6	0.10%
Balkhash town	33.1	0.02%
Zhezkazgan City	94.2	0.06%
East-Kazakhstan Oblast		
Ust-Kamenogorsk City	156.6	0.11%
Ridder town	19.1	0.01%
Semei City	128.6	0.09%
Glubokoye village	0.3	0.00%
Almaty Oblast		
Almaty City	486.2	0.33%
Taldykorgan City	39.6	0.03%
Pavlodar Oblast		
Pavlodar City	180.8	0.12%
Ekibastuz town	7.8	0.01%
Total (across cities/ towns)	**1341.6**	**0.90%**

Source: World Bank (2012).

Particulate matter pollution is considered to be one of the most serious air pollutants in terms of its impact on health – and even small steps to reduce it can lead to significant benefits. From the assessment above, it can be shown that reducing particulate matter concentrations by even 1 microgram per meter cubed ($\mu g/m^3$) will result in US$57 million in

[1] See Chapter 3 of this report.

annual health cost savings through reductions in premature mortality (death) and improved worker productivity (less sick days) (see table below).

Potential health 'savings' associated with a reduction in PM_{10} and $PM_{2.5}$ among cities in the selected 4 oblasts, 2011
(US$ million and % GDP)[1]

Ambient PM concentration reduction (μg/m^3)	Annual cost (US$ million)	% of GDP (2010)
1	56.7	0.04%
5	274.9	0.18%
10	514.1	0.34%
15	762.4	0.51%
20	1,010.5	0.68%

Source: World Bank (2012).
1 – Proportional reductions are applied to both PM_{10} and $PM_{2.5}$ at the same time.

Environmental priorities

Kazakhstan's current environmental priorities are best stated in the recently approved Green Economy Concept (GEC) for the Republic of Kazakhstan (2013-2020). The Concept and Action Plan provide an ambitious vision for the transition to a Green Economy. It highlights critical reasons for the transition and provides goals, targets, main principles and general approaches. The Concept is structured around six main pillars[2], one of which is *Air Pollution Reduction* with specific actions outlined in the accompanying Action Plan – 5 measures for the industrial sector and 3 for transport.[3] Several actions call for air emissions monitoring and harmonizing standards with those in Europe. European standards are considered best practice – but adherence is also strategically important since Kazakhstan seeks to expand product trade in European markets.

Measuring progress within the Concept will be critical and key to its success will be a modern, internationally-harmonized, monitoring program of air emissions and ambient air quality, along with supporting policies that promote resource efficiency and cleaner production.

[2] **PILLARS**: Effective Water Resources Use, High-Yield Agriculture, Energy Efficiency, Electric Power Industry, Air Pollution Reduction, Waste Management.

[3] **INDUSTRY**: 1) In conjunction with electric and thermal energy producers and other large industrial companies, design proposals to update the emissions standards (nitrogen oxides, sulfur oxides, solid particles, etc.) to be near the European standards; 2) Prepare plans to transit to new emission standards and install dust and gas collectors to comply with emissions standards (NOx, SOx, solids) at energy generation and industrial facilities, and align standards with the European documents; 3) Propose a more effective way to assess and monitor emissions and compliance with the new emission standards including the national budget impact assessment; 4) Make proposals to establish and adopt the benchmarking system for specific emissions per unit of production to improve the greenhouse gas emission trading in the Republic of Kazakhstan; 5) Make proposals to design a system for monitoring accredited independent organizations engaged in verification and validation (determination) of projects and confirmation of greenhouse gas inventory reports. **TRANSPORT**: 1) Revise the standards on car exhaust emissions for compliance thereof with the European regulations; 2) Make proposals to conduct annual car exhaust gas quality inspections; 3) Make proposals to convert public transport to natural gas in Almaty and Astana cities, and in major cities.

To support these objectives the Ministry of Environment and Water Resources and the World Bank, under the auspices of the Joint Economic Research Program (JERP), undertook a series of studies to: 1) identify gaps in the current Kazakh air quality monitoring program and provide recommendations for its modernization; 2) a gap-analysis of environmental permitting, monitoring, and reporting of industrial emissions; and 3) the development of good practice recommendations for an industrial emissions registration system.

The first activity that assesses the state of the air quality monitoring network is important since it not only covers hard infrastructure needs, but also the complementary soft measures such as harmonization with European standards (also mentioned in the GEC), quality assurance and control, data collection and management and corresponding capacity needs.

The second analytical piece evaluating the environmental permitting, monitoring and reporting of industrial emissions (also mentioned in the GEC) is important to on-going efforts within the Ministry of Environment and Water Resources (MEWR) to align more with European standards. The MEWR is also keen on developing its monitoring abilities in order to have a better overview of the industrial emissions in conjunction with permitting reform.. In addition, the current environmental permitting system has parallel systems in place (an old and new system) that sends incorrect signals to companies who only implement 'end-of-pipe' solutions – rather than taking steps to improve efficiency or adopt cleaner production techniques.

The third area covered in this report on developing good practice recommendations for an industrial emissions registration system, supports the emissions monitoring objectives stated in the GEC, increases transparency of actual pollution emissions and sources and thus serves to improve the enforcement functions within the MEWR.

Modernizing the State Air Quality Monitoring Network

The analysis of the current state of air quality management in Kazakhstan included benchmarking air quality in eleven pilot cities and a proposal for a pilot modernization of the air quality monitoring network. Cities were selected based on their urban and industrialized structure. A pilot was selected since a full assessment of all regions and cities of Kazakhstan could not be covered within the budget and time constraints of this study.

Overall, the analysis revealed that compared to current international criteria the air quality monitoring network in Kazakhstan has many features that are out of date. The number of monitoring sites is low for a large country with significant presence of heavy industry. The current selection of monitored pollutants does not comply with the current understanding of priority pollutants that most severely threaten public health and monitoring is based on slow, laborious manual analyses and unrepresentative sampling. The current legal system of air quality standards and the adopted practices related to it are not based on most recent knowledge on the health impacts of air pollutants.

Air quality in eleven cities in the eastern part of Kazakhstan was assessed according to best international practices. Monthly means of Total Suspended Particulates (TSP) (used as a proxy for PM_{10}), NO_2 and SO_2 concentrations from 29 monitoring sites from 2010-2012 in these eleven cities were available. Based on this information it was assessed that the European Union air quality standards were exceeded in ten of the eleven pilot cities. Often concentrations were many times higher than the European Union annual limit values. This suggests very high exposure of citizens to ambient air pollution.

Based on the assessment a modernization proposal of the monitoring network was developed. The pilot approach should also be phased to allow for learning, feedback and adjustments where necessary (see roadmap below).

The first phase includes the establishment of 31 fully-equipped fixed stations and 3 mobile stations. While this number initially appears low for the eleven cities it should be understood that this is the *minimum* number of stations according to EU siting criteria – where a three-year observational period would take place – and then more stations should be added to cater to the specific pollution profile of the area. The full complement of monitored compounds should include: SO_2, H_2S, NO_2, PM_{10}, $PM_{2.5}$, O_3, CO, VOC, Hg, PAH, As, Cd, Ni and Pb. Special emphasis should be made on monitoring high priority pollutants PM_{10}, $PM_{2.5}$ because of its high impact on health. The other compounds complete the picture relative to the wide array of industrial production in Kazakhstan – and reflect best practice monitoring in the EU. Field instrumentation should consist of fast-response and high-accuracy analysers from well-known suppliers (specifications are given in Chapter 5). The chemical laboratories should be updated with new trace element and PAH analytics. All activities need to be carried out according a Quality Assurance and Quality Control system (QA/QC system) that is aligned with best international practice. A national reference laboratory should be established to assure equal and consistent quality of all air quality monitoring in Kazakhstan. A comprehensive training program should also complement these initiatives in new and modern equipment operation and maintenance.

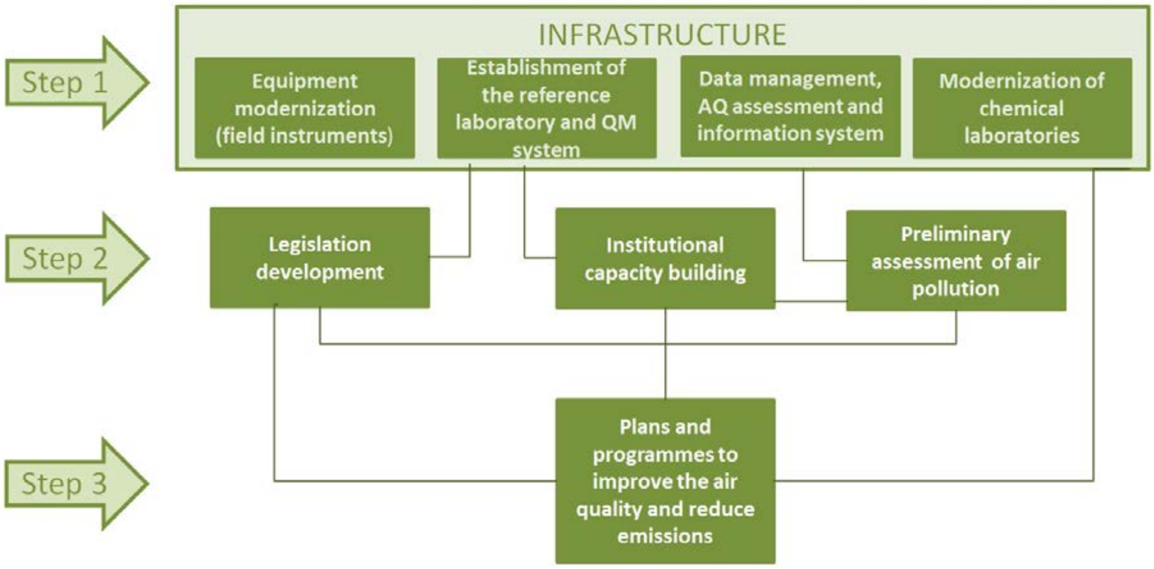
In the latter steps of the first phase - a national air quality data center should be established. Data from the real-time resolution automatic analyzers should be collected hourly and input to databases, processed into a user-friendly format and readily communicated to the public and other users via the internet. For this - an open access national air quality portal should be created. The validated data should also be transferred to the central database where it can be downloaded for annual air quality assessments and other purposes.

The second phase of modernization includes legislative reform, institutional capacity building and the preliminary assessment of air pollution. Legislative development and capacity building initiatives can occur concurrently to the first phase – but the preliminary air assessment should only take place after the appropriate infrastructure and QA/QC functions are established. Legislative reform is covered in more detail in the next section – but would include reassessing, and if necessary redefining, responsibilities related to air quality management. Reform would also address air quality standards for pollutants, assessment regimes, measurement methods, quality assurance, air quality improvement action plans,

programs, information availability and reporting. Institutional capacity building would also be necessary at this stage since the movement to a new regulatory regime requires experience in its implementation – and for that – the experience of other countries who have modernized their air monitoring systems would be invaluable (e.g. Poland, Czech Republic, Macedonia, Latvia, etc.).

The final phase is to use the accumulated information for planning and programs. Information collected will serve as a basis for decision-making on how to reduce air pollution and action plans such as the one that complements the Green Economy Concept can target specific initiatives in key areas. For example, even from the preliminary assessment, the analysis shows that focusing efforts on reducing fine particulate matter in places such as Almaty, Timirtau, Zhezkazgan and Pavlodar would realize substantial economic benefits in terms of reduced health costs.

In terms of a timeline – Step 1 has elements that could be achieved in one or two years, since it mostly includes equipment purchasing, whereas Step 2 activities such as legislative development may take longer depending on how reforms are approved. The preliminary assessment of air pollution is normally undertaken once the 3rd year of monitored data is available to establish a trend. Once the data has been validated across the system, it can then be fed into the decision-making processes of Step 3 – which could be as soon as year 4.



Action plan for the modernization of the State air quality monitoring network and management activities

Improved Environmental Permitting, Monitoring and Reporting

Context

A survey in 2012 of Kazakh companies[4] revealed some of the key reasons why there has not been widespread adoption of cleaner or greener production (CP/GP) or Best Available Techniques (BATs) (see table below). Many factors, whether internal or external, point to issues such as a lack of awareness, management's interest, finance, prices, technical assistance or even public pressure. One important driver that influences each of these is the uncertainty and lack of transparency in regulatory standards and legislation. Without a clear set of rules, companies are reluctant to devote any serious capital towards environmental improvements. The set of environmental fines for violating standards is ineffective as a deterrent and, in fact, these sanctions are often viewed as a 'hunt for fines' that simply support national and local budgets (OECD, 2009).

The current state of environmental permitting, monitoring and reporting underpinning environmental management is lacking and requires reform in a direction that can re-incentivize companies to be more proactive in investing in Cleaner/Green Production and Best Available Techniques which will be more costs effective then investments in end-of-pipe measures which are currently undertaken.

Internal factors in firms	**Technology issues**	**Lack of external incentives**
Lack of awareness and interest in CP/GP from company management	Complexity in CP/GP adoption	Low priced (or subsidized) raw materials and environmental costs
Lack of motivation by middle management in developing CP/GP projects	Costs of CP/GP and BAT technologies	Weak legislative framework to support CP/GP and BATs adoption
Lack of project development skills	Lack of standards	Absence to technical assistance and information support
Lack of financing possibilities		Lack of public pressure on industry and government
		Lack of integration of CP/GP with other policies

A path to reform

Improving the existing environmental permitting, monitoring and reporting system, at first glance, appears challenging. Kazakhstan has undertaken a number of measures to improve its system – and at times borrowing elements from what is practiced in the EU. The Green Economy Concept, and its corresponding Action Plan, also adopts EU principles – largely in response to improving its product/trade competitiveness with EU markets.

[4] World Bank (2012), Modern Companies, Healthy Environment: Improving industrial competitiveness through the potential of cleaner and greener production, Joint Economic Research Program (JERP) FY12, World Bank and the Republic of Kazakhstan, July.

Modernization in this regard involves looking at what exists, what international best practice offers, and then choosing a path of reconciling the two. While there is no, one blueprint for such reform, many other post-Soviet countries have undergone similar transformations and can serve as good examples (OECD, 2005; 2006a; 2006b, 2007).

In EU countries, interested parties should all be given an opportunity to comment on new regulations before the competent authority reaches its decision. The complexity and sector-specificity of environmental issues associated with industrial production also requires a consultative, if not cooperative, approach to policy making and instrument design. "Industrial sector strategy" presents such an approach and has been successfully applied in many countries for each of the present industrial sectors. Such sector strategies are developed by government and the relevant industry associations together and consist of a set of policy instruments tailored to address the sector specific barriers to meeting regulatory requirements. The four steps in developing an industrial sector strategy are: (i) government commitment to developing an industrial sector strategy and selection of sectors; (ii) consultation and coordination; (iii) data collection and analysis; and (iv) introduction of sector policy instruments. Annex 9: *Steps for Developing an Industrial Sector Strategy* describes this in more detail and is based on a World Bank study suggesting tools for policy makers to support cleaner industry in Turkey.

The Government would benefit from collecting detailed information on a sector by sector basis compliance, production processes, key drivers and barriers. Such data are necessary for sound policy making and instrument design and could begin with key, large polluting sectors, who would qualify for an integrated permit. The Government should consider piloting the industrial sector strategy approach in a few industrial sectors, which is recommended for a successful implementation of the industrial sector approach and would allow for a transition period. The transition would be important for revised environmental policy acts such that industry is given the possibility to prepare for changes and the close consultation and feedback of industry, public and other stakeholders. In this manner, the policy has a better chance of being successful. This will also demonstrate an early success which increases the chances of the full policy of being successful. Given these favorable conditions, namely strong sector associations, the Government's increasing inspection and enforcement pressure, and recent experience with consultative approaches – this would serve to increase positive results and show a real impact in terms of environmental improvements at a reasonable cost.

Such a consultative and participatory manner, with the involvement of industry and other stakeholders – who could bring knowledge, interests and help guide what might be practical in terms of compliance, monitoring and reporting - can avoid barriers and increase implementation success.

Assessment of the Kazakh system

In terms of the overall assessment of permitting, monitoring and reporting, no fundamental contradictions were found between the systems applied in Kazakhstan and in EU countries. Kazakhstan has introduced several new regulations in recent years to strengthen the

legal base for both permitting and self-monitoring systems, as well as to introduce elements of technological standardization. Presented here is a summary of some important areas of reform that still require attention – and are fundamental to a well-functioning permitting, monitoring and reporting system.

A key challenge is to ensure smooth implementation of reforms. This entails streamlining, avoiding duplication, removing obsolete elements of the system, as well as capacity building. The study identifies four major directions for regulatory change and improvement. The following sequence of reforms is only indicative in terms of priority – but begins with more fundamental reform areas that can be achieved in relative short periods of time (up to one year). Later reforms build on one another and can take up to 2-3 years to implement.

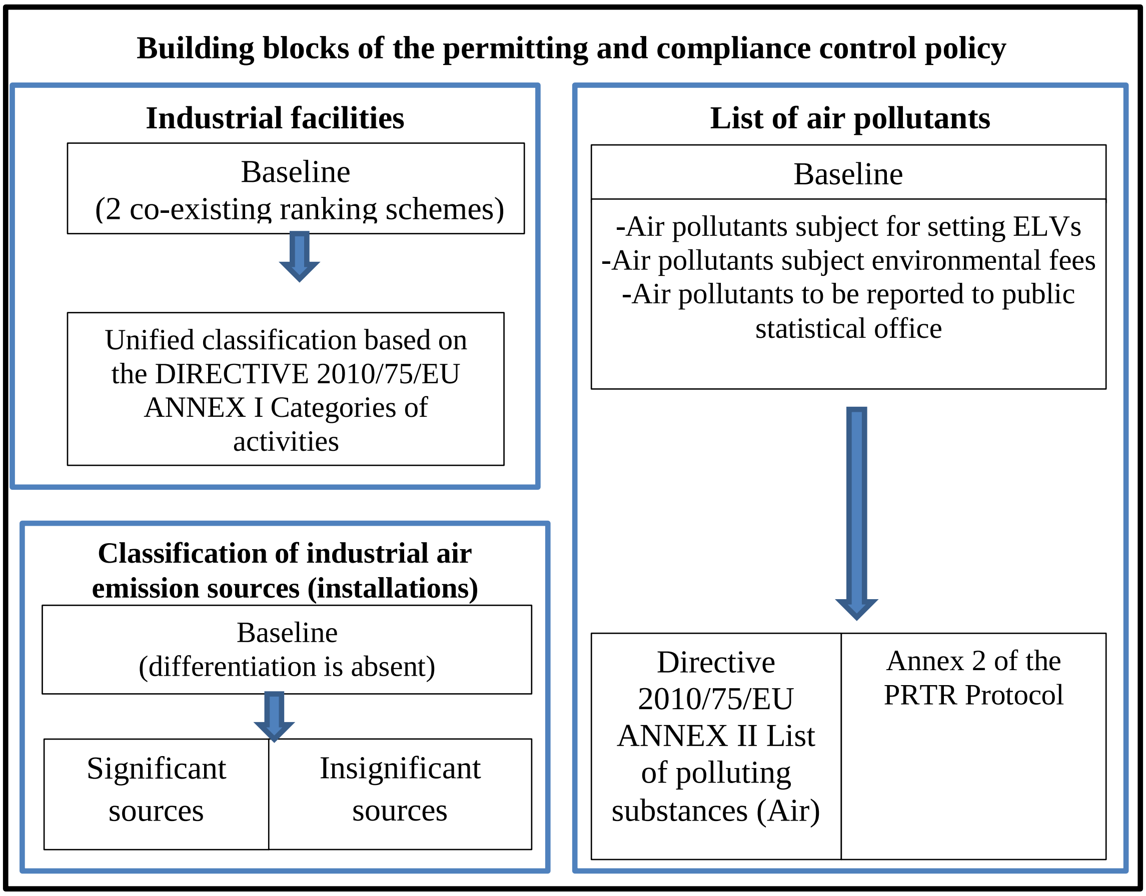
Clarification on the scope of permitting and compliance control
(Priority: to be achieved in one year or less)

The scope of reform for environmental regulation and industrial air emissions control should include several re-classifications to introduce more consistency and help clarify permitting and reporting requirements, including:

- Classification of industrial facilities which are subject to industrial emissions permitting and compliance control;
- Classification of emission sources (installations)[5] subject to permitting and control; and
- Classification of pollutants subject to mandatory environmental compliance control.

The figure below summarizes the current system of industrial classification and proposed changes.

[5] 'Emission sources' and 'installations' are similarly defined in this context as single-point sources of emissions, whereas industrial facilities can contain >1 emission source. The word 'installation' does not appear in Kazakh legislation – and the closest analogue is 'emission source'.



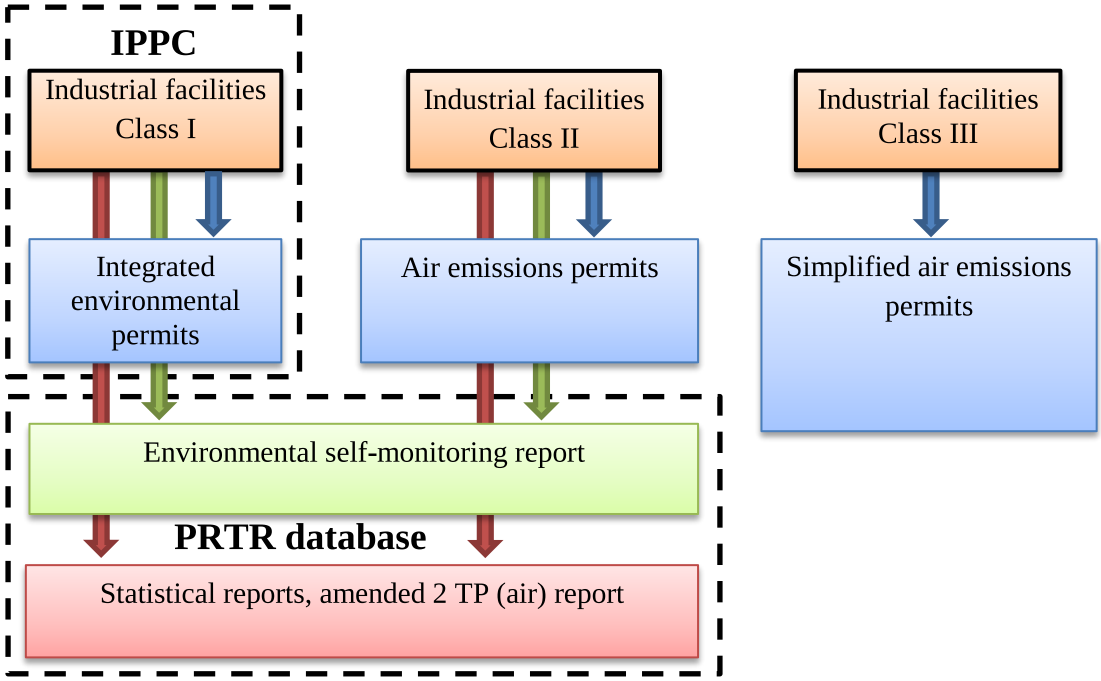
Building blocks and proposed changes to permitting and compliance control policy
(Arrows lead from the current system to the proposed change)

Industrial facilities are currently ranked by two co-existing schemes based on environmental exposure and these should be unified and regrouped into three classes (e.g. Class I-III) that are consistent with practice in the EU (Directive 2010/75/EU). Class I facilities would have the most stringent permitting, monitoring and reporting obligations, while Class III would be subject to more simplified processes (see figure below).

Analogously, emissions sources (installations) should be differentiated according to their relative 'significance' – with the main focus of identifying those whose contribution to overall emissions is quite low – warranting an exemption from the permitting process. The European methodology can help in the definitions finally adopted. Differentiation also lowers the administrative time and cost of issuing permits for all types of operations.

The third area is to harmonize the formal list of air pollutants subject to environmental monitoring with the list of pollutants requiring payment of environmental fees.[6] The current list of pollutants to be monitored in Kazakhstan is quite similar to that under Annex II of Directive 2010/75/EU – but minor adjustments should be made such as dropping those deemed as unnecessary and focusing only on those which have clearer linkages to health.

[6] Harmonizing in this case does not imply that monitored hazardous substances should be subject to environmental fees. Rather they should be banned.



Proposed ranking of industrial facilities and their reporting obligations

Optimizing permitting and compliance control requirements
(Priority: to be achieved in 2-3 years)

The main areas for optimizing the present permitting and compliance control requirements are (see next figure):

- Shifting the focus of environmental requirements from 'end-of-pipe' solutions to integrated pollution prevention and control;
- Amend measurement units of air emissions to better relate them to process conditions;
- Improvement of environmental reporting system.

For the largest ('significant') polluters there should be a shift away from the mentality of command-and-control regulation, which just penalizes non-compliance, and re-incentivize it through integrated pollution prevention and control. Integrated environmental permits are one of the most effective ways in achieving better pollution control since the permit is linked to specific techniques (i.e. BATs) which are associated with lower emissions.[7] In addition the

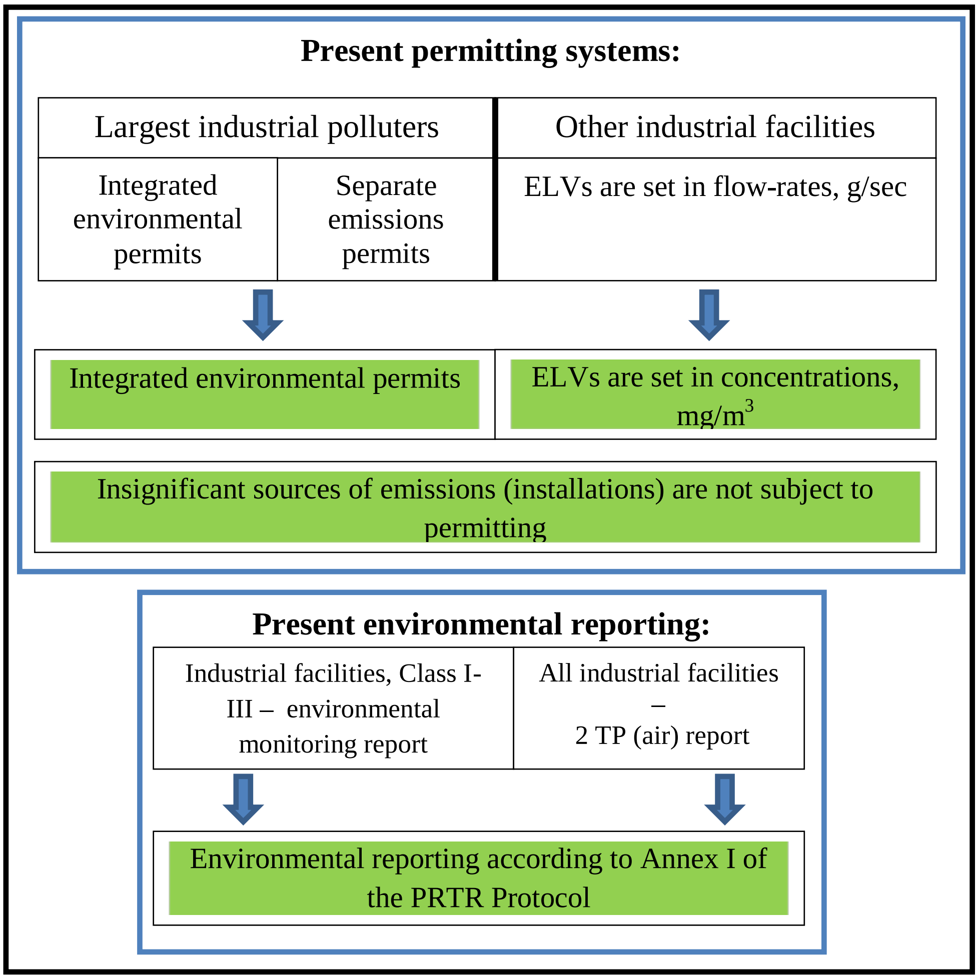
[7] Instead of deriving permit conditions from ambient quality standards (as in Kazakhstan) - European (and most other OECD) legislators derive permit conditions from the best environmental performers in industry. The most advanced enterprises using the best environmental practices are used as benchmarks. Their environmental performance standards and their environmental management practices are defined as best available technique (BAT). They are described and published by Governments in technical guidelines (BREFs) for individual industrial sectors. Specific technical guidelines, numerical performance indicators and references included in BREFs aim to curtail the discretion of permitting agencies and minimize the room for corruption. The "T" in BAT includes technology and the way in which the installation is designed, built, maintained, operated and decommissioned. Such an approach stresses behavioral aspects of permit requirements and comprehensive approach to environmental management of enterprise. It is also meant to prevent the Governments from

firm can realize certain cost savings through a more simplified (integrated) permitting process where separate permits for each type of emission are not required. In instances where integrated permitting is relatively unknown or not well-understood – pilots would be required to demonstrate the effectiveness of these new regulatory tools.

Most EU candidate countries have staged the introduction of integrated permitting (IPPC) with (i) a determination of costs for all prominent industrial sectors; (ii) defining one or pilot sectors to start the permitting process to gain institutional and industrial sector experience and making sure that lessons could be learned before moving to the next sector; (iii) determining a national plan and supporting legislation with concrete dates for each sector when industries are required to obtain their IPPC permit. Such an approach could be undertaken in the Kazakh context.

For other industrial facilities the system of standards needs to be revised. The current system of Emission Limit Values (ELVs) is based on a flow rate (grams/second) whereas it should be set according to the emissions concentration (milligrams/cubic meter). In this regard you benchmark the relative hazard of emissions with the health-based standard. ELVs would be stated as part of the environmental permit. Insignificant sources would not be subject to the permitting process.

prescribing specific technologies and brand names as BAT, as this could distort competition and trade (World Bank, 2006).



Proposed amendments to the environmental permitting and reporting system
(Highlighted areas are the suggested changes to be made)

Ensuring methodological integrity of permit conditions and monitoring of industrial emissions
(Priority: to be achieved in 1-3 years)

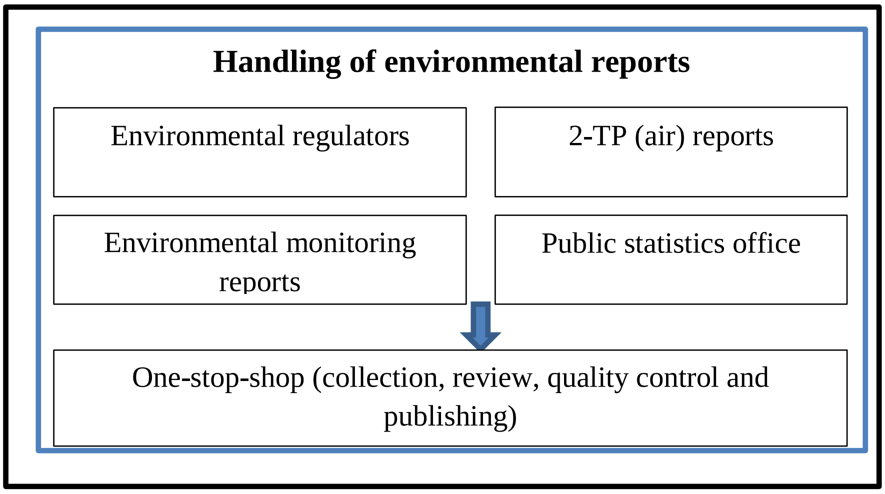
The third broad area of reform relates to integrating several processes into a single document (for both application and reporting purposes) and harmonizing current practice with internationally-recognized methods. One of the most urgent policy actions is to update the methodology for self-monitoring and collate it into a single document. This will increase quality of actual measurement and reduce the need for cross-checking measured values with theoretical methods. Although a bit repetitious from above – a short-list of actions should be to:

- Develop technological standards for emissions on the basis of BATs;
- Develop national reference materials for BAT implementation;
- Develop and adopt a methodology to determine “significant environmental impact” and “major pollution sources”;
- Develop guidelines for conducting environmental self-monitoring;
- Update present regulations on ELVs to reflect the unit assessment of a pollutant in concentrations (mg/m^3).

Enabling public access to self-monitoring and compliance control
(Priority: to be achieved in 1-3 years)

The Environmental Code of Kazakhstan provides an obligation to ensure public access to the results of environmental self-monitoring and environmental permit compliance control. However, in practice, the publication of information on air emissions is not mandatory. Access to information may be possible upon consent by an industrial facility – in written or electronic form - and a fee for providing the information may be charged.

Adoption of the main principles of the PRTR protocol should be the main direction for enabling public access. The processing of environmental reports by various government bodies, which often lack adequate communication, complicates the process making the PRTR operational. As a first step it would be quite important to define the main body which will be responsible for the collection of environmental reports, their verification and maintenance of the PRTR database, making available for all competent authorities, as well as public access to data on industrial air emissions. The essence of the proposed improvement is presented below.



Enabling public access to self-monitoring and compliance control

Stakes and incentives

Transitioning to a new permitting and monitoring system as suggested above will have both benefits and costs – and correspondingly different stakeholder interests. Key to the transition is incentives and a pilot sector approach to allow for incorporation of feedback and industrial barriers. First, the costs of sticking with the old environmental permitting and industrial emission monitoring system include:

- Does not protect human health and makes industrial zones in Kazakhstan unattractive to educated specialists;
- Discourages innovation, improvements in technology and process efficiency in Kazakh industry;
- Does not improve international competitiveness of Kazakh enterprises (acts as a trade barrier to Kazakh products entering more environmentally-sensitive markets and is too resource inefficient);
- Discourages new investments, especially FDI;
- Prevents technology transfer and modernization of Kazakh industry, particularly of green technology;
- Prevents access to finance from IFIs and responsible financial institutions.

Benefits of moving towards integrated permitting and application of Best Available Techniques, based on improved emission monitoring are:

- Focusing on establishing Emission Limit Values for only the hazardous pollutants will a significant reduction of paperwork and increase the industrial focus on emission reduction of the key emissions impacting public health;
- Using Best Available Techniques to increase resource efficiency and optimize production processes can be attractive for industries seeking lower costs structures and reduction in pollution intensity and greater recycling, which can also be financially profitable as there exists a great potential for saving of dust emissions, raw materials, final products, energy, water utilization and waste reduction.

A number of key barriers and disincentives to overcome to ensure successful transitioning to new permitting and monitoring system are:

- Companies benefit from the legally binding nature of EQS, from which ELVs are derived, and which can create a barriers to entry of new (and possibly cleaner) industry in non-compliance zones;
- Companies can avoid investment costs through negotiating individual emission limits and with the lack of benchmarked or actually-monitored industrial emissions, this allows companies to fulfil legal requirements without actually reducing their emissions or taking on accompanying investments;
- The lack of sector participation in the preparation of environmental regulations makes it easier for MEWR to prepare and adopt new legislation, but fails to bring the required effect as they are not underpinned by sub-laws, regulations and

methodologies; and because specific sector problems have not been taken into account.

Incentivizing cooperative outcomes in this situation calls for an iterative and step-wise approach as was suggested earlier. For example, in the EU, industry's IPPC compliance is normally discussed in draft for a number of years in order to allow for feedback of industries, sector associations, NGOs and public and also phased in over time – to accommodate for adjustment costs. This can be combined with other innovative tools to create champions or leaders – such as the development of an environmental fund or credit facility that would co-finance energy- and resource-saving investments. Kazakhstan has (unsuccessfully) experimented with environmental funds in the past, but using that as experience, could design a more effective mechanism founded on an improved permitting, monitoring and reporting regime above (OECD, 2000). Through cost-saving demonstrations – other industries may witness these benefits and undertake cleaner technology investments as well. But sector-specific and consultative approaches are the key to successful environmental industrial policy.

1 Context

The new industrial policy of Kazakhstan (2010-2014), implemented by the President of the Republic of Kazakhstan, aims to reduce raw material use, promote higher value-added production, develop the processing sector, and raise labor productivity through the introduction of innovative technologies.[8] Key actions include the diversification of existing production sectors and improving their (export) competitiveness; increasing manufacturing and agro-industrial labor productivity; developing regional growth centers and improving the public-private interface among priority sectors.

The new policy also includes actions intended to promote cleaner production as part of the (manufacturing) diversification strategy, and this can also be viewed as part of sector modernization:

> "*Successful diversification of economy relates to stable development of the Republic, including the way of optimization of the controlling system of stable development and implementation of "green" policy of low carbonic economy, including the issues of investments attracting, solution of ecological problems, reduction of negative influence of anthropogenic stress on natural ecosystems, strengthening of responsibility of users of natural resources concerning emission reduction in the environment, complex residue utilization*."

The "Green Bridge" Partnership program presented at the seventh "Environment for Europe" Ministerial conference[9] also emphasizes the promotion of green business and technologies and greater application of Best Available Techniques in terms of water conservation, eco-efficient use of natural resources (lowering material usage) and energy efficiency.

The Green Economy Concept for the Republic of Kazakhstan (2013-2020) provides an ambitious vision for the transition to a Green Economy. It highlights critical reasons for the transition and provides goals, targets, main principles and general approaches. The Concept is structured around six main pillars[10], one of which is *Air Pollution Reduction* with specific actions outlined in the accompanying Action Plan – with 5 measures for the industrial sector and 3 for transport[11]. Measuring progress within the Concept will be critical and key to its

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[8] 2010-2014 National Program of accelerated industrial and innovative development of the Republic of Kazakhstan, March 19, 2010.
2020 Strategic Development Plan of the Republic of Kazakhstan, approved by the President of the Republic of Kazakhstan, No 922 February 1, 2010.

[9] "Green Bridge" Partnership Program, Seventh "Environment for Europe" Ministerial Conference, Astana, Kazakhstan, 21-23 September 2011.

[10] **PILLARS**: Effective Water Resources Use, High-Yield Agriculture, Energy Efficiency, Electric Power Industry, Air Pollution Reduction, Waste Management.

[11] **INDUSTRY**: 1) In conjunction with electric and thermal energy producers and other large industrial companies, design proposals to update the emissions standards (nitrogen oxides, sulfur oxides, solid particles, etc.) to be near the European standards; 2) Prepare plans to transit to new emission standards and install dust and gas collectors to comply with emissions standards (NOx, SOx, solids) at energy generation and industrial facilities, and align standards with the European documents; 3) Propose a more effective way to assess and monitor emissions and compliance with the new emission standards including the national budget impact assessment; 4) Make proposals to establish and adopt the benchmarking system for specific emissions per unit of production to improve the greenhouse gas emission trading in the Republic of Kazakhstan; 5) Make proposals to

success will be a modern, internationally-harmonized, monitoring program of air emissions and ambient air quality, along with supporting policies to promote resource efficiency and cleaner production.

Initiatives that promote cleaner, greener and more efficient production can benefit firms through cost reductions in material input use and can enhance their (export) competitiveness by marketing products that adhere to international best practice standards – such as those marketed in the EU and elsewhere. As recognized by the targets set in the new industrial policy and the Green Economy Concept, many current manufacturing processes are resource-intensive and inefficient, and in many cases lead to residual pollution that is not appropriately controlled. The linkages between pollution emissions, ambient environmental conditions and public health are a concern in many localized areas in Kazakhstan.

A study conducted by the World Bank and Ministry of Environment and Water Resources of the Republic of Kazakhstan[12] in 2012 confirmed these observations. Using monitoring station data from major cities in Almaty, Karaganda, Pavlodar and Ust-Kamenogorsk Oblasts - on ambient air concentrations of total suspended solids – it was estimated that fine particulate matter[13] pollution is responsible for over 2,800 premature deaths and costs the economy over US$1.3 billion annually (or 0.9% of GDP) in terms of increased health care costs. Reducing particulate matter concentrations by even 1 microgram per meter cubed ($\mu g/m^3$) would result in US$57 million in annual health cost savings through reductions in premature mortality and improved worker productivity. Recommendations from the report included expanding the current air quality monitoring network - both in terms of the number of stations, and pollutants they monitor. This would lead to more reliable and accurate information that policymakers could use in designing mechanisms to reduce pollution and target sources for greater compliance and enforcement effort.

Against this background – the objective of this study is to inform government policy and identify regulatory changes for improved monitoring of industrial pollution. This is achieved through the development of policy recommendations on industrial environmental permitting, monitoring and reporting; a regulatory assessment to support an Industrial Emissions Registration System; and a conceptual design to modernize the State air quality monitoring network in key Oblasts and industrialized cities.[14]

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design a system for monitoring accredited independent organizations engaged in verification and validation (determination) of projects and confirmation of greenhouse gas inventory reports. **TRANSPORT**: 1) Revise the standards on car exhaust emissions for compliance thereof with the European regulations; 2) Make proposals to conduct annual car exhaust gas quality inspections; 3) Make proposals to convert public transport to natural gas in Almaty and Astana cities, and in major cities.

[12] World Bank (2012), Modern Companies, Healthy Environment: Improving industrial competitiveness through the potential of cleaner and greener production, Joint Economic Research Program (JERP) FY12, World Bank and the Republic of Kazakhstan, July.

[13] Specifically, particulate matter less than 10 microns in diameter (PM_{10}) and less than 2.5 microns in diameter ($PM_{2.5}$).

[14] Key Oblasts and cities covered in the analysis are reviewed in the Chapter 3.

This report is divided into two main study blocks. The first is an assessment of the current state of air quality management in Kazakhstan followed by a design of the air quality monitoring network and recommendations for air quality management for key Oblasts and industrialized cities. This includes:

- The number of monitoring stations and an indication of station types in each Oblast and city;
- Pollutants to be measured;
- Recommendations for the operation, calibration and maintenance of instrumentation including the calibration laboratory;
- Recommendations for the chemical laboratory;
- Recommendations for air quality data management, reporting and data dissemination;
- Priority lists and technical recommendations for needed investments in efficient air quality measurements and data management systems;
- Recommendations for the institutional organization, staffing and training required for different parts of an efficient air quality management system.

Pilot proposals for the Air Quality Monitoring Network in eleven cities - Almaty, Karaganda, Temirtau, Balkash, Zhezkazkan, Ust-Kamenogorsk, Ridder, Semei, Glubokoye, Pavlodar and Ekibastuz.

Background information was collected through stakeholder questionnaires, from reports and data from the Kazakhstan Hydrometeorological Service (Kazhidromet), information gained during the study tour to Finland from experts in the Ministry of Environment and Water Resources (MEWR) and Kazhidromet and interviews conducted during country visits by the Finnish Meteorological Institute (FMI) to Kazakhstan. In advance of this assessment, FMI produced a document on best international practice in designing air quality monitoring networks for use and support of officials working with air quality issues in Kazakhstan (see Annex 1. Best international practices on designing air quality monitoring networks).

The second block of the report assesses the regulatory and policy reforms necessary to improve environmental permitting, monitoring and reporting by industry. Sections include the legislative and institutional context of environmental permitting; monitoring and inspection of industrial emissions; and an assessment of Kazakhstan's industrial emission registration system. Where applicable Kazakh and EU/Norwegian practices and norms are compared to identify gaps and highlight recommendations for improvement. The last section, 14, summarizes these recommendations for improving green growth regulations and industrial emissions reporting and registration elaborated in the preceding chapters.

2 The current status of air quality monitoring network of Kazakhstan

The national air quality monitoring network, operated by the Kazhidromet, presently consists of 78 monitoring stations in 28 urban or industrialized areas. Of these, 56 stations are manual and 22 are automatic stations. The measured compounds, among others, include: total suspended particles (TSP), sulfur dioxide (SO_2), sulfate (SO_4^{2-}), carbon monoxide (CO), nitrogen dioxide (NO_2), ammonia (NH_3), hydrogen sulfide (H_2S), phenol (C_6H_5OH), formaldehyde (HCHO), hydrogen fluoride (HF), chlorine (Cl_2), and hydrogen chloride (HCl), ozone O_3, arsenic (As), cadmium (Cd), lead (Pb), zinc (Zn), chrome (Cr) and copper (Cu).

In Kazakhstan the manual measurements form the bulk of air quality monitoring at present. In the basic program three or four samples per day (i.e. 20 minutes collection at 07:00, 13:00 and 19:00 hours) are collected at each manual site, samples are weighted for TSP and analyzed for CO, SO_2, NO_2, HF, and SO_4^{2-}. At the automatic stations a wide number of pollutants are measured. However, in many cases these data are characterized by unstable data flows, inadequate maintenance and validation and therefore have no official importance. The automatic instruments are calibrated once a year by the manufacturer, and no other regular data validation procedures have been adopted. The instrumentation is generally old and there is a lack of adequate resources for maintenance.

Kazhidromet compiles monthly, quarterly and annual reports of the monitoring results.

Compared to current international standards the air quality monitoring network in Kazakhstan has many features that are out of date. Firstly, the number of monitoring sites is very low for a large country with a lot of heavy industry. Secondly, many high priority pollutants (as PM_{10}, $PM_{2.5}$, O_3, polycyclic aromatic hydrocarbons (PAHs)) are not monitored at all, while the monitoring program includes many substances that are internationally not considered necessary for ambient air monitoring. For example, compounds like ammonia, chlorine, hydrogen fluoride and hydrogen chloride are not included generally in the international ambient air quality monitoring networks and regulations. General public can come into contact with these highly toxic gases or vapours during short-term, high-level exposures due accidents, spills, or other disasters. Long-term exposure or frequent short-term exposure is likely only at workplaces or some other specific indoor circumstances, etc. Therefore these substances are usually rather controlled under e.g. the occupational safety regulations and surveillance, but are not considered necessary to be included in the nationwide operational ambient air quality monitoring networks targeted to the protection of the public health.

The currently used manual methods are partly problematic. The manual wet chemical methods for gaseous contaminants are no longer recommended due to interferences and the insufficient time resolution of data. Instead, high-resolution instrumental methods are currently recommended. By using fast automatic instruments the public and stakeholders can be informed immediately – usually online – about the short-term air pollution episodes. Online timely information to the public is a high priority nowadays internationally.

The current quality control and quality assurance procedures related to the automatic instruments in Kazakhstan are not adequate. For example, the concepts such as reference methods and/or demonstration of equivalence, regular field calibrations and data validation are not included in the current operations. Specific independent unit, reference/calibration laboratory should be established to ensure representativeness and traceability of the collected data. The measurements should be traceable to national and international standards or directly to SI units (International System of Units) and inter-laboratory comparisons should be arranged.

Maintaining the high quality and comparability of the data is a major task of a network operator and the available resources (funds, facilities, personnel, technical skills) should be adequate to be able to maintain measurement instruments within design parameters. Air quality monitoring results will be used as background information when deciding about the necessary emission reductions. Implementing the reduction measures may be very expensive and the decisions need to be based on reliable information.

The current legal system of air quality standards and the adopted practices related to it should be modernized in line with the technical modernization. The legislation in force defines the maximum permissible concentration (MACs) level of pollutants (Table 1). In this regulation the highest-allowed, single-observation value is set for each pollutant; the concentrations of the twenty-minute samples are compared to this value. Another maximum permissible concentration level is set for the daily mean, but in practice annual means are compared to this value. These two standards are defined for two dozen pollutants and each pollutant also has a defined hazard class.

Table 1. The maximum permissible concentration of pollutants in ambient air in Kazakhstan.

Component	Maximum Permissible Concentration (μg/m^3)		
	short term maximum	daily mean	hazard class
carbon oxide	5000	3000	4
nitrogen oxide	400	60	3
nitrogen dioxide	85	40	2
suspended matters	500	150	3
phenol	10	3	2
formaldehyde	35	3	2
ammonia	200	40	4
sulphur dioxide	500	50	3
hydrogen sulfide	8		2
chlorine	100	30	2
hydrogen fluoride	20	5	2
ozone	160	30	1
hydrogen chloride	200	100	2
chrome (VI)		1.5	1
Lead	1	0.3	1
cadmium		0.3	1
arsenic		3	2
chrome		1.5	1
copper		2	2
hydrocarbons	1000		3

These ambient quality standards, adopted from the Soviet Union, were derived in the 1980's from scientific theory of the maximum absorptive capacity of environment and atmospheric diffusion of pollution. They were based on the concept of zero risk to humans and the environment during the worst possible circumstances (e.g. worst-case meteorological conditions, most vulnerable part of population). Transposing these scientific approaches to the regulatory system resulted in the strictest ambient quality standards in the world.

In OECD countries, ambient quality standards are also based on sound scientific data, but are derived from a scientific assessment of acceptable risk levels under precautionary conditions. The desired level of 'quality' is not only a scientific prescription, but also a political and social decision.

One important difference about ambient quality standards (MACs) in Kazakhstan is the policy role they play compared to OECD countries. In Kazakhstan, MACs are considered to be binding limits for all users of a given environmental media. Individual limits (ELVs or Emission Limit Values) of emissions to air, discharges to water and waste disposal are derived primarily from MACs. Any installation who emits, discharges or disposes of polluting substances is required by law to prove to environmental authorities that its incremental pollution will not lead to an infringement of the MAC. Although based on a solid scientific method and high level of precaution, such an approach has a number of shortcomings discussed below in section 12.6 on EU Monitoring Principles.

In OECD countries, ambient quality standards (concentrations of polluting substances in air, water and soil) are policy objectives rather than binding limits. Governments are held politically accountable for achieving these desired objectives. In some countries (e.g. US) the accountability goes so far that governments may be sued by the victims of pollution for failing to achieve objectives of ambient environmental quality. Governments are responsible for translating policy objectives into a system of incentives for economic agents to improve environmental performance. Incentives are embedded in the mix of various policy instruments (permits, sanctions, taxes, tradable permits, subsidies).

In Kazakhstan, the selection of pollutants and permissible concentration levels should be updated based on internationally-accumulated scientific knowledge about the health impacts, and also taking into account the possibilities that the modern high speed/high accuracy monitoring instrumentation provides. The averaging times and minimum data coverage requirements should be defined taking into account the statistical distributions of the pollutant concentrations.

Another widely applied air quality assessment method in Kazakhstan is the annual ranking of cities by calculating an Air Pollution Index (API) for each city. In this procedure the ratio of the measured concentrations to the maximum permissible concentration are weighted by the hazard class of each pollutant and these ratios are summed into one city specific index. Commonly only five most important pollutants are considered in the pollution index calculation (i.e. API_5).

Based on this quite complicated system the cities are ranked according to their pollution levels. For example in 2011 the most polluted city in Kazakhstan was Shymkent (API_5=13.3), and the City of Kokshetau was the least polluted (API_5=0.7).

This approach is very obscure and opaque and doesn't support the targeting of emission reduction measures. This method tends to oversimplify air pollution problems in cities, and even worse, most of the monitoring information remains hidden, with no guidance for required emission reductions.

Air quality indexes certainly are a useful part of a modern air quality information system. However, in practice their use should be limited to the simplified first-hand, usually online information to the public, where attractive, fast and easy-to-understand information needs to be provided. The air quality assessment procedures of the network operators, environmental authorities, enterprises and other stakeholders must be based on component and site-specific monitoring results and their comparison to meaningful limit/maximum permissible concentration values.

In addition, the reporting and dissemination of air quality information procedures should be modernized. Open access to air quality monitoring data is the leading principle of any modern network nowadays. In order to do this effectively, state-of-art information technology methods should be applied. Secure, stable and compatible data and information flows should be ensured starting from the data acquisition systems in the field to the online information available to public and executive professionals in the public and private sector.

3 Assessment of the air quality in eleven cities

This assessment is based on the air quality assessment and management framework set by European Union, i.e., the focus is on the EU priority pollutants and comparison of the measured concentrations is to European standards, when applicable.

For this analysis the air quality monitoring results (manual measurements by Kazhidromet) from the eleven target cities from years 2010-2012 were available. The monthly means of TSP, SO_2 and NO_2 concentrations are used as indicators of particulate and gaseous pollution by industrial processes, energy and heat production and traffic.

In today's current practice, inhalable particles, PM_{10}, have replaced the total suspended particles (TSP) as a regulated priority pollutant. In this study the available TSP concentrations are used as a proxy for the PM_{10} concentrations. It is well-known that particles less than 10 µm constitute a significant proportion of TSP concentration in ambient air. Thus we use a very conservative estimate for the ratio $PM_{10}/TSP = 0.3$ to roughly estimate the PM_{10} concentration level from TSP observations. From the original monthly means, annual means were calculated and compared to the annual limit values set by the EU for protection of human health, i.e. 40 µg/m^3 for PM_{10} and NO_2. For the SO_2 comparison the annual limit value for the protection of vegetation was used, i.e. 20 µg/m^3. The time-resolution of these manual measurements do not allow for more sophisticated analysis, however, this is the best available

method at the moment and should be considered a rough estimation of the pollution levels at the eleven pilot cities.

3.1 Almaty oblast

3.1.1 Almaty

Almaty is located in south-eastern Kazakhstan, at the foot of the Tien Shan Mountains, which surround the city from the south, south-east and south-west. The city is located in the valley but is extensively expanding up to the mountain slopes. The climate in Almaty is a humid continental climate with very warm summers (July average $+22^{0}C$) and cold winters (January average $-8^{0}C$). Due to the wind-sheltered location wind speeds are typically low; and strong and persistent ground level temperature inversions occur frequently. The complex terrain, frequent thermal inversions together with the atmospheric emissions produced by around 1.5 million inhabitants of the city cause heavy local pollution and increase in smog in Almaty.

Figure 1. Photochemical smog over Almaty as viewed from Kok Tobi in June 2013.

Industry in the city can be characterized rather as light. Energy production is based on fossil fuel combustion (gas and coal, diesel as a reserve). The gas fuelled power plants are a major stationary source of air pollutants.

Almaty city has a public transportation system; however, the number of private cars is high. In Kazakhstan the vehicle emission and fuel standards are far behind the current European standards. The current standard for vehicle emissions in Kazakhstan is Euro-3 standard, which will be upgraded to Euro-4 in 2014 (EU introduces Euro-6 in 2014). For fuels “Euro 2” is in force, this standard allows among other things as high as 0.05% sulfur content in vehicle fuels (in EU 0.001%). However, the implementation of even this Euro 2 regulation in practice is difficult as the national oil refineries have only limited capacity to produce Euro 2-level fuels.

In addition to energy production, industrial processes and vehicular exhaust emissions, also small scale combustion for residential heating may seriously deteriorate air quality. Due to the cold climate and the poor dispersion conditions air pollution episodes caused by small scale combustion are also highly probable in Almaty in the winter time.

In the city of Almaty there are five manual ground level stations and the results in 2010-2012 are shown in Figure 2.

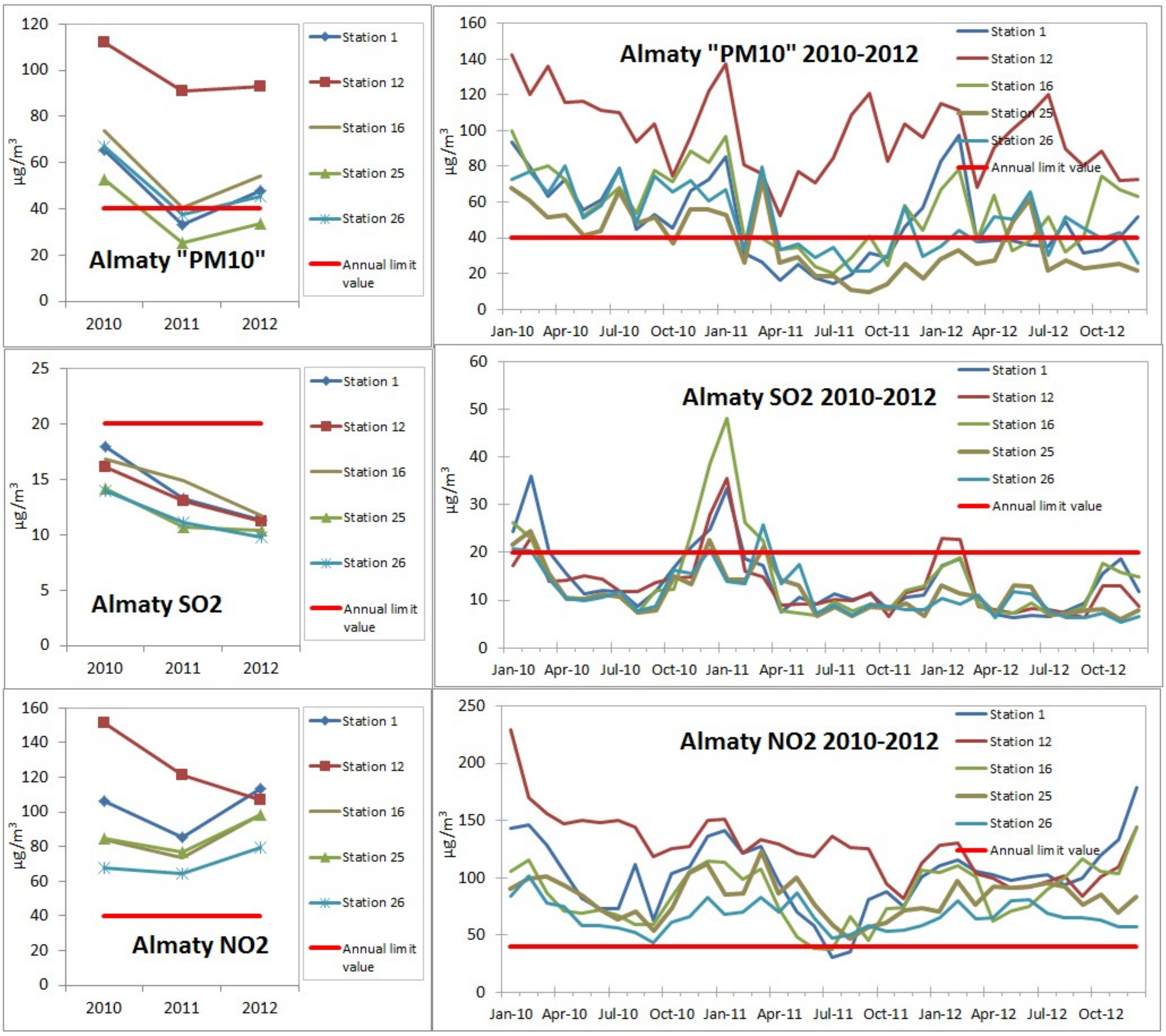


Figure 2. Measured concentrations of air pollutants at five sites in Almaty 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

Both PM_{10} and NO_2 levels are highly elevated widely in the city and exceed the annual limit value set by EU. NO_2 concentration level in the city is twice as high as the annual EU limit value (40 µg/m^3). For CO no direct comparison to the EU limit value (maximum 8 hour average is 10000 µg/m^3) can be done, but the annual mean values of CO at these five stations vary between 3000 - 5000 µg/m^3(not shown) , which strongly suggests that also EU limit value for CO is widely exceeded in the Almaty City. Highly elevated NO_2 and CO concentrations are an indication of high traffic emissions. Given that the highest

concentrations occur during winter time (Figure 2), also large and small scale heat production is a significant source of pollution.

Atmospheric trace element concentrations are measured in Almaty at two stations (Table 2). Heavy metal (Cd, Pb, As) concentrations are generally below their EU target values, but by no means negligible.

Table 2. Trace element concentrations in Almaty city (stations 1 and 3) in 2010 - 2012.

	Average (i.e. annual means) concentrations of trace elements, µg/m^3			
	2010	2011	2012	EU target value
Cd	0.001[1]	0.002[1]	0.002 (0.002-0.003)[2]	0.005
Pb	0.032[1]	0.108[1]	0.150 (0.027-0.272)[2]	0.5
As	0.002[1]	0.008[1]	0.002 (0.002-0.003)[2]	0.006
Cr	0.015[1]	0.010[1]	0.005 (0.004-0.007)[2]	
[1] average of one manual station				
[2] average and range of two manual stations				

Source: Information Bulletins on the State of the Environment in the Republic of Kazakhstan for 2010, 2011 and 2012.

The detected concentration levels in Almaty are high; which is as expected due to the topographic, climatic and emission related information presented previously. Under these circumstances also ozone formation is highly probable and ozone monitoring should be started in this city.

3.2 Karaganda Oblast

3.2.1 Karaganda

Karaganda city is the administrative, economic and cultural center of Karaganda Oblast. It is a major agglomeration with the population of around 500 000. Karaganda is situated at the center of important Karaganda coal basin, however, the working coal mines are outside the city and the closest heavy industry center is located at the Temirtau city around 30 kilometers north of Karaganda city. Although the pollution plume from Temirtau undoubtedly enters the Karaganda city area frequently, the ambient pollution profile of the Karaganda city is rather characterized by diffuse traffic source (Figure 3).

In spite of the rather favorable dispersion conditions (city is located in the middle of the vast steppe), the annual mean limit value of NO_2 is exceeded widely in the city. PM_{10} and SO_2 remain mainly below the EU limit values. High amount of vehicular emissions suggest high potential for photochemical pollution and thus measurements of ozone and fine particles should be included in the measurement program.

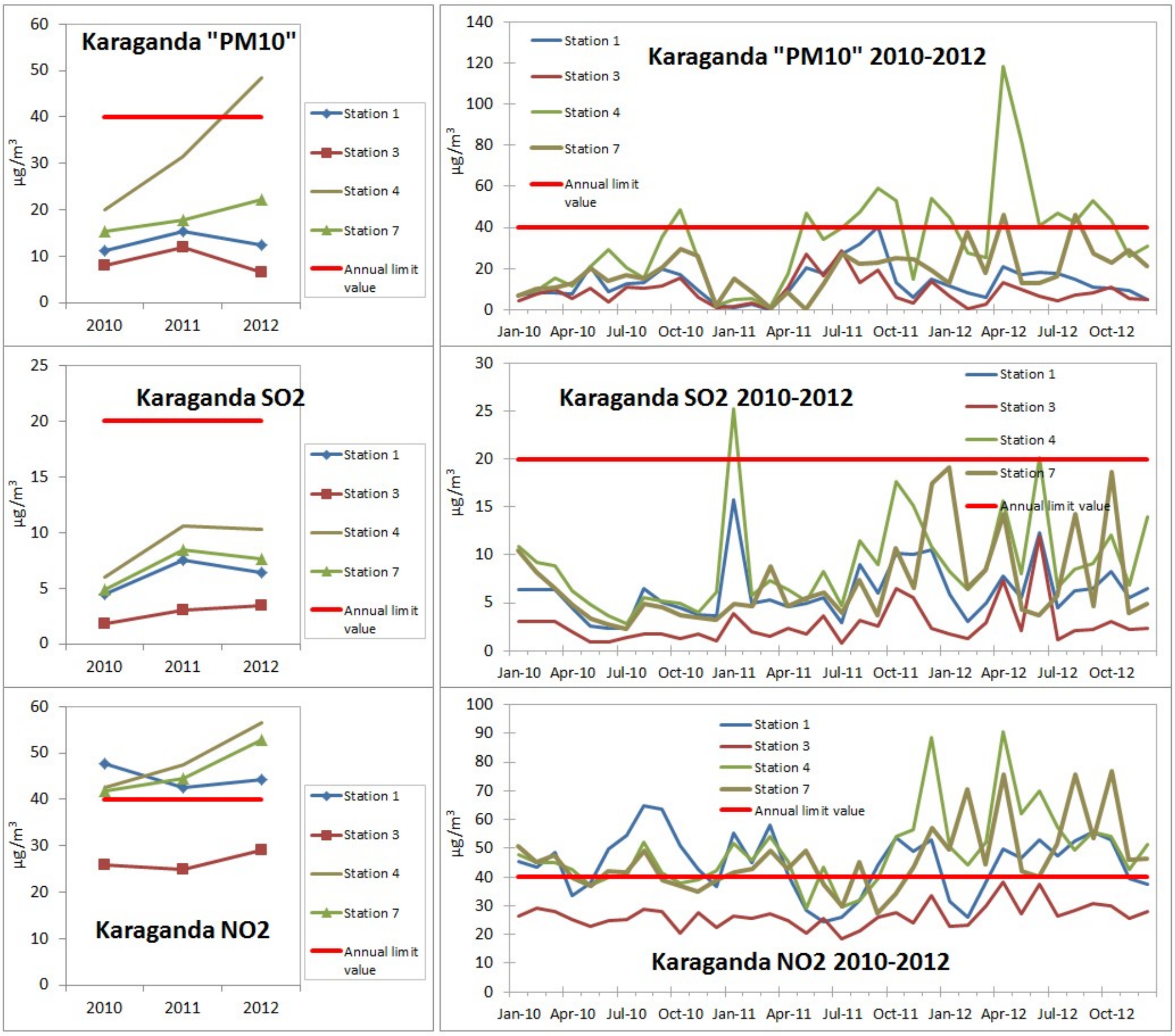


Figure 3. Measured concentrations of air pollutants at four sites in Karaganda 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

3.2.2 Temirtau

The industrial city of Temirtau is located quite close to the huge center of heavy industry (e.g. ArcelorMittal Temirtau steel plant) with massive atmospheric pollutant emissions (Figure 4).

Figure 4. The view from the Temirtau city to the steel production plant in June 2013.

Immense particulate pollution is detected with the current atmospheric monitoring; the estimated mean PM_{10} concentration level in the area is around 80 µg/m^3, i.e. at least twice as high as the EU limit value for PM_{10}. Due to the nature of the industry, high emissions of trace elements and polycyclic aromatic hydrocarbons are likely. Also, vast fugitive emissions are generated during material handling operations. Also the ambient concentrations of SO_2 and NO_2 are elevated (Figure 5). At the moment no appropriate $PM_{2.5}$, trace element and PAH monitoring is conducted in this highly polluted city.

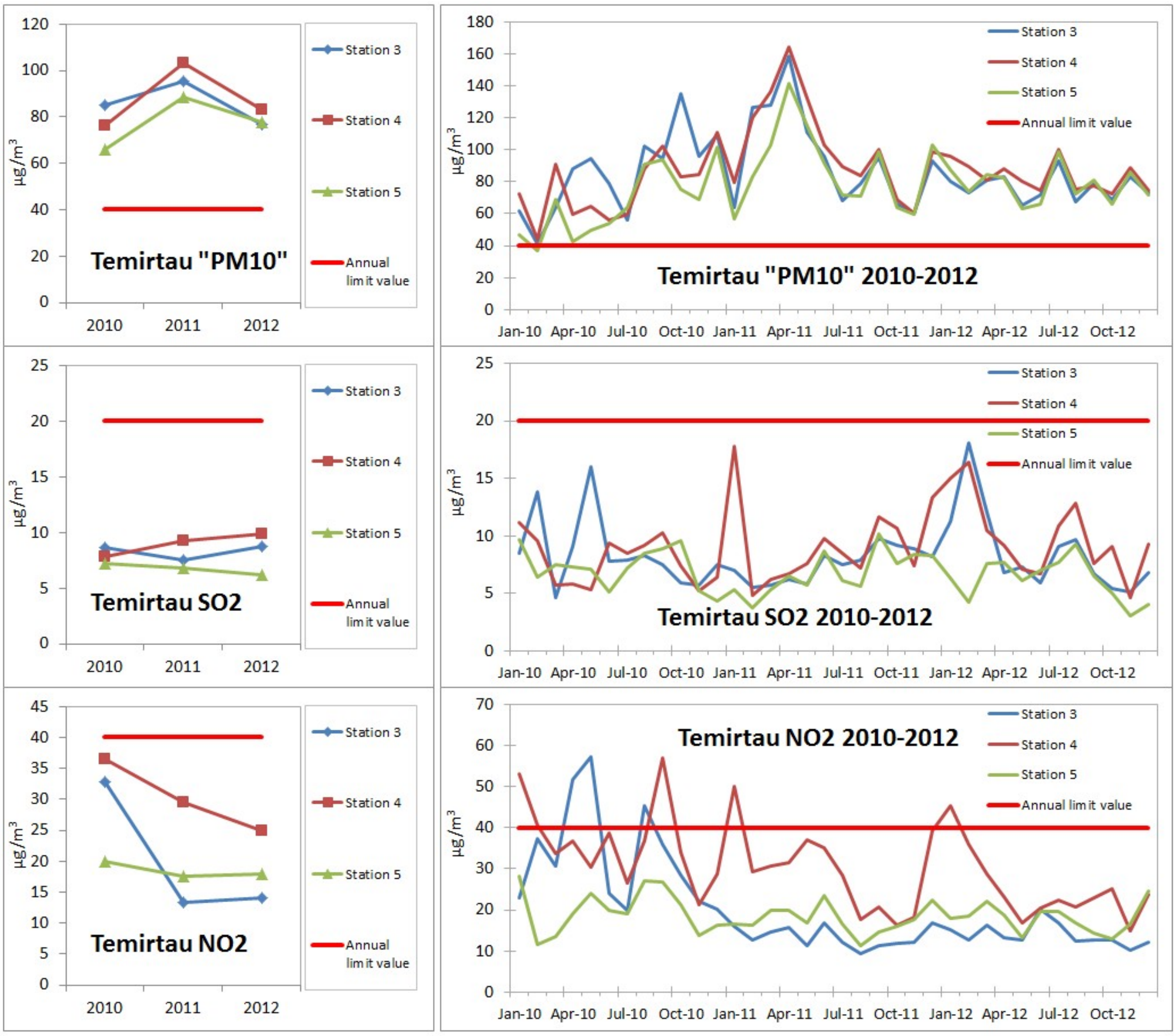


Figure 5. Measured concentrations of air pollutants at three sites in Temirtau 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

The city area suffers also from serious mercury (Hg) contamination. From the 1950s until its closure in the mid-1990s, an acetaldehyde production plant used high amount of mercury as a catalyst in the production process and among others released mercury-containing wastewater directly into the Nura River. As a result of inappropriate storage, spills and leakages, large amounts of mercury remain in the surrounding soils. Due to the re-mobilization of this previously deposited mercury, high concentrations of atmospheric elemental mercury are highly probable in Temirtau.

These results indicate that the around 200 000 inhabitants of Temirtau city are highly impacted by elevated concentrations of fine particles, the most harmful form of air pollution. Taking into account the huge emissions, the likely distribution patterns and obvious exposure of the population, enhanced monitoring of atmospheric pollution is recommended. Special attention should be placed on fine particle and trace elements (including Hg) and PAH compounds.

3.2.3 Balkhash

Balkhash city lies approximately 350 km to the southwest from Karaganda on the north side of the lake Balkash. Balkhash is an industrial city (population around 70 000) centered around the mining and smelting of copper. Emissions from primary copper smelters are typically particulate matter and sulphur oxides. Particulate matter emission constitutes of copper and iron oxides, but other oxides, such as arsenic, cadmium, lead, mercury, and zinc, may also be emitted. Depending on the process, high H_2S emissions are also possible.

The current air quality monitoring suggests serious sulphur and trace element pollution in the Balkhash city. In 2012, the mean SO_2 concentrations were 45 and 60 µg/m^3 at the stations 1 and 2, respectively (Figure 6). The mean values of Cd and As exceed frequently the target values set by EU for the protection of human health (Table 3).

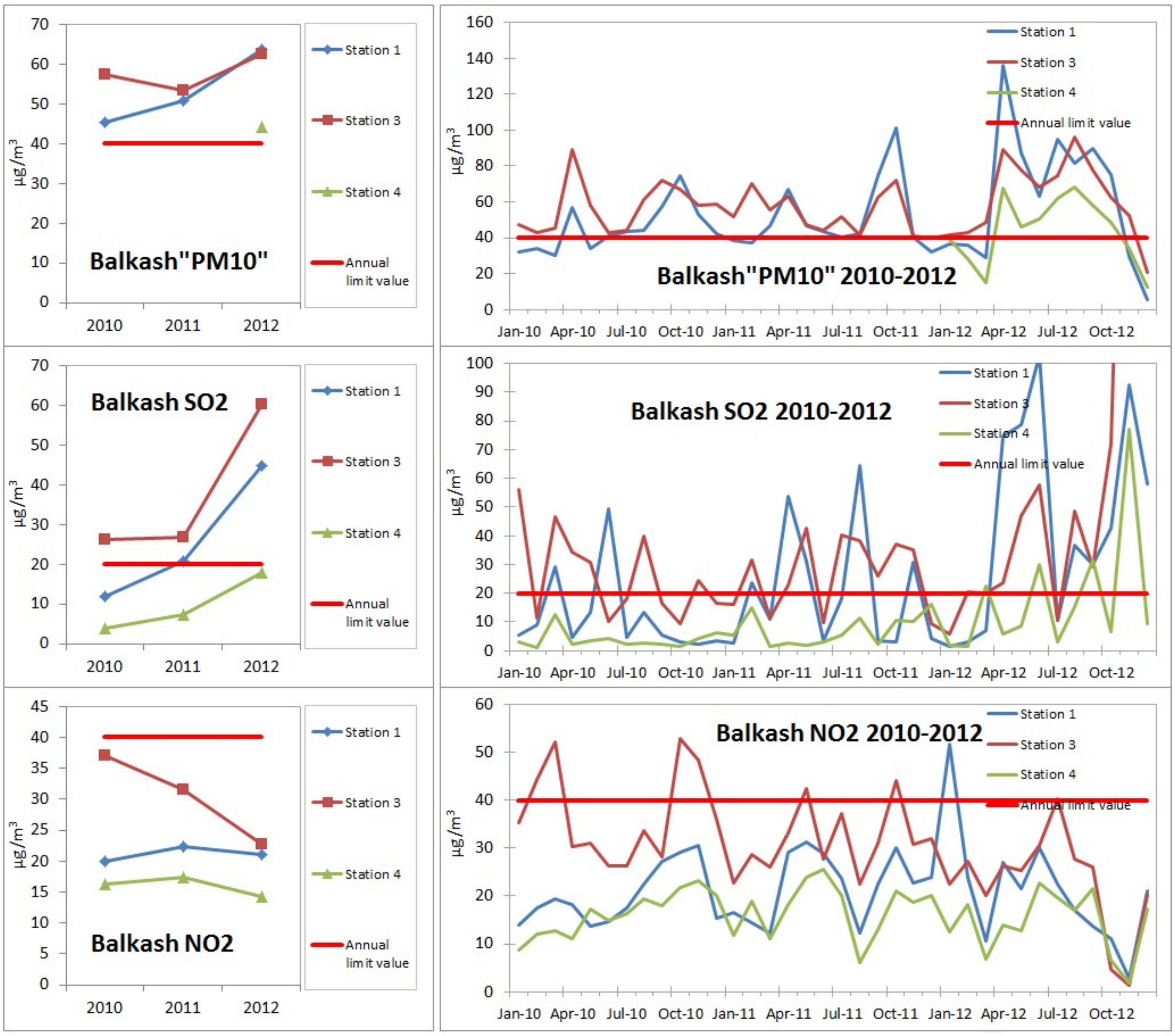


Figure 6. Measured concentrations of air pollutants at three sites in Balkash 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

Table 3. Trace element concentrations in Balkhash city (stations 1 and 3) in 2010 -2012.

	Average concentrations of trace elements in Balkash, µg/m^3			
	2010	2011	2012	EU target value
Cd	0.003[1]	0.006[1]	0.007 (0.006-0.008)[2]	0.005
Pb	0.145[1]	0.272[1]	0.36 (0.31-0.41)[2]	0.5
As	0.03[1]	0.042[1]	0.053 (0.056-0.051)[2]	0.006
Cr	0.015[1]	0.004[1]	0.002 (0.002)[2]	
[1] average of 2 manual stations				
[2] average and range of two manual stations				

Source: Information Bulletins on the State of the Environment in the Republic of Kazakhstan for 2010, 2011 and 2012.

These results indicate that the fine particle fraction in this area may be a complex mixture of very harmful inorganic and organic compounds. Enhanced monitoring of trace elements and PAH alongside with SO_2 and H_2S should be established.

3.2.4 Zhezkazgan

Zhezkazkan is the third highly polluted industrial city in the Karaganda Oblast. The city is located around 450 kilometers southeast from the regional center of Karaganda. It has population of around 80 000. Like Balkash, it is dominated by copper deposits and mining and metallurgical complex utilizing it. Compared to Balkash, clearly less air pollution information is available for this city. However, the estimated PM_{10} concentrations from the two manual measurement sites in Zhezkazgan city suggest extremely high particulate pollution (the estimated PM_{10} concentration levels between 100 and 140 µg/m^3, see Figure 7). Enhanced monitoring of trace elements and PAH alongside with SO_2 and H_2S are recommended.

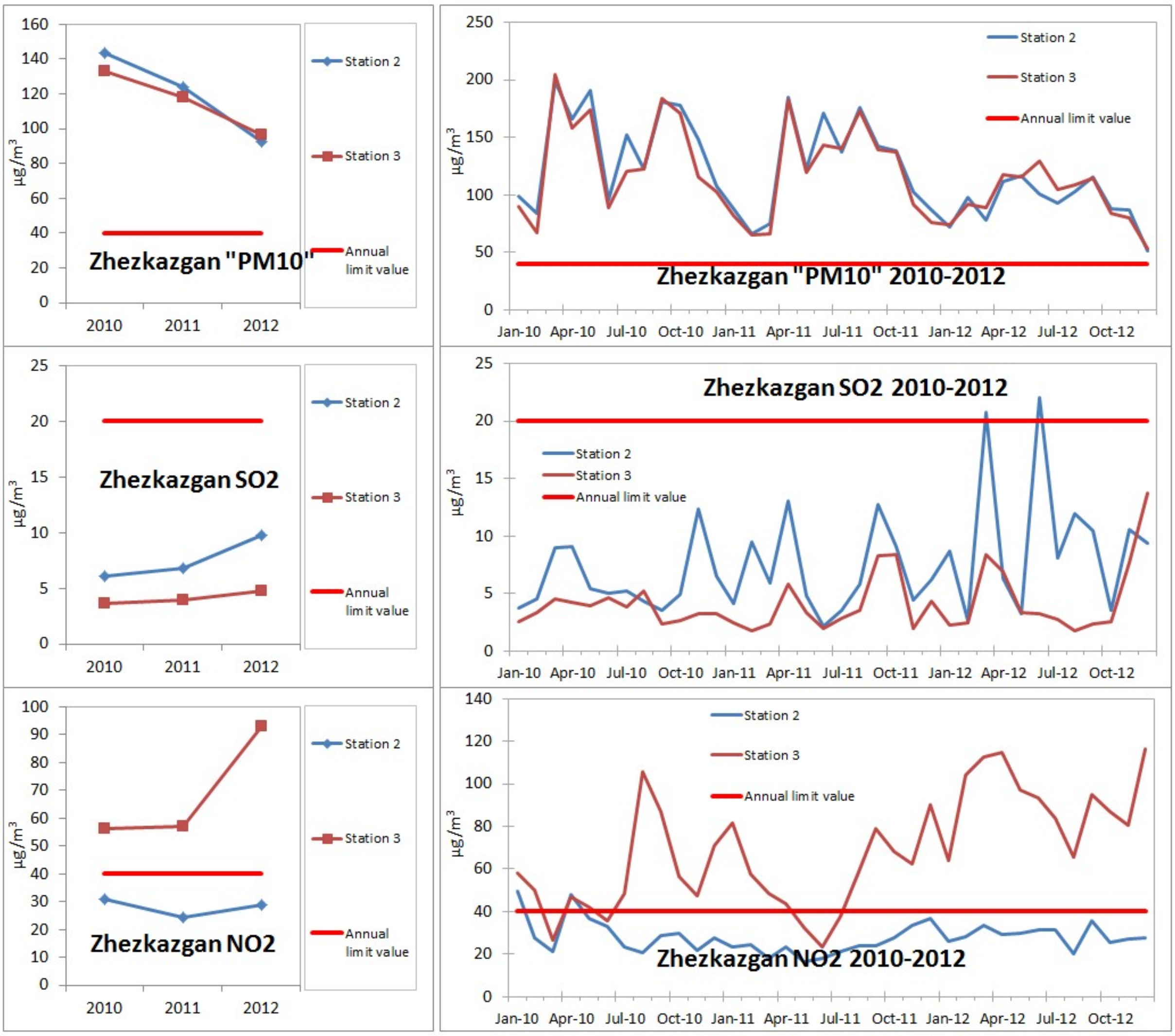


Figure 7. Measured concentrations of air pollutants at two sites in Karaganda 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

3.3 East Kazakhstan Oblast

3.3.1 Ust-Kamenogorsk

Ust-Kamenogorsk is the administrative center of the East Kazakhstan Oblast with the population around 300 000. It is located at the north eastern corner of Kazakhstan on the bank of the Irtysh River. The landscape of the city varies from hills on the left bank of the river to mountains on the right bank. The climate in East Kazakhstan varies from moderately continental to sharply continental.

Ust-Kamenogorsk was one of the greatest centers of mining and smelting industry of the former USSR and still it is a major mining and metallurgical center. Non-ferrous metals, especially uranium, beryllium, titanium, tantalum, copper, lead, silver and zinc are important products.

Being a major agglomeration and a center for heavy industry employing outdated technology is reflected in serious air pollution problems in Ust-Kamenogorsk. Air pollution monitoring results from five sites in the city area indicate that air pollution level seriously violate the European standards set for the protection of human health. The mean concentration levels of PM_{10}, SO_2, NO_2 in the city are alerting high; around 60 - 100 µg/m^3 (Figure 8). These high concentrations pose a serious threat on population health. The joint effects of extreme weather conditions and extremely high pollution level make situation even worse for the citizens.

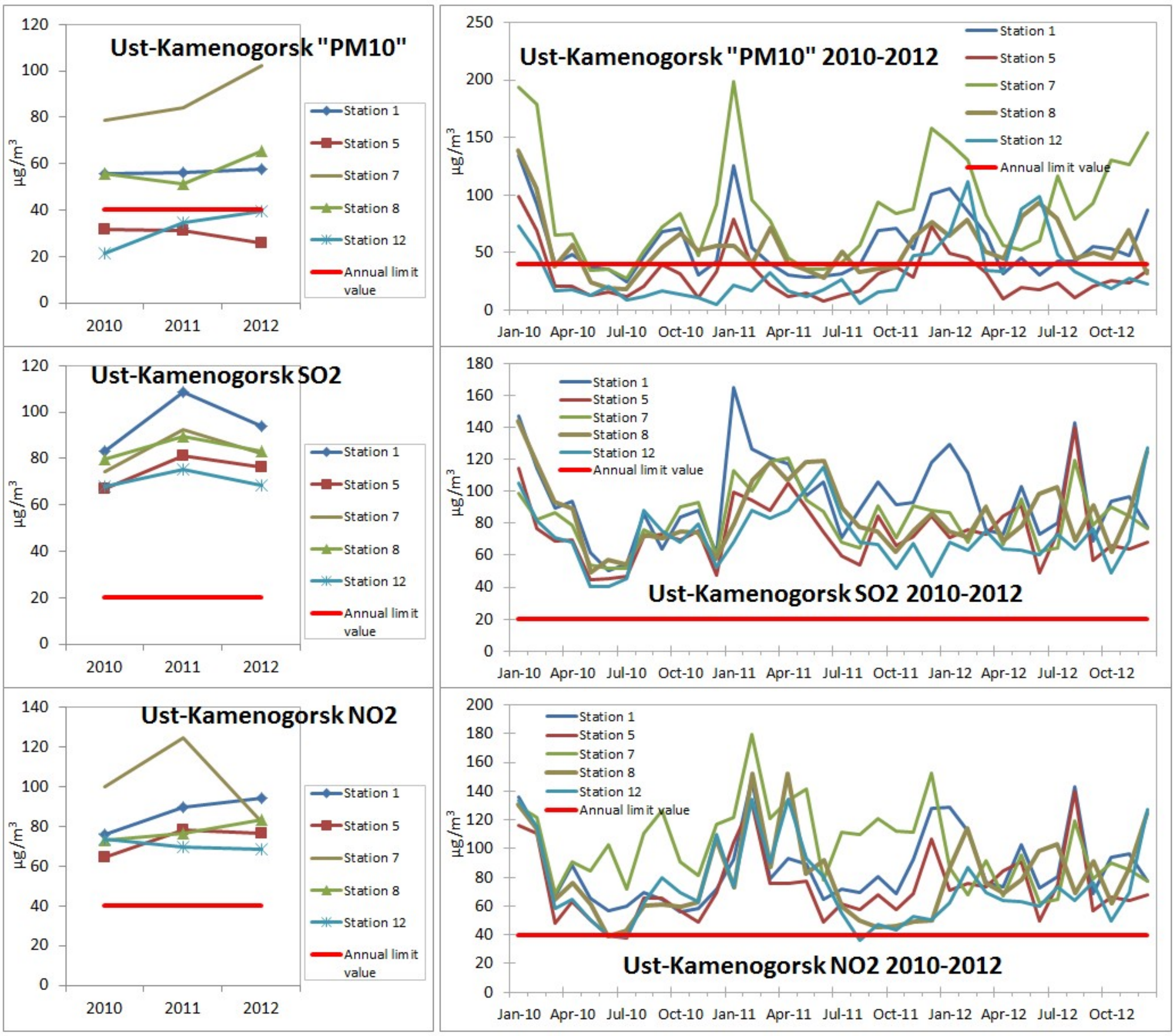


Figure 8. Measured concentrations of air pollutants at five sites in Ust-Kamenogorsk 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

3.3.2 Glubokoye

Glubokoye village is located 30 kilometers north-west form Ust-Kamenogorsk. Total population of Glubokoye area is around 60 000 inhabitants. Very little information is available to us regarding the industrial activities in this area. The area is rich in polymetallic ores, and at least a copper-smelting plant is located in the area. In Glubokoye village there is one monitoring station and alerting high levels of SO_2 and NO_2 are detected (Figure 9), suggesting serious industrial pollution.

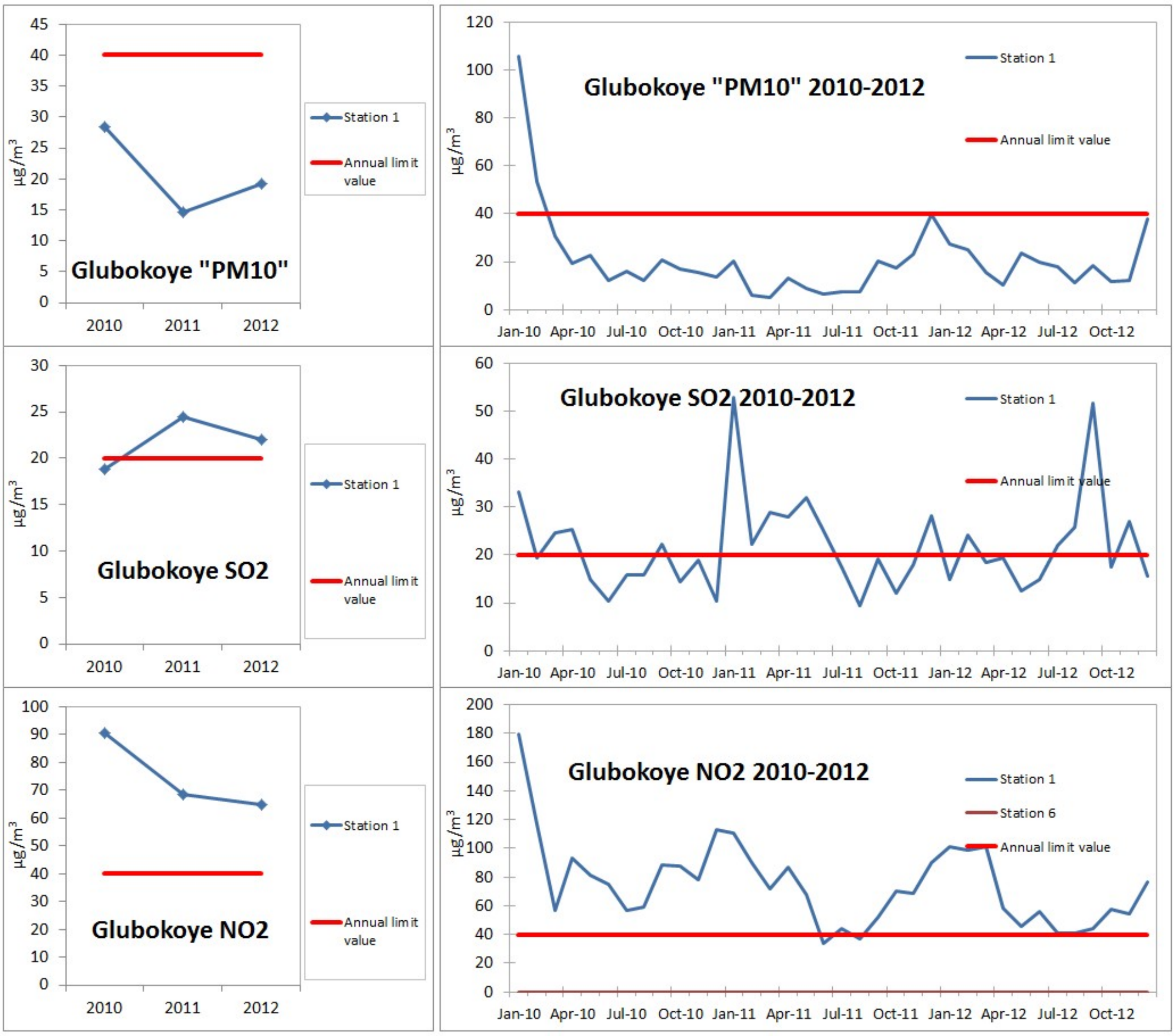


Figure 9. Measured concentrations of air pollutants at one site in Glubokoye 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

3.3.3 Ridder

Ridder is an industrial town of around 60 000 inhabitants, located 80 kilometers north-east from Ust-Kamenogosk, deep into the mountainous terrain. Local ore deposits are rich in lead, zinc, gold, silver, cadmium, antimony, arsenic, tin, iron and sulphur. These ores are utilized in heavy mining operations and processing of nonferrous metals in the town area.

In Ridder extremely high atmospheric pollutant levels are detected. PM_{10} exceeds the EU annual limit value, and SO_2 and NO_2 concentration level are four and two times higher, respectively, than the European standards (Figure 10). The nature of local industry (polymetallic processes) suggests a very complex mixture of harmful compounds in the atmospheric fine particle fraction.

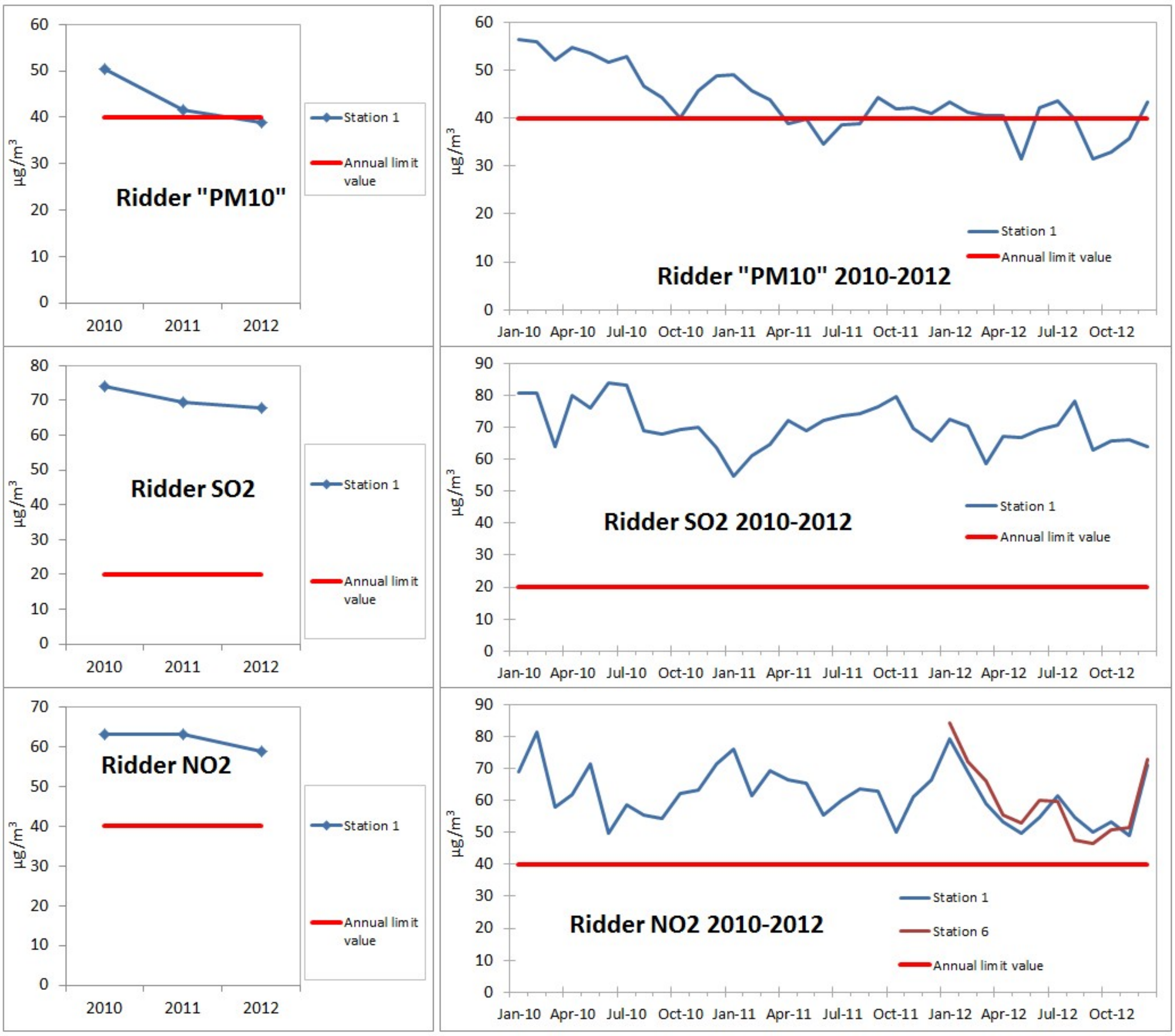


Figure 10. Measured concentrations of air pollutants at one site in Ridder 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

3.3.4 Semei

Semei is a city of 300 000 inhabitants located 175 kilometers north-west from Ust-Kamenogorsk on the banks of Irtysh River. The largest industrial activities include production of construction materials; cement, lime and silicate bricks and production of electric and thermal energy. Other industrial activities are rather light industry as food processing and textile industry.

The city does not host any outdated metallurgical industry, and as a result the air pollution problems in the city are not perhaps as enormous as in many of the cities addressed above. However, compared to the European standards, there is place for improvement there too; the results of the two air quality monitoring sites suggest that SO_2 concentration exceed the EU limit value and PM_{10} as well as NO_2 levels typically vary around their EU limit values (Figure 11).

The large population and the associated high number of vehicles may well be the major reason for these elevated concentration levels. High vehicular emissions suggest high

potential for photochemical pollution and thus measurements of ozone and fine particles should be included in the measurement program.

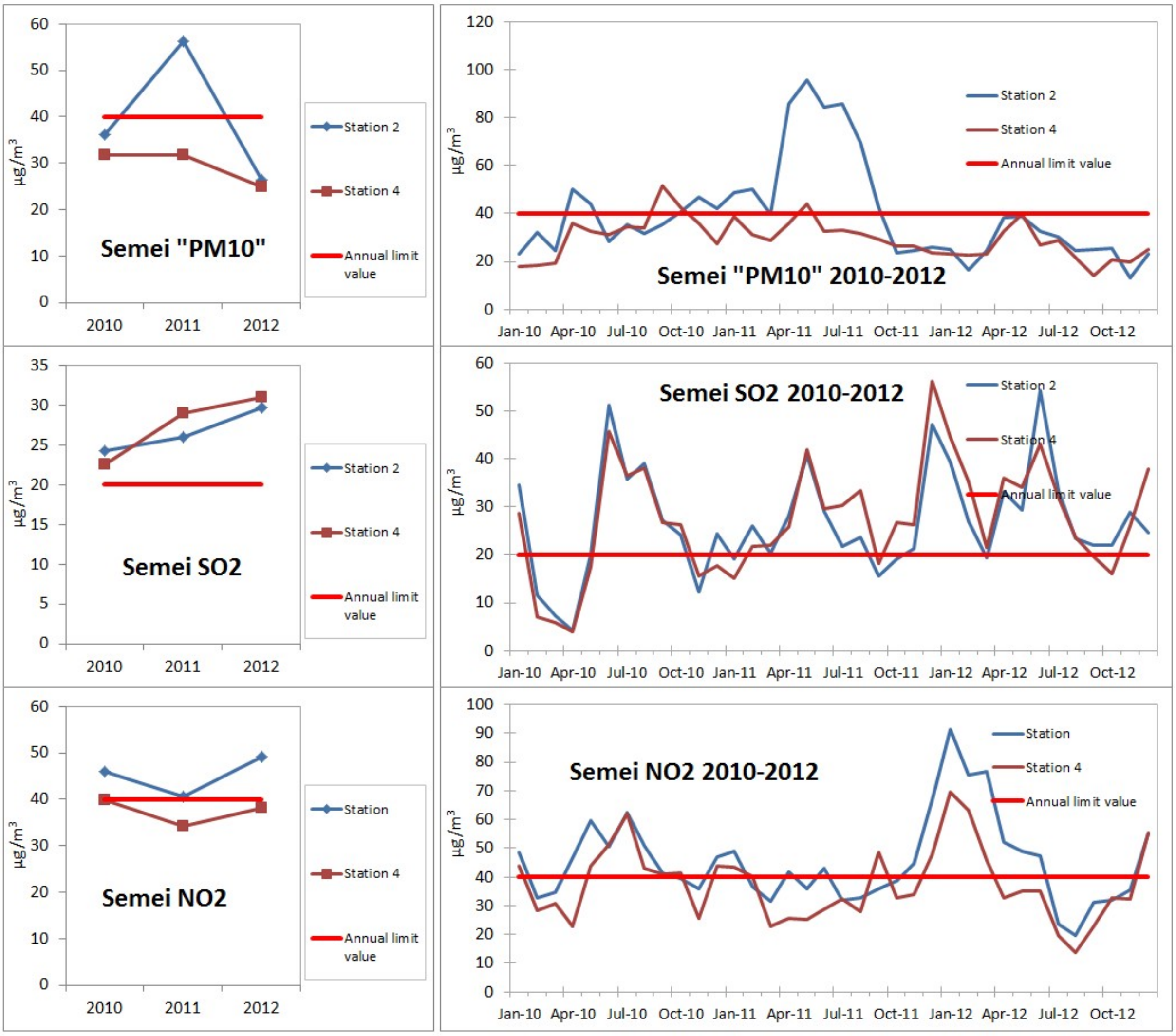


Figure 11. Measured concentrations of air pollutants at two sites in Semei 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

3.4 Pavlodar oblast

3.4.1 Pavlodar

Pavlodar city is the capital of Pavlodar Oblast, the population of the city is around 330 000 people. The climate is sharply continental and arid. Dust storms are common during hot, dry summers.

Pavlodar is a major industrial center, most important industrial sectors are bauxite mining, alumina and aluminum production, heat and power production, oil refining and mechanical engineering. However, in Pavlodar the heavy industry is mainly situated outside the city and residential areas, and moreover, the plants are relatively new or have been upgraded towards more efficient and cleaner production technologies. For example the aluminum smelter was

started in 2008 with the state-of-art technology. The power supply for this energy intensive production comes from a coal-fired power plant at Aksu, 30 kilometers south from Pavlodar.

As a result, the pollutant concentrations detected at the two sites in Pavlodar city are relatively low; i.e. SO_2 and NO_2 concentrations are well below the EU limit values (Figure 12). PM_{10} concentrations vary around the EU limit value, however, the seasonal cycle of the concentrations suggest that summer time dust storms have some impact on the concentration levels.

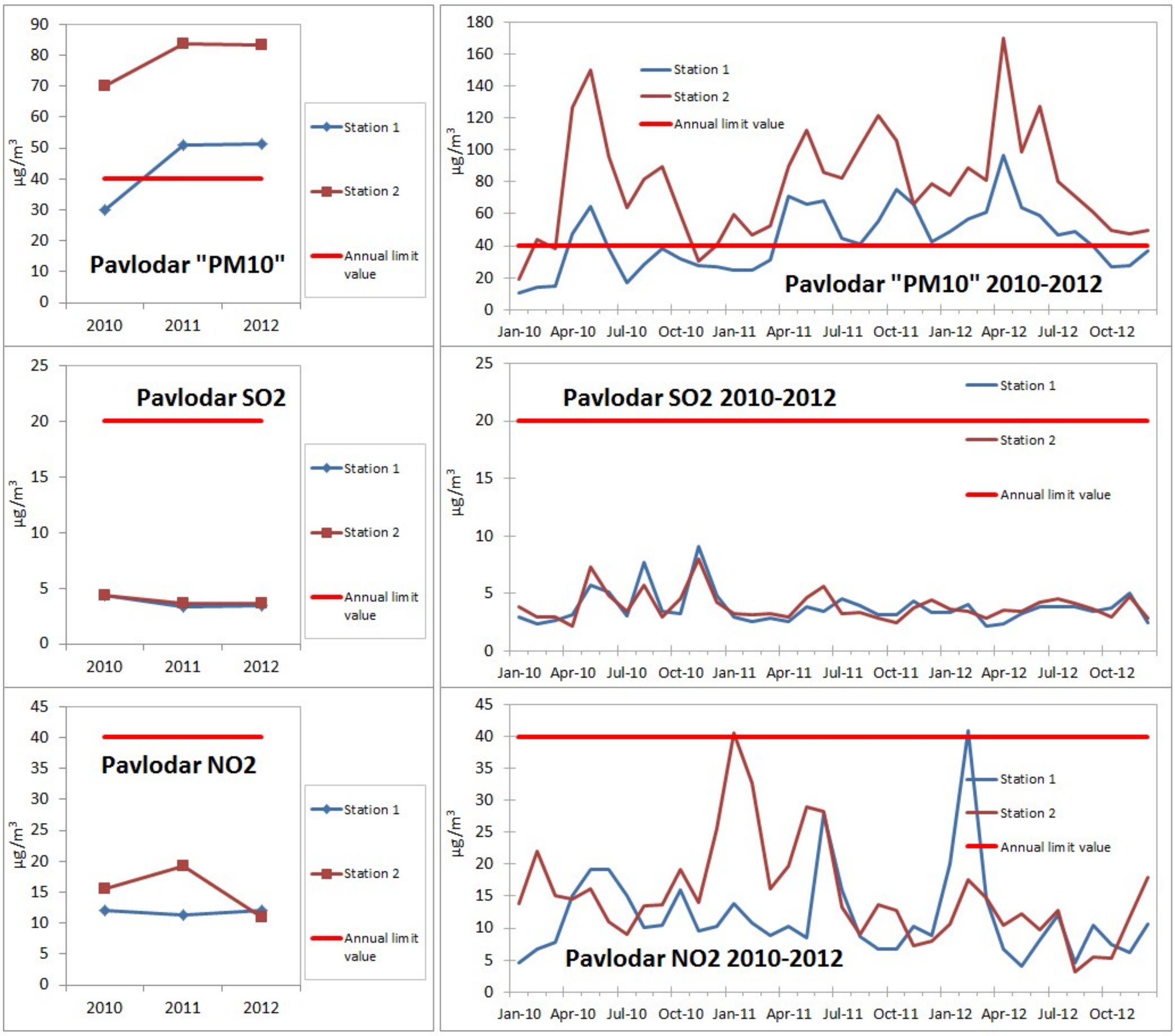


Figure 12. Measured concentrations of air pollutants at two sites in Pavlodar 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

Even though the major heavy industry is mainly located at some distance from the city, long range transported fine particles may still be problematic for the population. Therefore, it is important to start fine particle ($PM_{2.5}$) monitoring in Pavlodar. Also the monitoring of photochemical pollution (NO_x, VOCs and O_3) is important in this major agglomeration with over 300 000 inhabitants.

There is also serious topsoil mercury contamination at the northern industrial site of the former chlor-alkali production of Pavlodar Chemical Plant. Due to the demobilization of mercury the atmospheric monitoring of Hg in the city area should also be started.

3.4.2 Ekibastuz

Ekibastuz coal mining town is located 130 kilometers to the west from Pavlodar City (140 000 inhabitants). The town lies next to the vast open-cast coal fields. At the distance of 20-35 kilometers there are two major coal fired power plants which are important energy suppliers to Kazakhstan. One of the power plants (GRES-2) is famous for its 419 meter-high smokestack.

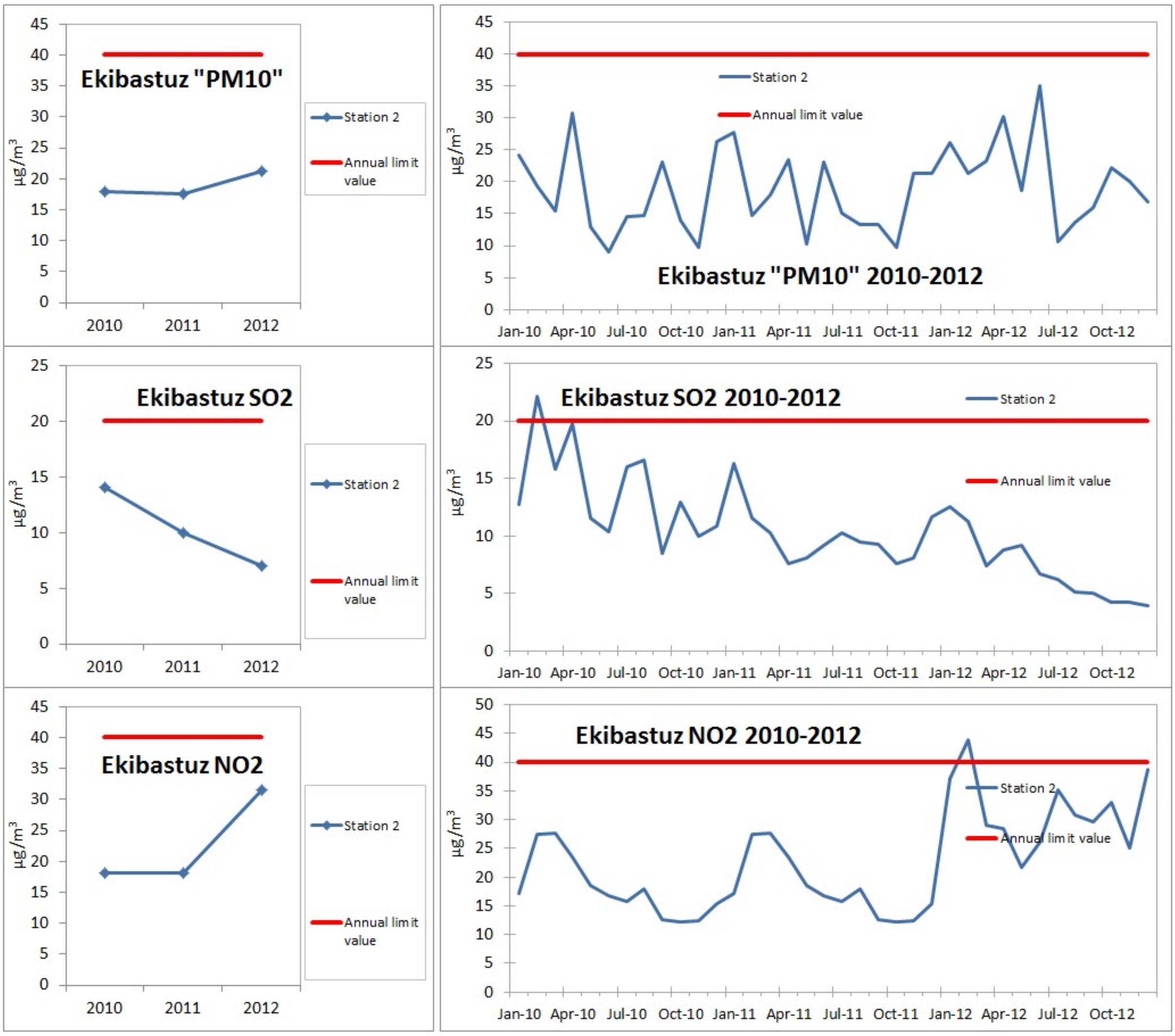


Figure 13. Measured concentrations of air pollutants at one sites in Karaganda 2010-2012. (annual means left, monthly means right). Red horizontal line is the EU annual mean limit value.

Results of the one air quality monitoring site suggest that air pollutant levels in Ekibastuz town are relatively low. PM_{10}, SO_2 and NO_2 concentration levels are well below the EU limit values (Figure 13). The measurement site is located in the middle of town, about three

kilometers from the nearest open mine, and thus not impacted by potential fugitive particle emissions of mining activities. Considering the major industrial activities in the vicinity of the town, it is recommended to expand the air quality monitoring in this city with fine particle monitoring.

4 Proposals for the number of monitoring sites and measured components

The design of the network is based on the best international practices described in Annex 1. Best international practices on designing air quality monitoring networks). As a design framework the European approach is followed. The major input material for the design is the air quality assessment as presented in the previous chapter. Input information thus consists of available concentration data as well as information on the activities and emissions in target cities as well as information on population, land use, topography and climate.

Other boundary conditions to the design of networks come from European regulations that provide specifications for the minimum number of stations to be established depending upon the concentration level and the size of exposed population or ecosystem (see Table 4).

In the European system lower (LAT) and upper assessment thresholds (UAT) have been established for each pollutant. Lower assessment thresholds are between 40 and 65% of the hourly/daily/annual limit values. Upper thresholds vary between 60 and 80% of each limit value. If the concentration of a pollutant is below the LAT no fixed measurements are needed and the air quality assessment for that particular pollutant can be done by modeling techniques and/or objective-estimation techniques. If concentrations are between LAT and UAT a combination of fixed measurements and modeling techniques and/or indicative measurements may be used to assess the ambient air quality. In this case a reduced number of fixed measurement sites are needed compared to the case when also UAT is exceeded (see Table 4). The higher is the number of potentially exposed population, the more measurement sites are required.

Table 4. Minimum number of sampling points for air quality monitoring related to health protection against diffuse sources.

	Minimum number of fixed sampling points (concentrations exceed LAT[1]… concentrations exceed also UAT[2])				
Population of city	PM_{10} + $PM_{2.5}$	SO_2 NO_2 CO Pb C_6H_6	As Cd Ni	B(a)P	O_3
< 250 000	1…2	1…1	1…1	1…1	
< 500 000	2…3	1...2	1...1	1...1	1
< 750 000	2…3	1...2	1...1	1...2	1
< 1 000 000	2…4	1...3	1...2	1...2	2
< 1 500 000	3…6	2...4	1...2	1...2	3
< 2 000 000	3…7	2...5	1...2	1...2	3
< 2 750 000	4…8	3...6	1...2	1...3	4
< 3 750 000	4…10	3...7	2...2	1...3	5
< 4 750 000	6…11	3...8	2...3	2...4	5
< 6 000 000	6…13	4...9	2...4	2...5	6

	Minimum number of fixed sampling points (concentrations exceed LAT[1]… concentrations exceed also UAT[2])				
Population of city	PM_{10} + $PM_{2.5}$	SO_2 NO_2 CO Pb C_6H_6	As Cd Ni	B(a)P	O_3
> 6 000 000	7…15	4...10	2...5	2...5	

[1] LAT lower assessment threshold
[2] UAT upper assessment threshold

The rules in Table 4 apply for areas where diffuse sources, such as urban road network, are a major source. In addition to these general rules, in the vicinity of major point sources additional sampling points may be needed depending on the nature of the pollution, the likely distribution patterns and the potential exposure of the population.

Exceedances of the assessment thresholds should be determined on the basis of concentrations during the previous five years. All fixed and indicative measurements and modeling should fulfill the established data quality objectives, the micro and macro scale siting criteria and the spatial representativeness should be defined (see e.g. Annex 1. Best international practices on designing air quality monitoring networks).

This kind of fully-qualified data is not available from Kazakhstan and consequently, a full scale verified ambient air quality assessment cannot be produced yet. Instead, this assessment framework together with the available concentration data and other information may, at best, give an informed estimation of the ambient air quality and required number of monitoring sites at each city. On the other hand the available concentration data suggest that pollutant concentrations mostly are very high and typically exceed the limit values themselves, which means that fine tuning related to UAT and LAT is unnecessary at this stage.

Recommendations for the number of monitoring sites and measured compounds at each city are summarized in Table 5. Here we shortly describe how the suggested numbers of sites in Table 5 were developed. For example in Almaty city the population is around 1.5 million; the annual means of NO_2 at five measurement stations in 2010-2012 were between 60 and 160 $\mu g/m^3$, (Figure 2) i.e., in all locations the annual limit value 40 $\mu g/m^3$ is exceeded (as well as UAT). Therefore, the number of required NO_2 measurements for monitoring of diffuse sources would be 4 (from Table 4). Due to the unidentified, but highly probable hot spots/point sources we suggest two more (all together 6) monitoring sites of NO_2 to be established in Almaty city (see Table 5). Due to the complex terrain of the city, the total of 6 monitoring sites may still be too few, but is a good starting point.

For SO_2 the reasoning is a bit more complex: from Figure 2 we see that the annual means of SO_2 have been approximately 10-12 $\mu g/m^3$, i.e. lower than the limit value of 20 $\mu g/m^3$ given for the protection of vegetation. The health protection limit values of SO_2 are based on the daily and hourly limit values. This kind of high time resolution concentration data is not available from Almaty. However, from Figure 2 we see that during winter time the SO_2 concentrations are highly elevated for a time period of several months at most sites. So it is

most likely that during winter time the short term limit values of SO_2 are widely exceeded in Almaty city. Consequently, we suggest the total of six monitoring sites for SO_2 in Almaty city in analogy to NO_2 (see Table 5).

For O_3 no concentration data is available from Almaty. Based on the climate, topography and population of the city, it is well-grounded to assume that photochemical smog is a serious air pollution problem of the city and UAT level is widely exceeded. Consequently we suggest that three measurement sites of ozone should be established in Almaty (from Table 4).

These examples show that defining the number of required monitoring sites is based on scarce and partly uncertain information. However, the available information strongly suggests that the air pollutant concentrations are extremely high in most of the study cities, and there really is an urgent need for reliable and appropriately targeted air quality monitoring. The final decisions of the number and siting of the monitoring sites should be done in close co-operation with local/regional environmental authorities and experienced air quality experts. Besides, the development of an air quality monitoring network is a continuous process. As soon as high quality data and relevant air quality assessment are available, the network should be modified accordingly, and this process should be repeated every five years.

In addition to the 31 fixed monitoring sites (Table 5) we recommend that three fully instrumented mobile monitoring stations should be purchased. Mobile monitoring stations are cost effective in screening of potential problem areas in order to define whether a fixed site is required or not. They can also be used for example to measure air quality impact of individual emission source and control the impacts of taken emission reduction measures. The measurement campaign periods with mobile stations can vary for example from three months to one year. Mobile stations should be used also in other areas than the eleven target cities of this study. In Kazakhstan the mobile stations will be very useful as the air pollution concentration mapping of the vast country is only just beginning.

In addition to these urban/industrial monitoring sites, Kazakhstan should establish a background air quality monitoring network as well. Information of concentration levels in rural and remote sites is needed for identifying possible long range transport episodes and as a comparison material for the polluted sites. The design of the background air quality network should be done on countrywide basis and thus no recommendation for it is given here.

Table 5. Air quality monitoring network proposals for the eleven cities in Almaty, Pavlodar, East-Kazakhstan and Karaganda Oblasts

			Number of sites	Automatic instruments (one hour time resolution)									Manual (varying time resolution)				
Oblast	City/Town	Population		SO_2	H_2S	NO_2	PM_{10}	$PM_{2.5}$	O_3	CO	VOCs[1]	Hg	PAHs[2]	As	Cd	Ni	Pb
Almaty	Almaty	1 500 000	6	6		6	6	6	3	6	3	-	3	2	2	2	2
Karaganda	Karaganda	500 000	3	3		3	3	3	1	3	1		1	1	1	1	1
	Temirtau	170 000	3	3		3	3	3	1	3	2	1	2	2	2	2	2
	Balkhash	70 000	2	2	1	2	2	2	1	2	2		2	2	2	2	2
	Zhezkazgan	90 000	2	2	1	2	2	2	1	2	2		2	2	2	2	2
East-Kazakhstan	Ust-Kamenogorsk	300 000	4	4		4	4	4	1	4	2		2	2	2	2	2
	Ridder	60 000	2	2		2	2	2	1	2	2		2	2	2	2	2
	Semei	300 000	3	3		3	2	2	1	3	2		2	2	2	2	2
	Glubokoye	70 000	2	2		2	2	2	1	2	2		2	2	2	2	2
Pavlodar	Pavlodar	340 000	2	2		2	2	2	1	2	2	1	1	1	1	1	1
	Ekibastuz	150 000	2	2		2	2	2	1	2	2		2	2	2	2	2
Mobile station			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

[1] including benzene C_6H_6

[2] including bentso(a)pyrene B(a)P

The analysis in Chapter 3 confirmed that air quality in Almaty city is seriously deteriorated by diffuse sources like traffic and small scale combustion. The topography and the climate of the area further aggravate the situation. Our recommendation for the Almaty City is altogether six monitoring sites (Table 5). Two of the six measurement sites should be located at the city area with the strongest traffic impact. At these sites also PAHs and trace elements should be monitored. One site should be located at a residential area with strong impact of small scale combustion. At this site, PAHs should also be monitored. The rest should be located at various distances from these “hot spots” to give information of the pollution gradients in the city area. In particular, it would be optimal to have one site outside the city area to get information of background pollution as well. Ozone monitors should be located in suburban areas.

In Karaganda traffic emissions contribute significantly to the air quality and one of the monitoring sites should be located to control the emissions of the busiest road in the city center. Also PAHs and trace elements should be measured at this hot spot. One site should be located in suburban residential area and the ozone monitor should be located there. This city is most probably impacted by regional pollution as well, and the third site should be located to monitor this regional impact, perhaps outside the city at the direction of the biggest emitters.

In Temirtau one of the three monitoring sites should be located in the city center to monitor the impact of traffic emissions. The other two should be located at various distances of the major industrial emitter in the direction of heaviest exposure. Estimates of the heaviest exposure can be done utilizing wind speed and direction analyses and estimates of the number of people exposed at different directions from the sites of major emission sources.

Balkash and Zhezkazgan are both small industrial cities with a considerable industrial zone located around three kilometers from the city center. The two industrial monitoring sites should be located to varying distances in the direction of the heaviest exposure.

Ust-Kamenogorsk is a high population industrial city. The orography, climatic conditions, the large quantity of polluting enterprises in the immediate proximity of residential areas and the high number of inhabitants and vehicles makes Ust-Kamenogorsk one of the most polluted cities in this study. Full set of instrumentation for both photochemical and industrial pollution is recommended. The current five manual monitoring stations are spread widely into the city area and give very uniform concentration levels. This set of stations could be used as the starting point when optimizing the new locations.

Ridder and Glubokoye village are small industrial cities with considerable mining and metallurgical industries. The two measurement sites should be located to varying distances in the direction of heaviest exposure.

In Semei traffic emissions likely contribute significantly to the air quality and one of the monitoring sites should be located to control the emissions of the busiest road in the city center. Also PAHs and trace elements should be measured at this hot spot. One site should be

located in suburban residential area and the ozone monitor should be located there. Very high SO_2 concentrations with similar time variation are also measured at the two current manual stations located at the different sides of the city. The source of this SO_2 should be identified and the third station should be located to control the emissions of this (most likely) industrial source. This city is most probably impacted by regional pollution as well, and the third site should be located to monitor this regional impact, perhaps outside the city at the direction of the biggest emitters.

Pollutant concentrations in Pavlodar are relatively low compared to those of the majority of the target cities. However with a population of over 300 000, vehicular emissions are without doubt high in this city too. One of the monitoring sites should be located to the busiest city center and the other in residential areas.

5 Instrument selection criteria

To help the authorities and technical responsible person from the air quality network or NRL to solve questions related to instrumentation, strategies, etc., a project of 'Air pollution monitoring technologies for urban areas, AirMonTech' was build up. The project is an EU funded project compiling information to harmonise current air pollution monitoring techniques and to advise on future monitoring technologies and strategy. It collects existing information on current and future air quality monitors (see in http://db-airmontech.jrc.ec.europa.eu/index.aspx). In the database of AirMonTech the user can find the full type approval test reports for the instruments that have passed the type approval tests according to the relevant EN standards. Similarly there are tests of equivalence especially for automated particle monitoring equipment.

It should be noted that the type of analysers that have passed the type approval or equivalence tests, are ones that can be used for compliance monitoring of air quality in Europe. The performance characteristics of the approved analysers fulfil the performance criteria defined in the relevant EN standards. Since the list of performance characteristics to be tested is rather long and each analyser has its own strengths, it is impossible to single-out any analyser as better than another.

It is important that the supplier of analysers be able to provide spare parts and maintenance services locally which may reduce choices in Kazakhstan. In addition, it can increase the costs of maintenance quite significantly if analysers are not from the same manufacturer. Therefore it is recommended to use the same instruments for the entire network. The rationale of choosing one type of analyser from all of those that have passed the type approval tests is difficult and can be related to (e.g.):

- price of the analyzer;
- warranty of the analyzer;
- location and maintenance capabilities of the local representative;

- compatibility with the data acquisition system;

In addition results of some individual performance characteristics from the type approval tests can be considered more important than others:

- better performance capability of the analyzer against the physical parameters e.g. dependence of the analyzer against the sample temperature, environment temperature, environment pressure and line voltage;
- better performance capabilities of the analyzer that are important at the field conditions: reproducibility of the analyzer, long term drift, averaging effect and lower respond to interferences like other chemical compounds and water vapor.

Table 6 presents types of analyzers (not a complete list) that are commonly used in various parts of Europe and Annex 10. Air Quality Monitoring Station Specifications (example from Kosovo) provides technical specifications of monitoring equipment procured for a recent modernization project in Kosovo.

Table 6. Types of analyzers used in Europe

Manufacturer	Sulfur dioxide	Oxides of nitrogen	Carbon monoxide	Ozone	Hydrogen Sulfide	BTEX	Particulate matter PM10&PM2.5
Horiba Instruments http://www.horiba.com	APSA-370	APNA-370	APMA-370	APOA-370	MEXA-1170SX		
Thermo Fisher Instruments http://www.thermofisher.com	Thermo 43i	Thermo 42i	Thermo 48i	Thermo 49i	Thermo 450i		TEOM 1405, D, DF, F 1514 beta SHARP 5030
Environnement SA http://www.environnement-sa.com	AF22M	AC32M	CO12M	O342M	AF22m-TRS	VOC72M BTEX	MP101M + CPM
TELEDYNE http://www.teledyne-api.com	API-T100	API-T200	API-T300	API-T400	API-T101		Model 602 beta
Grimm Aerosol Technic GmbH & Co. http://www.grimm-aerosol.com							Grimm 180

6 Reference laboratory for air quality

6.1 Tasks of the National Reference Laboratory

The establishment of a reference laboratory is one of the first priorities to ensure representativeness and traceability of collected data. For example, legislation from the EU includes requirement for ensuring measurements of known measurement uncertainty that are comparable across the EU. This is crucial for ensuring that appropriate abatement measures

are triggered, where necessary, and that a level-playing field exists for any potential enforcement of the provisions of the ambient air quality Directives.

The term ‘National Reference Laboratory (NRL)’ has been used for a number of years, but there has been no explicit formal definition of what constitutes an NRL. Article 3 of Directive 2008/50/EC, Responsibilities, states:

Member States should designate at the appropriate level a competent authority and bodies responsible for the following:

- assessment of ambient air quality;
- approval of measuring systems (methods, equipment, networks and laboratories);
- ensuring the accuracy of measurements;
- analysis of assessment methods;
- coordination on their territory if Community-wide quality assurance programs are being organized by the Commission;
- cooperation with other Member States and the Commission.

Where relevant, the competent authorities and bodies should comply with Section C of Annex 1. Best international practices on designing air quality monitoring networks. A number of points may be concluded and emphasized concerning Article 3 of Directive 2008/50/EC e.g.:

- It is the responsibility of the competent authority of the specific Member State, to designate or appoint relevant organization(s) to carry out all the tasks listed in (a) – (f) above, where these competent authorities in each country are as defined above generally national government ministries or national agencies;
- It may be practical to appoint different organizations to cover different tasks or pollutants, some of these tasks are broader or different than those required of an NRL. These issues are all for the competent authority to define;
- The NRL(s) in a given Member State are also those that take part in the ‘Community-wide’ inter-comparisons covering one or more of the pollutants regulated by the directive, as stated in Annex 1. Best international practices on designing air quality monitoring networks, Section C, and these require accreditation to the EN ISO 17025 standard. The exact scope of the accreditation required is discussed below.

As stated above the tasks of the NRL can be described based on Article 3 and Section C of Annex 1. Best international practices on designing air quality monitoring networks, i.e.:

- that all measurements undertaken in relation to the assessment of ambient air quality are traceable in accordance with the requirements set out in Section 5.6.2.2 of the ISO/IEC 17025:2005;

- that institutions operating networks and individual stations have an established quality assurance and quality control system which provides for regular maintenance to assure the accuracy of measuring devices;
- that a quality assurance/quality control process is established for the process of data collection and reporting and that institutions appointed for this task actively participate in the related Community-wide quality assurance programs;
- that national laboratories, when appointed by the appropriate competent authority or body designated pursuant to Article 3, that are taking part in Community-wide inter-comparisons covering pollutants regulated in this Directive, are accredited according to EN/ISO 17025 by 2010 for the reference methods referred to in Annex VI of the Directive. These laboratories should be involved in the coordination on Member States territory of the Community wide quality assurance programs to be organized by the Commission and should also coordinate, at the national level, the appropriate realization of reference methods and the demonstration of equivalence of non-reference methods.

An overall objective of the National Reference Laboratory is to assure equal quality of the data from different monitoring stations in Kazakhstan and to assure that data is comparable to each other. To fulfill overall objectives, the NRL will be responsible for the development, administration and maintenance of the Quality Assurance and Quality Control system (QA/QC system) for operation of the air quality monitoring network in Kazakhstan. This includes preparation of standard operation procedures (SOPs) for all activities that are needed for operation of the calibration facilities, instruments, maintenance of the reference standards, QA/QC procedures at the NRL and at the networks.

6.2 Generation of the traceability chain

To achieve comparability of the data within the air quality networks in Kazakhstan, the NRL should provide traceable calibration service to all air quality measurements conducted in Kazakhstan. The traceability chain up to System International Unit, SI (e.g. kg, mole), should be established through the National Metrology Institute (NMI) in Russia or in other NMI in Europe. In practice this can be achieved by purchasing primary reference gas standards (e.g. SO_2 gas standard) prepared by a gravimetric method at a precise concentration (mole/mole fraction) and stated uncertainty. These standards are used at the NRL for preparation of gas mixtures at known concentration levels to calibrate transfer calibration systems, working gas standards or automatic gas analyzers measuring the specific gas compounds (e.g. SO_2) in the air. This is the way NRL will provide traceability to the monitoring network through the transfer standards, working standards as well as direct calibration of the instruments of the network.

In addition to gas standards, the other standards that are also used for maintaining the calibration facilities should be traceable to NMI e.g. flow measuring devices, temperature and pressure meters.

The calibration facilities that are necessary for providing the traceable calibration service to all air quality networks consist of gas dilution unit i.e. by the dynamic dilution method, high quality gas standards, pure air generator and high quality flow measurement system. This system is applicable for gas compounds of SO_2, NO, CO, BTEX and H_2S. In the case of ozone, calibration activities can be resolved by an ozone photometer (commercial ozone calibrator). The ozone photometer is used to calibrate the transfer ozone standards and is compared at regular intervals at the metrological laboratory.

The transfer standards that are used to calibrate the field instruments (site calibrators, and other instruments) are similar devices as in the NRL, but meant for field calibrations (not too delicate instruments). The transfer standards are calibrated against the laboratory calibration system in order to establish the traceability chain from the NRL to the monitoring network.

The backup of most important instruments are needed both in the laboratory but also for the transfer standards and the working standards at the network.

The NRL should perform comparison exercises and audits to the measurement network to assess the actual quality of the measurement. In addition the NRL facilitates the comparison exercises or project organized by competent body (accredited laboratory, metrological laboratory or international organization).

7 Data management

All air quality monitoring data needs to be collected into one data center (Figure 14). Real-time-resolution automatic analyzers apply direct first-order, on-line quality controls, so that this data should be collected hourly, processed into a user friendly format and readily communicated to the public and other users via internet. For this an open access national air quality portal should be created. From this data center also other forms of real-time information dissemination can be organized (display boards, SMS messages, media communications, etc.).

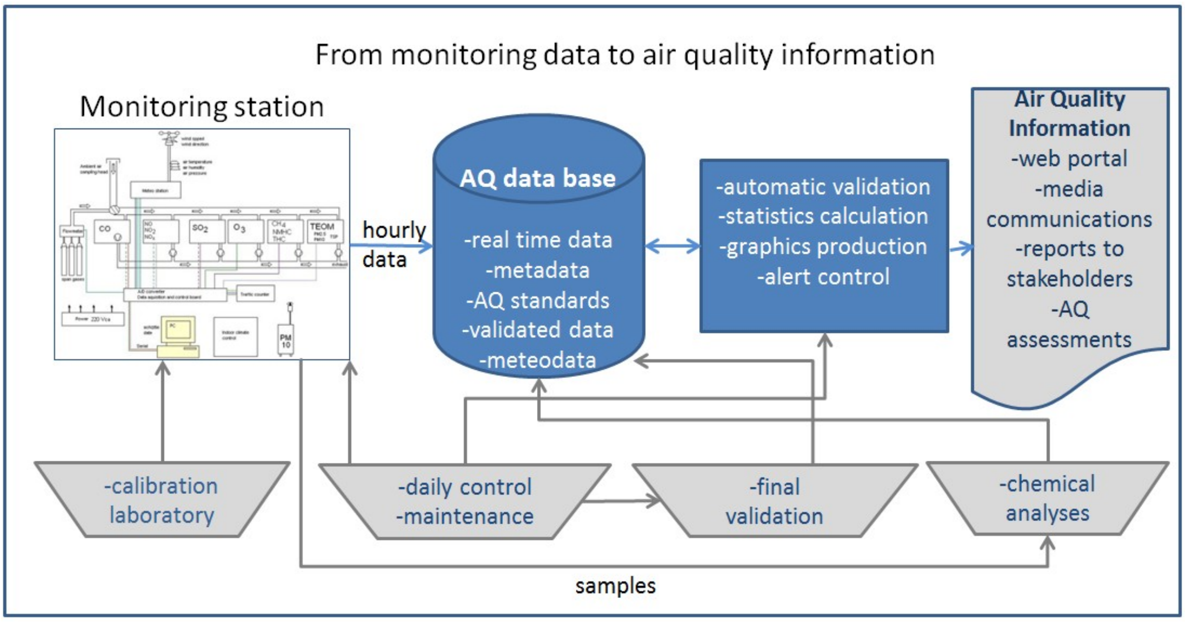


Figure 14. Major data and information flows and processes related to operational air quality monitoring

This central data base also incorporates all validated air quality data of the country. In Kazakhstan the procedure could be that the regional centers of Kazhidromet are responsible for the validation of the data in their area, and for sending the validated automatic data to the central database in calibration cycles. The manual results are sent to the data base from the chemical laboratory/laboratories periodically, perhaps a couple of times per year. The data center is also responsible for the annual air quality assessment (exceedances of the limit values, based on the validated data) and dissemination of the information to the public and MEWR for further actions. Local offices should have free accesses to the central data base to make locally important studies.

When establishing this central data base of air quality information, possibilities for integration with the weather data flows and bases should be carefully studied. To enable various on-line data transfers effectively, timely and reliable central data acquisition system has a key role.

Several commercial air quality data management software is available. For example, Envidas for Windows software, a trademark of Envitech Ltd, includes a set of software programs designed to perform data acquisition and control for environmental and process monitoring applications. Local reporting and graphical display capability is included, reflecting the air monitoring data.

Some air quality management software includes tools to publish the air quality data in the internet. In many countries (for example in Finland and Macedonia) air quality portals have been specifically designed for the real time data dissemination (Figure 15). The air quality portals include hourly information of pollution concentrations from the monitoring stations

represented in concentration values and as air quality index, general information of the pollutants, emissions, sources and health effects and legislation.

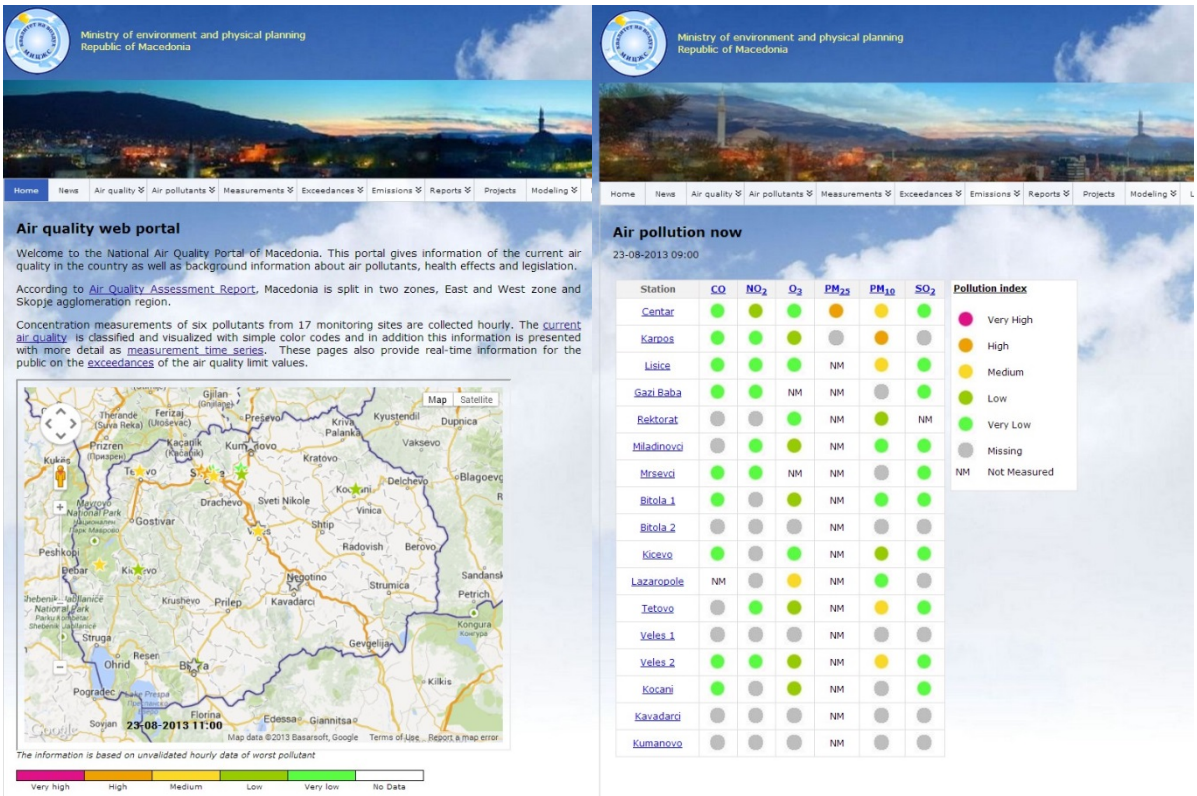


Figure 15. Air quality portal in Macedonia developed as a part of a capacity building project

8 Human resources

Efficient air quality management requires defining organizational responsibilities for monitoring and related activities. In Kazakhstan (or at least in the four target Oblasts of this study) the state institute Kazhidromet with its regional centers, is responsible for the environmental monitoring including the air quality monitoring. The operation of a modern national air quality network requires a number of trained staff with specific responsibilities related to the different parts of air quality management (Figure 16). For the most part, tasks related to air quality monitoring require personnel with higher education with additional training related to the specific tasks.

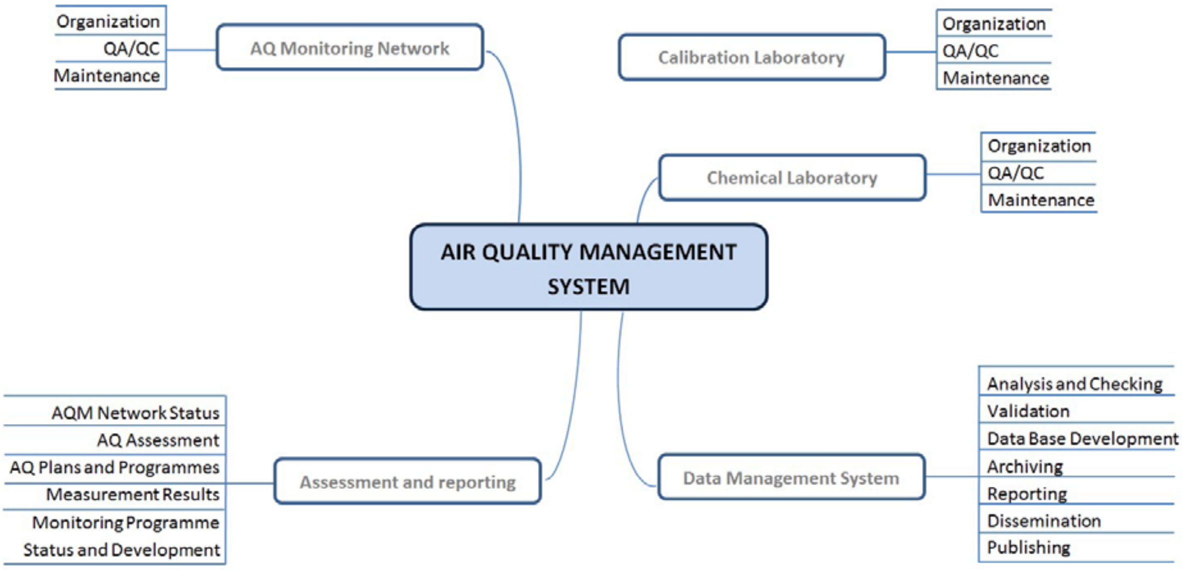


Figure 16. Tasks related to the operational air quality management system

Technicians responsible for the regular maintenance of the field site must be able to perform preventative maintenance and do routine checks of the complicated and sensitive instruments. When a problem arises the technicians should be able to diagnose and even fix it. At the calibration and chemical laboratory, the technicians, engineers and analysts need to implement several new analytical methods and master in considerable depth the requirements imposed by ISO standard 17025.

Establishing real-time continuous data and information flow from the monitoring site to the end-user involves expertize in system design, data base design, geographical information systems and software development. Detailed specifications for the data management system come from the used measurement techniques, QA/QC system, national air quality and other standards and end-user requirements. Thus the co-operation between system developers and each substance expert must be smooth and close.

An air quality assessment requires wide knowledge of the emission sources, used measurement techniques, basics of air chemistry and meteorology and thorough knowledge of the existing regulations and standards. Data analysis methods such as statistics, time series and multivariate analyses are also needed to make a thorough air quality assessment. For the successful dissemination of the air quality information via e.g. the web, the data must be processed into compact, attractive and user-friendly format. Most of these tasks require typically postgraduate professional skills that can be obtained in hands-on-training or training courses.

Kazhidromet with its regional centres is responsible for the environmental monitoring in Kazakhstan and consequently it should operate the new modernized air quality network, too. In this project thorough evaluation of the available human resources was not made. However,

it is quite obvious that, a targeted education program needs to be provided for the current and new employees working in this field.

Staff requirements largely depend on the size of the monitoring network. In this plan the total number of sites remains at reasonably low level (34) which also limits the need for new personnel providing tasks is efficiently re-organised and re-education is provided.

The network of 34 sites (of which 24 sites has also manual measurements) could be operated with 2-3 full-time trained persons in the reference laboratory, 3-4 persons in the chemical laboratory, 2-3 persons in the field maintenance and 2-3 persons in the management of data flows, databases, assessment, reporting and information. However, due to the long distances between the monitoring sites (e.g. Ridder, Almaty and Astana are 800-900 kilometres apart from each other) some of these task are most efficient to be decentralized to the regional centers of Kazhidromet. This is due that the manual sites must be visited at least every 3-10 days, field calibrations should be done every three months and on top of this there are the irregular, but recurrent, problem situations which need to be treated right away. Multiplication of the field personnel or laboratory personnel of course increases the number of required trained employees as well.

An estimation of annual man-hours needed for the operation of the air quality monitoring network and supporting activities in Table 7 is done based on an OECD study on the average annual hours actually worked per worker in OECD countries (OECD 2013). Taking into account the proposed number of personnel needed to operate the air quality network, and the number of 1765 hours worked per year, it can be estimated that the overall working hours that need to be invested in the air quality management per year amount to approximately to 16 000 to 23 000 hours. The costs related to the human resources can be estimated based on this and the information of the local wage levels. Note that the possible multiplication of the personnel due to long distances is not included in Table 7.

Table 7. Estimation of annual man-hours required for air quality management

Position	No. of staff	No. of man-hours per year
Reference laboratory	2-3	3 530 – 5 295
Chemical laboratory	3-4	5 295 - 7 060
Field maintenance	2-3	3 530 – 5 295
Management of data flows, databases, assessment, reporting and information	2-3	3 530 - 5 295
Total	8-12	15 885 - 22 945

9 Estimation of the investment and maintenance costs

In the following estimations of the costs related to the monitoring stations, laboratories and data management based on the recommendations of this study are given. The costs are

calculated based on the prices of commonly used instruments, software etc., and the prices may wary depending on the manufacturer. In Table 8 the costs are separated for the installation, measurement container and other supporting infrastructure and for the actual monitoring devices for which the costs per station vary depending the number and type of monitors proposed. In Table 8 and Table 9 we give the estimation of the costs related to the investments. Table 10 includes an estimation of the annual costs related to maintaining the proposed systems. The costs related to the human resources were presented in Chapter 8.

Table 8. Cost estimation of new monitoring stations

TYPE	Station type	Type	Quantity	Station (installation, cabin, facilities)	Monitors	Components	TOTAL PRICE STATIONS
A	Traffic/industrial	1	1	21 000 €	65 000 €	Traffic1: NOx+SO2+CO+PM10	**86 000 €**
A	Traffic/industrial	2	4	21 000 €	93 000 €	Traffic1 + BTEX	**456 000 €**
A	Traffic/industrial	3	0	21 000 €	115 000 €	Traffic 1 + Hg	**0 €**
A	Traffic/industrial	4	17	21 000 €	93 000 €	Traffic1 +BTEX+ TE	**1 938 000 €**
B	Traffic/industrial		0	21 000 €	185 000 €	NOx+SO2+CO+O3+H2S+NH3+BTEX+PM10(s)+Hg+TE+PAH	**0 €**
C	Urban background		7	21 000 €	89 000 €	NOx+SO2+O3+PM10+PM2.5	**770 000 €**
	Suburban background		2	21 000 €	51 000 €	NOx+O3+PM2.5(+PM10(s))	**144 000 €**
	Regional background		0	21 000 €	164 000 €	NOx+O3+NH3+GHG+PM2.5(s)+Hg+EC/OC+IC	**0 €**
	Mobile Unit		3	25 000 €	239 000 €	NOx+SO2+CO+O3+H2S+NH3+BTEX+GHG+PM10/PM2.5+Hg+TE+PAH	**792 000 €**
	TOTAL		**34**				**4 186 000 €**

Table 9. Summary of the costs related to the monitoring stations, laboratories and data management.

Type	Unit cost	Quantity	Total cost
Monitoring stations			
Stations type A	86 000-136 000 €	22	2 480 000 €
Stations type B	206 000 €	0	0 €
Stations type C	110 000 €	7	770 000 €
Sub urban background	72 000 €	2	144 000 €
Regional background	185 000 €	0	0 €
Mobile Unit	264 000 €	3	792 000 €
	TOTAL 1: STATIONS	**34**	**4 186 000 €**
Calibration and chemical laboratory			
Calibration laboratory	272 000 €	2	544 000 €
Transfer calibration	191 800 €	3	575 400 €
Chemical laboratory			
A: Trace elements	252 200 €	1	252 200 €
B: PAH	129 300 €	1	129 300 €
C: VOC	94 000 €	1	94 000 €
Consumables/Transfer calibration	35 000 €	3	105 000 €
	TOTAL 2: LABORATORIES		**1 699 900 €**
Data management			
Central software (over 6 stations)	14 000 €	1	14 000 €
Software for the stations	2 500 €	34	85 000 €
Servers	5 000 €	2	10 000 €
	TOTAL 3: DATA MANAGEMENT		**109 000 €**
Capacity building			
Twinning project for strengthening the capacities of the air quality administration	2 000 000 €	1	2 000 000 €
	TOTAL 4: CAPACITY BUILDING		**2 000 000 €**
TOTAL			**7 994 900 €**

Table 10. Summary of the costs related to the monitoring stations, laboratories and data management

Annual cost of services			
Calibration laboratory	30 000 €	2	60 000 €
Chemical laboratory	30 000 €	1	30 000 €
Monitoring stations	3 000 €	34	102 000 €
TOTAL			**192 000 €**

10 Action plan for the modernization of the state air quality monitoring network and management activities in Kazakhstan

Based on the assessment of the current air quality monitoring network and air quality management activities it is evident that the air quality monitoring network, much of the supporting infrastructure related to it and also part of the legal framework need fundamental rebuilding and restructuring. It will be the most efficient to adopt some existing practical approaches to nationwide air quality management to implement the necessary modernization air quality management in Kazakhstan. The following action plan follows the functional practices adopted in European Union, and which is based on two directives, Directive 2008/50/EC and Directive 2004/10/107/EC.

It is recommended that the air quality network modernization start with the 11 cities covered in this study. In parallel, the process of identification of the modernization needs for the air quality network for the rest of the country is recommended to be started. In the following we give suggestion of the steps to be taken to modernize the air quality network and management in Kazakhstan. Figure 17 outlines the major development needs for air quality administration. The major actors in this modernization process are the MEWR and Kazhidromet. Once the decision has been made and budget allocated (this task led by the MEWR) to modernize the air quality monitoring and management in Kazakhstan, practical implementation should start from the network infrastructure (Figure 17, Step 1).

Field instrumentation, the establishment of the reference laboratory and the data management system are indispensable to each other and these tasks should proceed in parallel. In order to get the complete set of pollutants (i.e. including PAHs, trace elements and VOCs) analyzed right from the start also the chemical laboratories should be updated in the first stage. Setting up this infrastructure could be the responsibility of the Kazhidromet under the auspices of the MEWR.

Simultaneously with the updating of the infrastructure the legal reform and institutional capacity building should be started (Step 2). The legal reform is the responsibility of the MEWR and the institutional capacity building involve both MEWR and Kazhidromet. MEWR and Kazhidromet should invest significantly in institutional capacity building to take care that the headquarters as well as regional offices have sufficient resources (human and financial) to reach and maintain the required high level of expertise to operate a modern air quality management system.

Assessment of air pollution is a repetitive activity which importance increases as more information on the actual pollution situation becomes available. In the preliminary stage the assessment is mainly a tool to design the needed measurement network (as done here for the eleven cities). As soon as network provides reliable information about pollution, focus of the assessment shifts to the needed air quality actions, i.e. it becomes the main information source for the development of the measures to reduce emissions and improve air quality (Step 3). In the annual air quality assessment the compliance with the air quality standards is surveyed (by Kazhidromet) and in case of exceedances the corrective measures will be required by public and private sector, regulatory and permitting authorities and inhabitants of the cities. MEWR will have a central role in designing and guiding through these emission reduction measures.

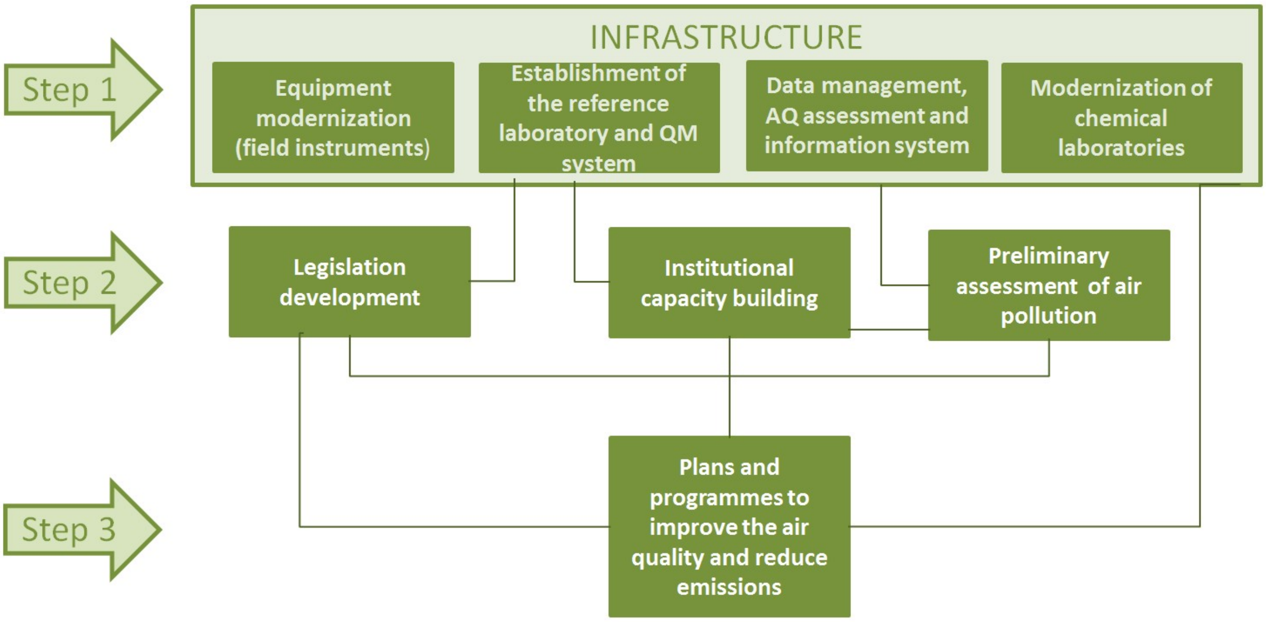


Figure 17. Action plan for the modernization of the state air quality monitoring network and management activities

10.1 Equipment modernization including the field instruments

According to the assessment carried out, the existing monitoring equipment from the field stations of the 11 cities included in the study should be replaced with modern automatic monitors and additional monitoring stations should be established according to the recommendations given in this report (Chapters 4 and 5). Priority of the investment could be given to the most polluted cities identified based on the available air quality data. These cities include Almaty, Ridder, Temirtau, Ust-Kamenogorsk and Zhezkazkan. In all these cities the levels of air pollution concentrations significantly exceed for example the EU limit values set for protection of human health and therefore urgent actions are needed to improve the availability and quality of the air quality information from these cities. The modernization of the monitoring equipment and establishment of new stations should then be done for the other cities included in this assessment and for the other parts of the country followed by an assessment of monitoring needs (see section 10.5).

10.2 Establishment of the reference laboratory and quality management system

The quality of the air pollution data is crucially important for reliable analysis of the air pollution levels, the health impacts and the planning of actions to reduce the levels of pollution. The establishment of the reference laboratory should be one of the first priorities to ensure representativeness and traceability of the collected data. Details of the reference laboratory requirements are included in Chapter 6. Use of reference methods and/or demonstration of equivalence should be introduced as well as regular field calibrations and maintenance of the instruments. At the beginning one calibration laboratory may be sufficient, but as the monitoring network expands the need of the second laboratory should be considered.

10.3 Reconstruction of the data management, air quality assessment and information system

Currently there are no adequate data management practices in place to ensure high quality air quality information availability. In connection with the modernization of the measurement network to be consisting of automating measurement stations, the air quality data management system should also be established according to the recommendations from Chapter 7. This should consist of the data collection, storage, validation and correction, analysis and reporting and data publishing tools. The investment in data management system is recommended to take place as soon as there are several new automatic monitoring stations in place in order to ensure that the data from the modernized network is adequately available, stored and quality controlled from the beginning. The data management system should allow inclusion of unlimited number of stations as the monitoring network will gradually expand. In addition to the data management system, which can be realized with commercially available system, an air quality portal is recommended to be established. Through the air quality portal, information of the levels of air pollution and other information related to air quality and emissions can be distributed.

10.4 Modernization of the chemical laboratories

According to the assessment, the current chemical laboratory facilities will need a significant updating to ensure good quality information of the pollution measured with sampling methodologies. At present in Kazakhstan there are a number of local and regional chemical laboratories that collect the samples and perform the analyses close to the sampling sites. In future the chemical analyses should be centralized into 1-3 fully equipped laboratories, the number depending on how the logistics related to the sample collection and field maintenance will be solved.

Since Kazakhstan has significant heavy industry contributing to high levels of pollution, it is essential that, for example, trace element measurements are carried out using reliable methodologies for sampling and analysis. The current accredited chemical laboratories in Astana and Almaty have good premises for performing the analysis required, but equipment is in need of significant modernization. Most importantly laboratories should take over the new equipment needed for PAH, trace element and VOC collection and analysis. Continuous sampling (instead of twenty minutes) should be adopted to get samples that are representative and comparable to the AQ standards.

10.5 Preliminary assessment of the air pollution

To determine the need for air quality measurements for the other parts of the country, a preliminary assessment of the air pollution should be carried out. The main information needed for the assessment comes from air quality measurements and air emission inventories, but information from other sources such as air pollution dispersion models or indicative measurements can be used if available. The requirement for continuous air quality measurements depends on the level of air quality and the population within certain area. Based on the assessment the number and location of fixed monitoring sites can be determined and the site-specific selection of the measured compounds can be made (as done in this study for 11 cities).

The process of preliminary assessment is used in the EU as according to the EU Directives regarding air quality, the Member States are required to monitor the air quality in their region with common methods and assessment principles. The requirement for continuous air quality measurements depends on the level of air quality and the population within certain area. The preliminary assessment to define the monitoring need has been used also in other countries, for example in Macedonia as a part of two EU funded Twinning projects: ‘Improvement of air quality’ and ‘Strengthening the central and local level capacities for environmental management in the area of air quality’.

During the first Twinning project (starting in 2005) FMI supported the Ministry of Environment and Physical Planning in modernization of the monitoring network and preparation of the first preliminary assessment report for air quality in Macedonia. Basic pollutants SO_2, NO_2, NO_x, PM_{10}, CO and ozone O_3 were included in the first phase. During the second Twinning project (starting in 2008) the whole air quality management system was upgraded to the European level. At this stage it was also possible to conduct a thorough assessment of air quality.

Three main assessment methods were used in the assessment: air quality measurements; air emission inventories and air pollution dispersion models. Six years period (2005-2010) of air quality data and eight years period of reported emission data were taken into account in the second assessment. The assessment included evaluation of the air pollution levels for different pollutants using the combination of the three methodologies and comparison of the levels to the assessment thresholds (LAT and UAT). Based on this assessment minimum measurement requirement for each area were defined for the basic pollutants according to the EU legislation.

10.6 Institutional capacity building

In addition to the strengthening the technical capacities related to the air quality management through investments to measurement infrastructure, efforts should be made to improve the capacities of the institutions responsible for the air quality management. The modernized air quality monitoring network and management practices will require availability of adequately trained personnel for each specific part of the air quality management activities. As it is recommended that the monitoring network is significantly expanded and new activities are introduced, it is likely to be necessary that the number of staff working with the air quality management needs to be increased (see Chapter 7). The need for additional staff and the training needs of the existing and new staff should be assessed as the modernization of the air quality management proceeds and efforts should be made to ensure that the appropriate human resources will be made available. It is recommended that the possibilities to gain support for the training of the staff responsible for the air quality is explored. The training can be provided for example through Twinning project-type support where experts from air quality administrations from countries where the air quality management is in advanced level will train the experts from Kazakhstan.

Following the realization of investments for the monitoring network, the laboratories and the data management system a capacity building project would be recommended to be implemented. This project could include for example following priority issues:

1. Support in development of operational air quality monitoring network and training of personnel in maintenance and calibration;
2. Support in development of operational calibration laboratory equipped and training of personnel;
3. Support in development of operational chemical laboratory and training of personnel;
4. Introduction of quality management procedures for field activities, calibration laboratory and chemical laboratory. Development and implementation of priority documentation for quality control and assurance. Training of personnel in quality management;
5. Support in development of operational air quality data management system developed and training of personnel in data management;
6. Training of personnel in the utilization of different air quality assessment methodologies;
7. Development of a platform to enable public access to air quality information data (web applications, software tools etc.);
8. Support in development of air quality related legislation.

10.7 Legislation development

The current legislation regarding air quality and the adopted practices related to it should be modernized in line with the technical modernization. The legislation development should include reassessing and if necessary redefining the responsibilities related to air quality management, the air quality standards for pollutants, assessment regimes, measurement methods and quality assurance, air quality improvement action plans and programs and information availability and reporting. This is the focus of Chapters 11 and 12.

10.8 Air quality plans and programs to improve the air quality and reduce emissions

The main aim of air quality management activities is to ensure that there is adequate information of the levels of air pollution and that actions are taken to improve the air quality in areas where the level of air pollution is assessed to be harmful to human health. Air quality plans and programs should be developed to ensure that concentrations of air pollutants will not exceed the air quality standards. The plans and programs should be developed indicating the measures to be taken in the short term or long term to decrease the emissions and improve the air quality to meet the requirements from the standards. The plans and programs should be developed on national level to include the measures to be implemented at the central level, for example measures related to quality of the fuels or national limitations to emissions from specific sectors. The local air quality plans and programs should be developed for those cities or areas where the air quality exceeds the national standards set to protect the human health. The main responsibility of the development and implementation of the local plans could be in the local authorities supported by the national air quality administration. It is recommended that the first local air quality plans and programs are developed for those cities where the air pollution is the worst as soon as reliable air quality data is available from 2-3 years period.

11 Environmental Permitting System

11.1 Permitting System and environmental classification of industries

While the Environmental Code has introduced integrated environmental permitting, in line with the European Union's Integrated Pollution Prevention and Control Directive and regulating cross-media transfer of pollution, industrial permit applications all still follow the standard Environmental Emissions Permit system which deals with different pollutants separately.

Because of these two parallel permit systems in place, there are two approaches for ranking industrial facilities according to their environmental exposure:

- Ranking based upon environmental exposure of specific industrial processes, based on the Integrated Pollution Prevention and Control (IPPC) principle;
- Ranking of environmental exposure upon compliance to sanitary (hygienic) standards.

The Government has adopted[15] a list of industrial facilities to which the Integrated Environmental Permit requirements can apply, which is identical to the Annex I of the IPPC Directive. However, no applications have yet been made for an integrated permit. In contrast, ranking of environmental exposure upon compliance of industrial facilities to sanitary (hygienic) standards remains a common practice in Kazakhstan and industries could be ranked differently dependent on whether the IPPC principle is applied or the environmental exposure based on sanitary standards.

According to the Environmental Code, classes of environmental exposure of production facilities are attributed depending upon: (i) human health risks; (ii) production capacity; (iii) type of production; (iv) environmental emissions and exposure; and (v) operational modus. In practice, however, environmental authorities classify production facilities with the use of sanitary norms and rules. The recently adopted sanitary norms and rules[16], distinguish and define the size of sanitary zone for more than 450 industrial activities. Four classes of environmental exposure are identified, with class I considered most hazardous and IV considered as least hazardous. Industrial facilities of class I of environmental exposure are in turn sub-divided into two groups: (i) industrial facilities with emissions which remain above the permitted quantities; (ii) other industrial facilities which can be classified as class 1 industrial facilities depending on the dimension of their sanitary zones. In turn, classes of environmental exposure II – IV are not further subdivided. They fully accord with the hygienic and sanitary classes III – V. The table below clarifies the main classification criteria for production facilities and the relation between the two classifications.

[15] Government's Resolution № 95, on February 4, 2008.
[16] Sanitary and Epidemiological Requirements to Production Facilities and Buildings, №93 dated of 17 January 2013.

Table 11. Classes of environmental exposure

<table>
<tr><th colspan="2">Classes of environmental exposure</th><th>Hygienic and Sanitary classes</th></tr>
<tr><td rowspan="4">I[17]</td><td>> 1000t of environmental emissions a year;
> 50t a year for oil and gas</td><td rowspan="4">- class I of sanitary exposure, sanitary zone of 1 000 m and more;

- class II of sanitary exposure, sanitary zone of 500-1 000 m</td></tr>
<tr><td>> 2000t of pollutants disposed with waste waters</td></tr>
<tr><td>> 10000t of solid waste generation a year</td></tr>
<tr><td>Other</td></tr>
<tr><td colspan="2">II</td><td>class III of sanitary exposure, sanitary zone of 300-500 m;

Production activities which are not classified upon sanitary exposure</td></tr>
<tr><td colspan="2">III</td><td>class VI of sanitary exposure, sanitary zone of 100-3 000 m</td></tr>
<tr><td colspan="2">IV</td><td>class V of sanitary exposure, sanitary zone of 0-100 m</td></tr>
</table>

Although production facilities are classified according to the environmental exposure class - the measurement unit is in tons of emissions. This can be misleading since although emissions are correlated with ambient conditions – which are linked to health – emissions can vary dramatically in their relative contribution to ambient concentrations in air. So the classification of facilities by their tons of emissions may underestimate the true environmental impact.

The use of sanitary zones is also an outdated concept – with little basis on how emissions may interact with the surrounding population. More appropriate would be to require installations to design their operations to the surrounding environment. For instance, if there is a nearby population then production facilities would then have to ensure adequate environmental safety and emissions controls that would not pose any significant risk. Meteorological conditions should also be taken into account such as wind, temperature and precipitation so that any emissions dispersion is well-understood in terms of its potential impact.

The double classification system is also not convenient for the MEWR or industrial facilities. It does not facilitate any transition to integrated permitting, whose main objective is to prevent pollution and minimize waste in an integrated manner and to protect the environment as a whole. Figure 18 below shows a simplified flowchart for processing environmental permit applications. Most of industrial facilities belonging to the class I normally apply for the permit and report to the Ministry directly, while the class II-IV industrial facilities report to the regional departments of environmental protection. CO_2 emissions are regulated now by a separate permit.

[17] Industrial facilities of class I of environmental exposure are in turn sub-divided into two groups: (i) industrial facilities with emissions which remain above the permitted quantities; (ii) other industrial facilities which can be classified as class I industrial facilities upon dimension their sanitary zones.

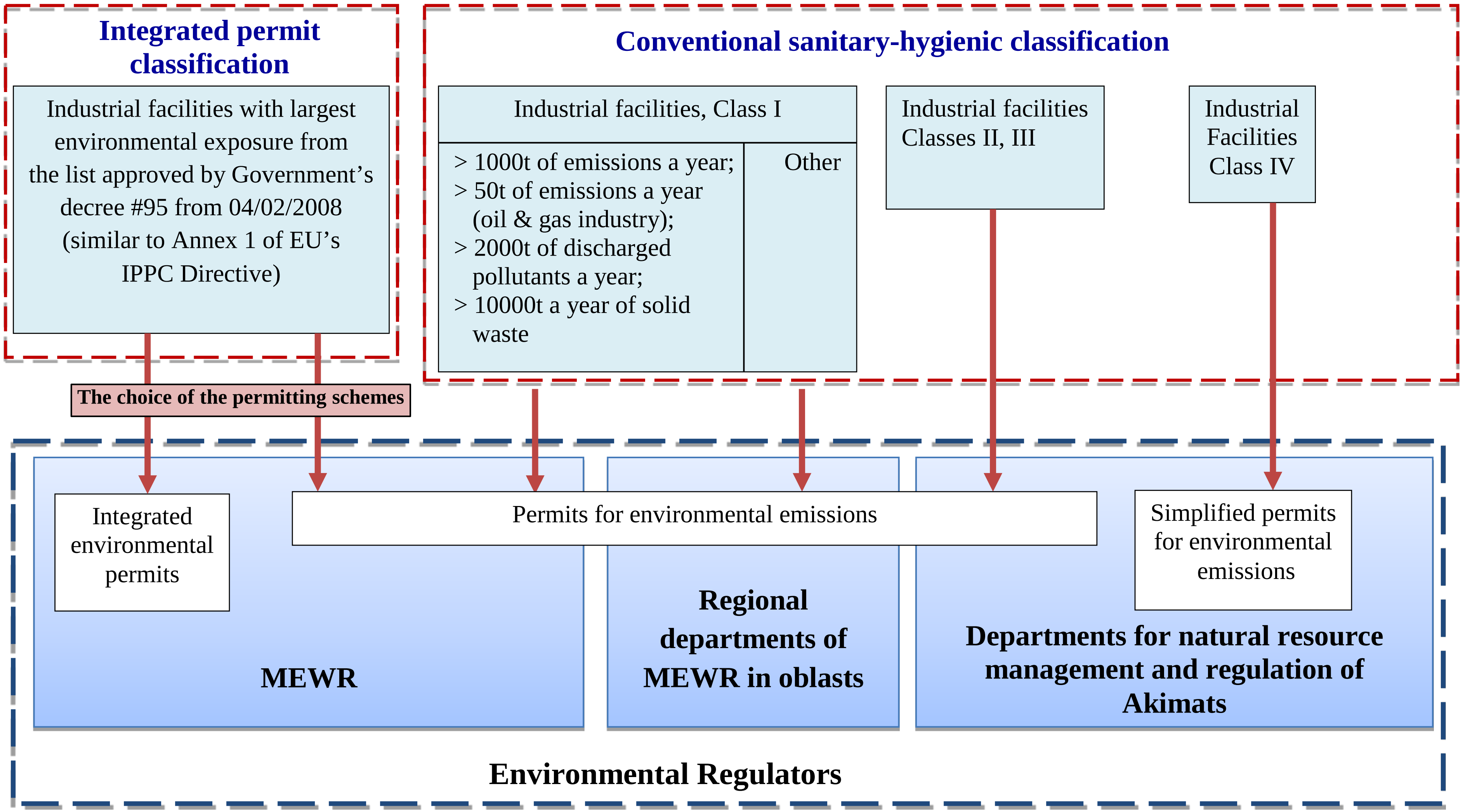


Figure 18. Handling environmental permits in Kazakhstan

11.2 Environmental Emissions Permit

The procedure for environmental permitting includes the preparation, submission, validation and approval of different documents, depending on the environmental classification as shown below.

Required package of the permit documents for industrial facilities

classes I, II	class III	class IV
▪ Application form; ▪ Conclusion of the State Ecological Expertise; ▪ Environmental action plan for the permitting period; ▪ Public hearings protocol; ▪ A program of environmental monitoring.	▪ Application form; ▪ Conclusion of the State Ecological Expertise; ▪ Environmental action plan; for the permitting period; ▪ A program of environmental monitoring.	▪ Application form; ▪ Emission limit values.

Figure 19. Required package of documents for industrial facilities

The main document in the permitting package is the application form which includes: (i) information on the production facility; (ii) inventory of emission sources; (iii) permitted quantities of air emissions (t/year and g/second); (iv) permitted quantities of waste water discharge (mg/l, t/year); (v) permitted solid waste generation (t/year); (vi) special permit on the quantity of sulphur disposal (t/year); and (vii) other special terms.

The application form has to be approved by the State Sanitary Inspectorate to ensure that the proposed emission Limit Values (ELVs) will not lead to the deterioration of air quality within the residential areas. After approval of State Sanitary Inspectorate, the environmental permit application documents are reviewed, called 'State Environmental Expertise', performed either by the Committee for Ecological Regulation and Control of the MEWR for class I industrial facilities or by regional departments for the rest of industrial facilities[18]. The Environmental Action Plans of the industries must be communicated to the local stakeholders.

Documents for the permit include the following:

1) Information on the applicant, profile of its economic activity;
2) Duration of the permit;
3) Conditions for environmental emissions, including:
    i. Emission Limit Values (ELVs) for emissions[19] (g/sec, t/year);

[18] Class IV production facilities have a significantly reduced scope of the permitting process as they are not obliged to undergo public hearings, prior to the State Sanitary Inspectorate. The simplified procedure for the class IV companies was proclaimed by Environmental Code and introduced in practice by the State Service Standard 'Issuance of environmental emissions permit for production facilities of classes I, III and IV of environmental exposure in 2012.

[19] The permit limits emissions just for the entire industrial facility, but it does not provide information on the ELVs as per emission source, which are in the emission source inventory book.

ii. Limits for discharge of pollutants (mg/l, t/year);
iii. Limits for solid waste disposal (t/year);
iv. Limits sulphur disposal (t/year);
v. General Terms and Requirements,

4) Environmental actions plan for the permitting period;
5) Waste handling and management plan[20];
6) Environmental monitoring plan.

If an industrial facility has sources of emissions, which exceed ELVs, the mitigation and environmental plan should include specific measures to reduce these emissions. The company can plan both end-of- pipe measures and those aimed at minimizing emissions "at the source"[21]. However, the general list of environmental mitigation strategies has been published by MEWR[22] suggest that most are described quite generally and belong to “end of pipe” strategies. The Environmental Emissions Permit requirements contain no reference to the BATs or preventative cleaner production measures.

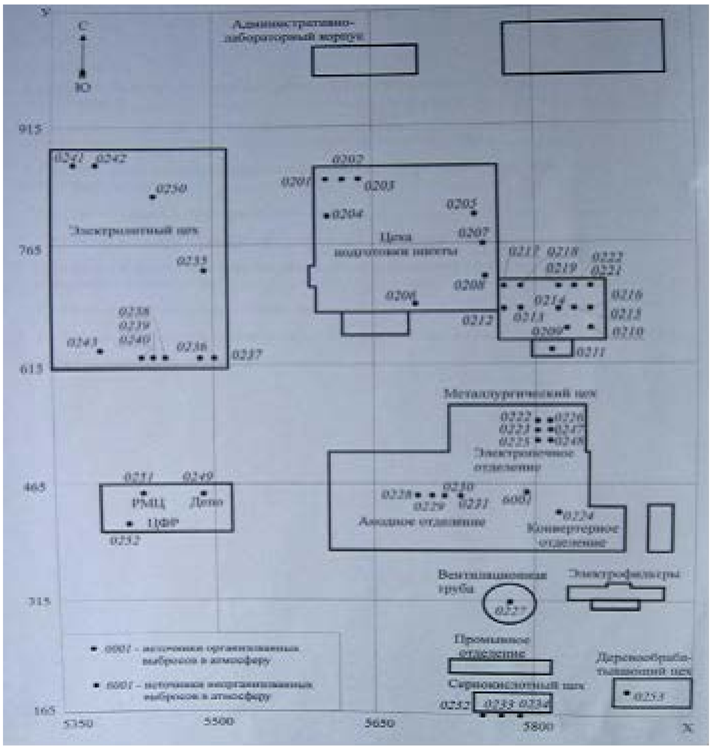


Figure 20. Example of inventory of air emissions

11.3 Integrated Environmental Permit and Best Available Techniques

Rules for issuing integrated environmental permits in Kazakhstan were approved by the government in 2008 and further detailed in 2012[23], which also included a list of industrial facilities to which the Integrated Environmental Permit requirements could apply. Integrated Environmental Permit Application should include information on the production facility, inventory of emission sources, a program for transition to Best Available Techniques, a plan for mitigation of emergency situations, waste management plan, environmental monitoring plan, as well as:

- Permitted quantities of air emissions (mg/m^3, t/year and g/second);
- Permitted quantities of waste water discharge (mg/l, g/hour, t/year);
- Permitted solid waste generation (t/year, th.m^3/year).

[20] From 2013, the Ministry requires industrial facilities to submit a waste management program. The Program should aim to minimize the waste generation and to reduce the amount of accumulated waste. The Program development methodology has been prepared by the MEWR.
[21] If an industrial facility meets the emission limit values, such plan is still required, however it is not evident if its implementation and effect on the actual emissions is followed up by the authorities.
[22] Decree #119 from 24/04/2007
[23] Government’s Resolution № 95, on February 4, 2008 and further detailed by Government’s Resolution № 1033, on August 8, 2012

Industrial facilities apply for Emission Limit Values (ELVs) for all identified emission sources, which is a notable improvement compared to the conventional permitting system where ELVs are only specified for the total emissions from an industrial facility[24]. The terms and provisions for integrated environmental permitting in Kazakhstan resemble the IPPC permit and offers the following innovative features related to air pollution:

- Emission limit values are considered in concentrations (e.g., mg/m^3);
- The permit may also include specific emission values, the so-called process benchmarks, if those are approved in Kazakhstan;
- The permit should specify the baseline use of materials and energy and that by the end of ‘BAT transition period’, i.e.:
  - Energy consumption per year (KWh-year);
  - Maximum Energy consumption (KWh-year);
  - Energy consumption per unit of production output (KWh/unit of production output);
  - Renewable energy sources utilization (% of the total use);
  - Material use per unit of production output (t/unit of production output).

However, there is at present no experience in Kazakhstan with obtaining integrated permits by enterprises. The procedure of obtaining the integrated environmental permit presumes that the emissions limits should be established based on application of the Best Available Techniques (BATs), but the national BAT documents are too general[25]. The process based emission limits benchmarks are not taken into account when emission limits are established. The lack of use of integrated permits in Kazakhstan is stated by the interviewed companies to be due to the following factors:

- Companies are anxious about new permitting procedure, as the need for change from the current system is ill understood and there is reluctance to apply the integrated permitting system due to the understanding the BATs are unrealistically expensive due to strict technological limits and technically unfeasible in Kazakhstan;
- Current integrated permitting procedures are not clear and need to be streamlined;
- Companies are concerned that integrated permitting accommodates considerable risk of additional costs. In the event of any deviation, companies would have to redo the whole permitting from the very beginning; while one of the advantageous of an integrated permit system is that it should be shorter and less laborious than issuance of separate permits;
- There is far too little information on practical application of the integrated permit.
- The companies miss temporary permits, especially desired for a transition time for the BATs adoption;

11.4 Emission Limit Values in Permits

The objective of Emission Limit Values (ELVs) in industrial permits in Kazakhstan is to ensure that air quality at the nearest residential area or at the boundary of the so-called “sanitary zone”

[24] The application has to be approved by the State Sanitary Inspectorate, which mainly looks at the proposed emission limit values and quantities. Once this is done, Committee for Ecological Regulation and Control of the Ministry of Environment and Water Resources performs ‘State Environmental Expertise’.
[25] MEWR is currently preparing amendments to the Environmental Code to improve the quality of BAT documents.

meets the hygienic requirements[26] for air quality within residential areas, with the reference to background air pollution level.[27,28] Compliance to the required air quality is being assessed taking into account the background pollution levels. If concentrations of air pollutants exceeds the Maximum Allowable Concentrations (MACs) in the nearest residential area/boundary of the sanitary zone, the environmental authorities can adjust the emission limits of the industrial facility, if the dispersion calculations show that the excess is caused by the industrial facility. In practice, there are a number of problems with the manner in which Emission Limit Values are determined in permits.

Firstly, while the objective of ELVs is to ensure that air quality is good in residential areas, these are often close to sources of air pollution and within the defined sanitary zone, see Figure 21. Air pollution also travels much further distances in reality than modelling calculates and air pollution within a residential area is typically caused by more than one industrial facility. In the case of multiple pollution sources, background pollution will be beyond hygienic requirements for air quality while industrial facilities would obtain environmental permit for ELVs that would not ensure air quality compliance.

Figure 21. Example of significant air emissions close living area, Central Kazakhstan

[26] The hygienic requirements are approved by the Government's Decree #168 dated of 25/01/2012.

[27] General rules for determining the emission limit values are approved by the Government of the Republic of Kazakhstan in the Decree #448 from 1/06/2007.

[28] These ambient quality standards have been derived in the 1980's from the academically sound scientific theory of maximum absorptive capacity of environment and atmospheric diffusion of pollution and are based on the concept of zero risk to humans and the environment during the worst possible circumstances (e.g., worst-case meteorological conditions, most vulnerable part of population). Transposing these academic approaches to the legislative and regulatory framework resulted in very strict ambient quality standards, which would require heavy investments by industries to comply and which may become unfeasible for most companies.

Secondly, the permit specifies ELVs for an entire industrial facility, rather than source-specific emission limits taking into account production activities at different sources. There may be an excess of emissions at one source, while the other source is not operating. In this case, the industrial facility may stay within its total emission limit, but in reality there would an excess of emissions from the operating sources.

Thirdly, Kazakh industrial facilities typically obtain ELVs based on the emissions being measured during the maximum production output which offers a safety margin to ensure that the ELVs are not exceeded but places insufficient incentives to reduce the present level of emissions. Likewise, they can be based on the design capacity of process equipment, while in reality enterprises frequently do not work at full capacity which also facilitates compliance without the improvement of technological processes, reduction of emissions and implementation of Best Available Techniques (BAT).

Fourthly, the ELVs should only be set for the list of pollutants subject for mandatory setting up ELVs.[29] In practice, however, many industrial facilities, their consultants, as well as environmental regulators are not well informed about the mandatory lists emission limits. Many of the environmental permit applications include ELVs for all identified emissions regardless to their quantities and potential hazard, which means a significant and redundant paperwork both for environmental responsible at industrial facilities and environmental regulators without environmental/health benefits and insufficient focus on the pollutants which cause most health impacts. In the European Union, ELVs are only for the most hazardous emissions and based on emission limits which are possible to obtain when industries use BAT.

Fifthly, the emission limits in the permitting process are based on the level of historic pollution and background concentrations rather than on the basis what emission limits an industry could achieve when applying BAT. The approved BAT which are in place today in Kazakhstan provide only specific technical emission limits and reference methodologies for three industrial processes which should be the basis for approved ELVs in permits[30]. This is insufficient compared to variety of processes used by industrial facilities in Kazakhstan. The reference documents for BATs do also not clearly specify emission standards for all key pollutants causing health impacts and only recommend strategies for the emissions reduction and methods for measuring their effectiveness.

[29] The lists of pollutants mandatory for establishing ELVs consists of the following: (i) sulfur dioxide and other sulfur compounds; (ii) nitrogen oxide and other nitrogen compounds; (iii) Volatile Organic Compounds (VOCs); (iv) metals and their compounds; (v) arsenic and its compounds; (vi) cyanides; (vii) chlorine and their compounds; (viii) fluorine and their compounds; (ix) aromatic hydrocarbons; (x) mercaptan; (xi) hydrogen sulphide; (xii) black carbon; (xiii) dust, including asbestos dust;(xiv) polychlorinated dibenzofurans; and (xv) other pollutants of 1-II class of hazard for which the sanitary maximum allowable concentrations in sanitary zones are established. Pollutants of the environmental hazard classes III – IV should not be subject to mandatory emission limit setting.

[30] The following methodologies/technological emission values are currently approved:

- "Requirements for emissions into environment from various fuels burning in the thermal power plant boilers" (Decree of the Government of the Republic of Kazakhstan issued on December 14, 2007 № 1232);
- "Requirements for emissions into environment during the ferroalloys production" (Decree of the Government of the Republic of Kazakhstan, January 26, 2009 № 46);
- "Requirements for emissions into the environment from the alumina production by the Bayer sintering process" (Decree of the Government of the Republic of Kazakhstan issued on August 6, 2009 № 1207).

Table 12 below compares the Kazakh technical emission standards for the heat and power industry with similar requirements of the EU's Directive 2010/75 on Industrial Emissions Directive.[31]

Table 12. Comparison of emission standards in heat and power industry with Directive 2010/75 EU

Pollutants	**Heating Capacity (P), MW**	**Technical Emission Standards, Kazakhstan (after 01.01.2013)**			**Directive №2010/75/EU[32]**		
		Solid fuel	**Fuel oil**	**Natural gas**	**Solid fuel**	**Fuel oil**	**Natural gas**
Dust/PM	50≤P<100	150 – 500			30	30 (50)	5
	100≤P<300				20-25	25	
	300≤P	100-200			20	20	
Sulphur dioxide	50≤P<100	1200 – 1400			200-400	350	35
	100≤P<199				200-300	250	
	200≤P<249	1800 – 2000					
	250≤P<299	700					
	300≤P	780			200		
Nitrogen oxides	50≤P<100	320-640	250	125	300 (450)	450	100
	100≤P<300				200-250	200	
	300≤P<500	300 - 550			200 (450)	150	
	P>500				200	150 (400)	

The EU's Directive requirements for the ELV are far more stringent than the Kazakhstan Technical Emission Standards and are able to be achieved due to the advanced processes and technologies, which have been introduced due to implementing Best Available Techniques for production processes during the past 10 years in the EU. This same deviation between the level of the ELVs in Kazakhstan and the EU can be seen in an example from the permit of Karaganda Heating and Power Plant 3 (Karaganda HPP 3).

[31] The Directive on Industrial Emissions will replace the Integrated Pollution Prevention and Control Directive and the sectoral Directives on January 2014, with exception of the Large Combustion Directive which will be repealed by January 2016.

[32] http://ec.europa.eu/environment/air/pollutants/stationary/

Example: Karaganda HPP 3
The combined heat and power plant combusts lignite and produce heat and electricity in three blocks. The ELVs in the permit are given in amounts, g/s, and are therefore not easy comparable with European plants and the IED/IPPCD, where ELVs are given in concentration, mg/Nm^3.

From the permit the following operational information and ELVs are given for CHP-3:

- Fuel consumption: 1.448.400 tons/y
- Operational hours: 5100 hours/y
- ELV for NOx – Chimney 1: 244,8327 g/s
- ELV for NOx – Chimney 2: 133,5954 g/s
- ELV for SO_2 – Chimney 1: 441,6534 g/s
- ELV for SO_2 – Chimney 2: 262,1736 g/s

The amount of flue gas per unit of fuel is not given, but for lignite as fuel the typical amount will be 7-8 Nm^3 of flue gas per kilogram of lignite combusted, given 6% O_2 in the flue gas. In this example the amount is assumed to be 7,5Nm^3/kg at 6% O_2.

Based on the operational data from the permit and the assumed amount of flue gas the ELVs can be recalculated to concentration and compared with IED/IPPC:

Parameter	CHP-3 ELV				IED/IPPC ELV [mg/Nm^3][1]
	Chimney 1 [g/s]	Chimney 2 [g/s]	Total [g/s]	Total [mg/Nm^3][1]	
NOx	244,8327	133,5954	378,4281	640	200
SO_2	441,6534	262,1736	703,8270	1190	200

As the calculation shows, the ELVs for NOx and SO_2 are significant higher in the Kazakh permit than allowed for similar plants in the IE/IPPC Directive.

11.5 Recommendations for improvement of permitting system

With the adoption of the Environmental Code in 2007, Kazakhstan made improvements to harmonize national environmental legislation with good international practices and streamline the rules for obtaining permits to make it simpler and more transparent. The Environmental Code has superseded and replaced as many as approximately 80 previous regulations since its introduction and rules for obtaining permits were revised towards simplification and to reduce the environmental permitting paperwork burden for companies and environmental authorities. A list of Governmental Acts and Regulations governing the Environmental Permitting in Kazakhstan provided in Annex 5. Inventory of Relevant Regulations.

The Environmental Code is underpinned by a number of environmental regulations which aim at introducing innovative schemes for environmental permitting, etc. A number of key improvements which have already been introduced are:

- Permit application now has been extended to once every five years, compared to once every three years and even once a year before;
- Simplified EIA procedure for newly constructed industrial facilities;
- Licensing requirement for developers of ELVs is abolished for all but industrial facilities; belonging to class I of environmental exposure;

- Temporarily agreed emission limits are no longer existent in Kazakhstan;
- Inventory of emission sources requires no longer any approval by environmental authorities;
- Previously, the MEWR was responsible to issue permits for emissions to all industrial facilities of the class I. Now, only the largest industrial facilities of class I apply for permits at MEWR, while the rest of the industries can apply at the regional departments;
- Gradual transition to electronic document flow is underway. MEWR introduces a system of submitting environmental permit applications electronically through a special web-portal.

At the same time, industrial facilities now face tougher compliance requirements and conditions for obtaining environmental permits. More importantly, there is still a lack of incentives for industrial facilities to adhere to modern, innovative environmental strategies aimed at continual pollution prevention and control, as well as application of Best Available Techniques. While most of Kazakh industrial companies meet a challenge of ever growing environmental compliance requirements from the public authorities, only few of them are keen to go beyond the emission limits set-up by environmental regulators.

This section analyses main gaps and disincentives in the present permitting framework, in comparison with EU’s practices, which could be abolished or streamlined by introduction of specific and realistic policy actions.

11.5.1 Unification of the permitting schemes and categorization of large polluters

Large polluters, i.e., industrial facilities of class I of environmental exposure may choose between conventional air emissions permit and integrated environmental permit. In the European Union countries large polluters have to apply for an Integrated Permit, see Figure 22 on the comparison of permitting systems below. Major pollution sources are subject to an integrated environmental permitting scheme, which is based on integrated pollution prevention and control, as well as on BATs. Environmental aspects are addressed simultaneously, but site-specific issues and risks are taken into account through the risk analysis. In all European Countries, including new member states, BAT is seen as one of the most effective ways of improving production efficiency, saving money and the key element in the permit process.

Industrial facilities in Kazakhstan are used to the conventional permitting system and find it appropriate. The free choice between the two parallel permitting systems for the large polluters, without any long-term targets and policy objectives, places a disincentive for transition to the integrated environmental permitting, both for the industrial facility and environmental regulators. A gradual unification of the permitting systems is needed and a plan needs to be established in close consultations with the industries for enabling integrated permitting system for large industrial polluters and sector by sector. Smaller industrial facilities may still follow the present procedure for obtaining environmental permits.

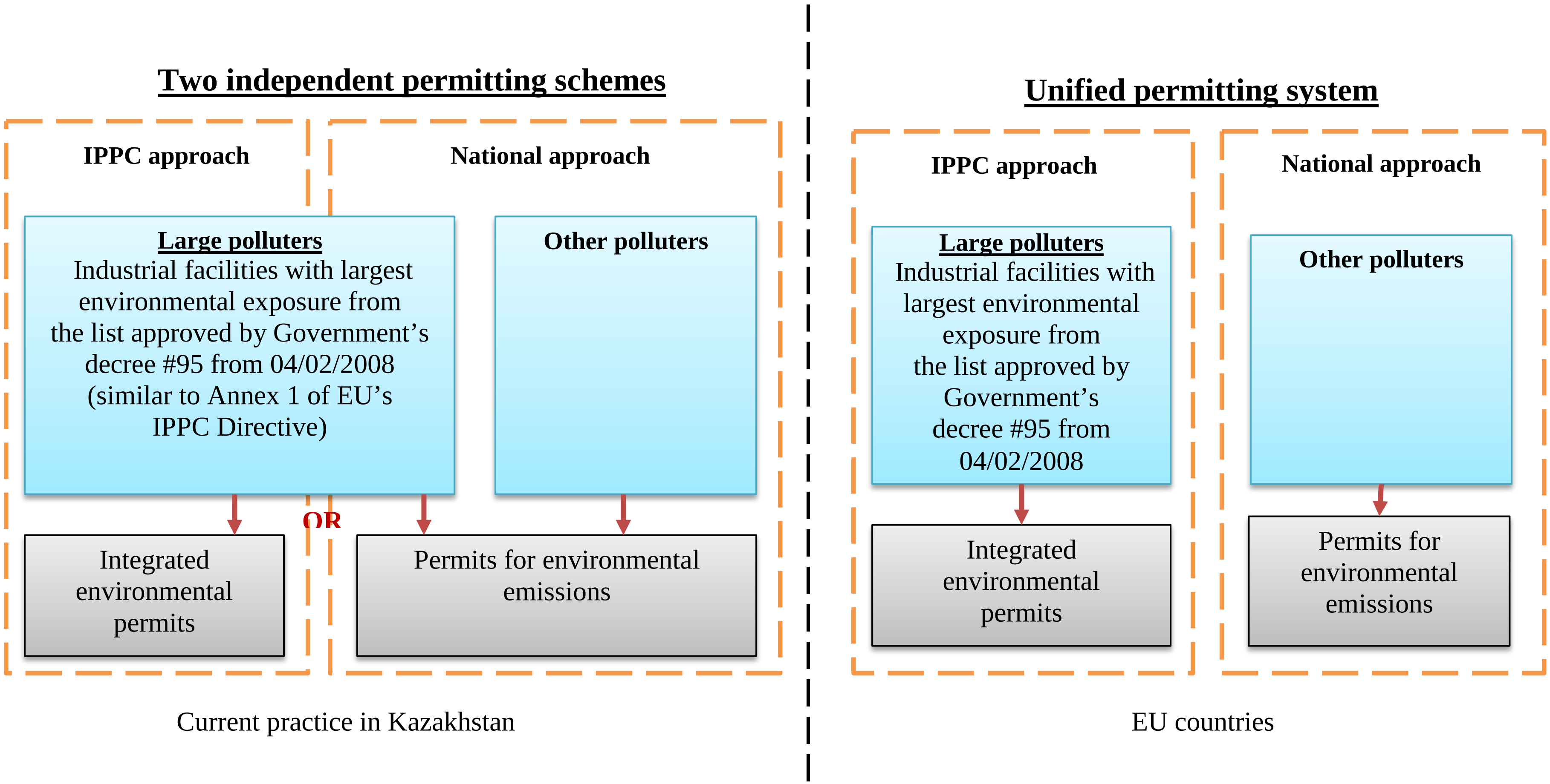


Figure 22. Comparison of permitting systems

This shift should also address the issue that Kazakhstan currently faces two independent approaches to categorize industrial facilities based on their environmental exposure.[33] These approaches are not consistent with each other and as a result, environmental exposure of industrial facilities can be ranked differently. This situation does not facilitate the performance of environmental management systems at large industrial facilities and makes transition to a unified environmental permitting scheme less smooth.

Table 13. Categorization of industrial facilities upon environmental exposure

CATEGORIZATOIN OF INDUSTRIAL FACILITIES UPON ENVIRONMENTAL EXPOSURE	
Current practice, Kazakhstan	EU countries
List of industrial facilities which may apply for integrated environmental permits instead of separate environmental permits	DIRECTIVE 2010/75/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 24 November 2010 on industrial emissions (Integrated Pollution Prevention and Control) ANNEX I Categories of activities referred to in Article 10
Industrial facilities of class I of environmental exposure (sanitary protection zone is greater than 500 m)	

The list of industries in Kazakhstan which may apply for integrated environmental permits and the list of large polluters according to the IPPC Directive, are quite similar in categorizing industrial facilities with the largest environmental exposure, see Table 14 below. It is recommended to transition to a unified approach for ranking of industrial facilities with largest the environmental exposure, the list of the IPPC facilities can be a reference for such transition.

[33] One approach follows the EU's IPPC Directive, while the another one ranks environmental exposure of industrial facilities upon their compliance to sanitary (hygienic) standards.

Table 14. Comparison of ranking between IPPC directive and Kazakh legislation

DIRECTIVE 2010/75/EU *ANNEX I* **Categories of activities**	**Industrial facilities, Class I environmental hazard**	**List of industrial facilities, approved by Government's decree № 95 from 4 February 2008 (integrated permitting scheme)**
Energy industries	**Combined heat and power generation based on fossil fuels combustion**	**Energy facilities**
Combustion of fuels in installations with a total rated thermal input of 50 MW or more	CHP with capacity of 600 MW electrical equivalent and above, using coal and fuel oil as a fuel.	Incineration plants with a rated thermal input exceeding 50 MW;
	CHP with capacity of 600 MW electrical equivalent and above, using gas and gas-fuel oil	
	CHP and boiler houses of 200 GCal and above, using coal and fuel oil	
Refining of mineral oil and gas	**Chemical industries**	Oil and gas refineries;
	Oil processing, production of associated petroleum and natural gas. During the processing of hydrocarbons containing sulfur compounds above 1% (by weight) sanitary zone should be reasonably increased	
	Bitumen and other products of residues from coal tar, oil, pine needles (tar and other semi tar)	
Production of coke	**Metallurgical, machine-building and metal objects**	Coke ovens;
	Coke production (coke gas)	
	Coke firing (de-coking)	
Gasification or liquefaction of: (a) coal; (b) other fuels in installations with a total rated thermal input of 20 MW or more.	**Chemical production**	Installations for coal gasification and gas liquefaction.
	Underground coal gasification stations	
Production and processing of metals	**Metallurgical, metal processing and engineering industrial facilities**	**Industrial facilities for metal production and processing**
Metal ore (including sulphide ore) roasting or sintering	Production of granulation of ferrous and non-ferrous ores and pyrite stubs	Installations for the roasting and sintering of metal ore (including sulphide ore).
Production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tons per hour	Iron and steel industry with a full-cycle production over 1,000,000 tons per annum of iron and steel.	Installations for production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2.5 tons per hour.
	Iron and steel industry with a full-cycle production under 1,000,000 tons per annum of iron and steel.	
	Steel production by open-hearth and converter furnaces with waste recycling workshops (crushing of basic cinder and others)	
	Steel production by open-hearth, electric smelting and converter ovens	

DIRECTIVE 2010/75/EU *ANNEX I* Categories of activities	Industrial facilities, Class I environmental hazard	List of industrial facilities, approved by Government's decree № 95 from 4 February 2008 (integrated permitting scheme)
	with waste recycling workshops (crushing of basic cinder and others) with production output of up to 1,000,000 tons / year	
	Smelter of special types of pig iron	
	Ferroalloys production	
Processing of ferrous metals: (a) operation of hot-rolling mills with a capacity exceeding 20 tons of crude steel per hour; (b) operation of smitheries with hammers the energy of which exceeds 50 kilojoule per hammer, where the calorific power used exceeds 20 MW; (c) application of protective fused metal coats with an input exceeding 2 tons of crude steel per hour.		Installations for the processing of ferrous metals: Hot-rolling mills with a capacity exceeding 20 tons/hour of crude steel; Forge with hammers with the capacity exceeding 50 kilojoule per hammer, whereas the calorific value exceeds 20 MW; Application of protective fused metal coats with an input exceeding 2 tons of crude steel per hour.
Operation of ferrous metal foundries with a production capacity exceeding 20 tons per day	Production of pig iron directly from ores and concentrates, with a total blast furnace up to 1500 m^3	Ferrous metals foundries with a capacity exceeding 20 tons per day
	Production of pig iron directly from ores and concentrates, with a total blast furnace from 500 m^3 to 1500 m^3	
	Mold casting of pig iron in an amount of more than 100,000 t / year	
Processing of non-ferrous metals: (a) production of non-ferrous crude metals from ore, concentrates or secondary raw materials by metallurgical, chemical or electrolytic processes; (b) melting, including the alloys of non-ferrous metals, including recovered products and operation of non-ferrous metal foundries, with a melting capacity exceeding 4 tons per day for lead and cadmium or 20 tons per day for all other metals.	Recycling of non-ferrous metals (copper, lead, zinc) in an amount of 3000 tons / year	Installations for the production of non-ferrous crude metals from ore, concentrates or secondary raw materials products by metallurgical, chemical or electrolytic processes: for the smelting, including the alloying non-ferrous metals, including recovered products (refining, foundry casting, etc.) with a melting capacity exceeds 4 tons per day for lead and cadmium or 20 tons per day for all other metals.
	Smelting of non-ferrous metals directly from ores and concentrates (lead, tin, copper, nickel)	
	Production of aluminum by electrolysis of molten alumina	
	Production of alumina (aluminum oxide)	
	Mercury production and appliances containing mercury (mercury rectifiers, thermometers, light bulbs)	
	Magnesium production (in all ways except the chloride treatment)	
Surface treatment of metals or plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m3		Installations for the surface treatment of metals and plastic materials using an electrolytic or chemical process, whereas the volume of vats exceeds 30 m.

11.5.2 Focus environmental action plan control on emission reduction and Best Available Techniques application

Under the current system, an environmental action plan is part of the set of documents for the permit application. The formal implementation of the provisions in the environmental action plan is subject for a strict control, including scope of measures, status of its implementation, actual financial requirements etc. If an industrial facility does not comply with any of the action plan provisions, even when the costs of certain environmental measures were lower than planned due to efficient procurement and realization and the measure itself is properly implemented, this may be the reason for ceasing the permit and requiring re-application. This policy is not effective and prevents industrial facilities from actively managing and reducing their environmental footprint and taking an active role in its environmental management. A company may be forced by environmental authorities to implement a project which was planned a number of years in the past, even if a better alternative is identified in the mean-time.

Excessive attention to formal implementation of environmental action plans force the industrial facilities to put in their plans the environmental mitigation measures with smallest risk of non-compliance or non-implementation, i.e., relatively small projects. This situation represents a barrier for industrial facilities with regards to planning of substantial and large investment environmental improvements. Also, Environmental Action Plans are proposed to meet the Emission Limit Values; if there is no excess of the ELVs, then companies would normally plan relatively small Operational and Maintenance measures as there is no motivation for continuing environmental improvements.

In EU countries, environmental regulators observe environmental compliance and use the EU Best Available Techniques Reference documents as the reference documents for what is considered best available techniques in each key sector and companies are obliged to have agreed action plans with implementation deadlines to adopt these Best Available Techniques in their process even when the ELVs are not exceeded.

In Kazakhstan, as in other countries, industrial pollution control is often seen as a trade-off between the economy (employment, energy supply, production) and a clean environment. As a result, it is often difficult for regulators to enforce environmental standards. However in Kazakhstan, as in Europe and America in the past decades, demand for cleaner industry can be expected to increase as the economy continues to grow. Furthermore, this ‘trade-off between the economy and the environment’ is not always as clear cut as it seems. Win-win solutions exist, most notably in the form of cleaner technologies and comprehensive economic studies have shown that the cost of preventing or reducing pollution associated with an industrial activity is often lower than the damage it causes to society (such as increased mortality, cost of illness in terms of workdays lost or cost of treatment, loss of recreational values, decreased agricultural productivity, reduced availability of drinking water), when adequately taken into account.

It is recommended for environmental regulators to move away from formal enforcement of the approved environmental action plans to close control and actual monitoring of the achieved results in terms of emissions reduction, improvement of process efficiency and employment of best

available techniques. Each environmental measure should be related to a particular source of emissions and the expected emissions before and after its implementation.

11.5.3 Optimize the validity of environmental permit

Currently, environmental permits are valid until the replacement of the applied technologies and/or environmental conditions or until the 5 year maximum validity has been reached. However, such periodical mandatory renewal of environmental permits every five years causes an unnecessary paperwork burden, to both environmental managers at industrial facilities and environmental regulators. In the European Union countries, environmental permits are valid up to the change of applied technologies and/or environmental conditions and once in four year an industrial facility which has an IED/IPPC permits, should be audited to check compliance to BATs and permit provisions. Also in Kazakhstan, there is the opportunity to introduce the practices of a longer validity of the permit for companies applying for an integrated permit as an incentive for industries to move towards integrated permitting.

11.5.4 Streamline the present integrated environmental permitting procedures

Until now, no single industrial facility in Kazakhstan has chosen to apply for integrated environmental permit. The complexity and uncertainty of procedures for preparation and approval of documentation for the integrated permit are partially responsible for this situation. In addition industrial facilities have a lack of awareness on how to apply for an integrated permit.

In European countries, all industrial facilities with production processes included in the ANNEX I (Categories of activities) of Directive 2010/75/EU are obligated to obtain integrated environmental permits. In Kazakhstan, the procedures for applying integrated environmental permits are complicated in relation to EU practices. Table 15 below illustrates this assumption.

Table 15. Environmental permitting procedures in Kazakhstan and EU countries

Current practice	EU countries
Integrated environmental permit includes: 1) Information on the production facility; 2) Time required to meet BATs requirements; 3) Permitted quantities of emissions before and after BATs implementation: • Permitted quantities of air emissions (mg/m^3, t/year and g/second); • Permitted quantities of waste water discharge (mg/l, g/hour, t/year); • Permitted solid waste generation (t/year, th.m^3/year). The application may also include specific emission values (specifics emissions to air, water, soil and disposal of solid waste), if those are approved in Kazakhstan. 4) Plan for transition to best environmental techniques: • Technology planned for introduction; • Planned environmental effects; • Timeline for implementation; • Estimated budget. 5) Main terms and conditions of the permit. 6) The Permit should specify the baseline use of materials and energy and that by the end of 'BAT transition period', i.e.: • Energy consumption per year (KWh-year); • Maximum Energy consumption (KWh-year); • Energy consumption per unit of production output (KWh/unit of production output); • Renewable energy sources utilization (% of the total use); • Material use per unit of production output (t/unit of production output). 7) Waste management plan (including baseline situation and upon compliance to BATs). For each of the waste flow, the following should be indicated: - saldo from the bygone year; - quantities of solid waste generated during the year; - quantities of solid waste reused onsite; - quantities of solid waste neutralized; - quantities of solid waste disposed at landfills; 8) Action plan for emergency situation.	An integrated permit should contain conditions covering the following issues: (1) ***Operational Matters.*** Conditions related to operational matters must be based on BAT, as described in relevant technical guidance (2) ***Emission Limit Values.*** ELVs for emissions should be set based on the risk assessment and BREF-considerations (combined approach) (3) ***Improvement Program.*** When the regulatory authority accepts an argument from the operator of an existing installation that it cannot afford an immediate move to a BAT, an improvement program to achieve the BAT should be stipulated in the permit. Existing industrial installations will need management strategies (4) ***Records.*** A permit should contain conditions for making, keeping, and providing access to appropriate records, including monitoring results and a log record of any failures that had, or could have had, an effect on the environment. (5) ***Reporting and Notifications.*** The permit should specify reporting requirements for the installation, including parameters to report and frequency of reports, and arrangements for notifying the regulatory authority about such events as exceedance of ELVs, accidents, temporary or permanent cessation of operations. (6) ***Payment of Environmental Taxes and Charges*** (if applicable). (7) ***Validity and Provisions for Renewal and Variation.*** The permit should specify the date of its entry into force and the validity period (in accordance with relevant legislation).

Simplifying and streamlining present regulations and procedures for obtaining integrated environmental permits will be required to transition from the current permit system to integrated permitting. It is recommended to initiate a pilot project for assisting one or a few of the 'industry's champions' in obtaining integrated environmental permit in the key industrial sectors in Kazakhstan to serve as an example and learn lessons for the rest of the sector on both the industries' and the environmental authorities' side.

11.5.5 Promoting Pollution Prevention and Best Available Techniques

Integrated environmental permits entail introduction of BATs. The approved list of BAT in Kazakhstan includes two "horizontal" and six sector lists with BATs. The total volume of the BAT document in Kazakhstan is about 35 pages and it includes both technical and technological

solutions. For some of the technical options, the benchmarks for efficiency are suggested. Among the recommended technological solutions, the "end of pipe" technologies prevail.

The present BATs approved in Kazakhstan are suboptimal because:

- they are not fully consistent to the basic BAT concept, which is aimed at combining pollution prevention and control, rather than just at the end-of-pipe techniques;
- they are not linked to the permitting regulations;
- industrial facilities are poorly informed about the list of BAT approved in Kazakhstan;

As a result, the BAT concept is not commonly applied in Kazakhstan, both when setting up the air emission limits and to environmental management of industrial facilities.

In the EU, the European Integrated Pollution Prevention and Control (IPPC) Bureau (EIPPCB) was set up in 1997 to organize an exchange of information between Member States, industry, industrial sector associations, and non-governmental organizations promoting environmental protection on Best Available Techniques (BAT), associated monitoring and developments in them. An exhaustive number of reference BREF documents have been published by EIPPCB, available at http://eippcb.jrc.ec.europa.eu/reference/

The sector-specific BREFs cover technical and operational features associated with BAT for the sector, together with appropriate ELVs. There are also BREFs that address cross-cutting themes such as monitoring systems and economic and cross-media issues in integrated permitting. There is an obligation to update the BREFs every eight years and a multi-year review and consultation process with key stakeholders undertaken before the updated BREF is finalized.

The present Kazakh BATs are incomplete. For instance, the list of Kazakh BATs for non-ferrous metallurgy is a two-page long document, while EU’s BREF on the non-ferrous metallurgy is 807 pages long covering the production of non-ferrous metals in 10 groups. As shown in Table 16 for the example of Non-Ferrous metal industries, the approved list of Kazakh BATs is focuses on pollution control techniques, while the BATs presented in EU BREF documents comprise both pollution control and prevention techniques.

Table 16. BAT Non-Ferrous metallurgy

Process	**Recommended BATs, Kazakhstan – Non Ferrous metallurgy**	**Structure of relevant EU BREF Non Ferrous Metals Industries**
Main process	• Bag filter, electrostatic filter and cyclon • Carbon filter • After-burner (incl.cooling for dioxins) • Wet, half wet scrubber • Alumina scrubber • Chlorine recovery • Optimized burning • Low NOx burner • Oxidizing scrubber • Elimination and recovery of sulfur (SO_2 recovery) • Cooler, wet ceramic filter, lime/carbon adsorption and bag filter • Tightening and insulation of kilns and other process equipment • Minimization materials movement between the processes • Smoke exhaust and dust capturing at the processes related to replacement and release of melted metal, stein and sludge	• Industry overview o Cooper and its alloys o Aluminum o Zinc, lead and Cadmium o Mercury o Refractory Metals o Ferro-alloys o Alkali and Alkaline Earth Metals o Nickel and Cobalt o Carbon and Graphite • Common processes and equipment • Emission measurement and use of emission data • Metal Production and Process Control Techniques • Air Abatement and Recovery Techniques • Effluent Treatment and Water Reuse • Waste Minimization and Handling • Energy Recovery • Safety Aspects • Best Available Techniques • Specific cost data for metal production and abatement • International regulations (overview)
Chemical cleaning of metal solutions	• Permanganate bleaching of arsenic dioxide and antimony when refining zinc and lead • After-burning, condensation and dry adsorption of resins • Use of alkali scrubber • Oxidizing of HCN by hydric dioxode	
Waste reuse and recycling	• Recycling of waste for recovery of metals • Recycling waste for use as building material • Neutralization of toxic compounds • Recycling of waste heat from melting and annealing of metal concentrates and metal scrap in the converter • Use hot process gases for drying feed materials • Preheating of furnace charge by flue gases from oven or hot gases from another source • Use of recuperative kilns or preheating of air for combustion • Use of the generated carbon monoxide (CO) as a fuel • Heating of alkaline solutions by process gases or liquids • Use of plastic masses contained in some kinds of raw materials as fuel, unless plastic of good quality could be recovered and if there are no volatile organic compounds or dioxins	

Furthermore, the present list BATs does not cover all industry processes comprehensively. This is well seen in comparison with the list of EU’s BREF documents, as shown below:

Table 17. List of BAT/BREF documents

LIST OF KAZAKHSTAN'S BATS	LIST OF INTERNATIONAL REFERENCE DOCUMENTS ON BAT INCLUDES
Two "horizontal" reference lists 1) Waste water treatment for industries - irrigation farming - purification of municipal sewage - light industry - food industry - oil refining - mining - galvanic production - non-ferrous metallurgy 2) Tails Storage and Waste-rock in Mining Activities	**Seven "horizontal" reference documents** 1) Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector 2) Management of Tailings and Waste-rock in Mining Activities 3) Industrial Cooling Systems 4) Emissions from Storage 5) General Principles of Monitoring 6) Economics and Cross-media Effects 7) Energy Efficiency
Six industry lists of BAT 1) Combined heat and power 2) Marine and continental oil production 3) Processing and storage of oil, petroleum products and hydrocarbon gases 4) Ferrous Metals Processing Industry 5) Non-ferrous Metals Industries 6) Chemicals industry	**Twenty-Six Industry Reference Documents** 1) Large Combustion Plants 2) Refining of Mineral Oil and Gas 3) Iron and Steel Production 4) Ferrous Metals Processing Industry 5) Non-ferrous Metals Industries 6) Smitheries and Foundries Industry 7) Surface Treatment of Metals and Plastics 8) Cement, Lime and Magnesium Oxide Manufacturing Industries 9) Manufacture of Glass 10) Ceramic Manufacturing Industry 11) Large Volume Organic Chemical Industry 12) Manufacture of Organic Fine Chemicals 13) Production of Polymers 14) Production of Chlor-alkali 15) Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers Industries 16) Large Volume Inorganic Chemicals – Solids and Others Industry. 17) Production of Speciality Inorganic Chemicals 18) Pulp and Paper Industry. 19) Textiles Industry. 20) Tanning of Hides and Skins. 21) Slaughterhouses and Animals By-products Industries. 22) Food, Drink and Milk Industries. 23) Intensive Rearing of Poultry and Pigs 24) Surface Treatment Using Organic Solvents. 25) Waste Treatments Industries. 26) Waste Incineration.

The EU BREFs may be translated into the national language and used directly or adapted to the country specific conditions and/or include locally available techniques to constitute a set of national BAT guidance documents. In so doing, it is important to extend the scope of pollution prevention / cleaner production related measures in the national BATs.

11.5.6 Streamlining the permitting procedure

In the current process, a package of documentation required for the permit application contains repeating information requirements. Industrial facilities have to approach various public offices for

approval or reference letters prior the application could be submitted. Many countries have introduced the “One-stop shop” system, where the applicant deals with one designated competent authority that ensures coordination with all other stakeholder agencies is encouraged. It increases the consistency and predictability of the permitting process and reduces the administrative burden on both government and industry.

It is advised to review the present permit requirements upon the possibility for simplifying and streamlining. Options for the improvements may include, but not limited to:

- To combine procedures for the state environmental expertise (which is currently required prior to the final submission) and environmental permit application;
- Introduce on-line submission and processing of the permit application;
- Consider a ‘one-stop-shop’ system implying that 1 destination at environmental regulators follows-up the entire process of submission and processing of the permit application.

11.5.7 Optimizing the establishment of Emission Limit Values

Focus on the significant emissions and major pollution sources

In Kazakhstan, environmental permitting procedures apply the same way to all stationary sources of emissions. Any flow of air emissions is subject for the emission limit, regardless of the quantity of emissions and impact on environment. Even a miserable flow of emissions needs to obtain a permit through a standard scheme. As the result, the process of environmental permitting and compliance control is essentially overloaded with a great number of applications for relatively small emission sources. Moreover, it provides no methodological basis for setting priorities for environmental management. Therefore, both environmental managers at industrial facilities and environmental regulators are urged to tackle all emissions sources (installations) rather than focusing at minimization of most hazardous emissions.

Environmental regulations in the EU distinguish emissions with «significant environmental impact», as well as «major pollution sources». These definitions make it possible to rank industrial facilities and their processes according to their (potential) exposure to environment. The methodology for the risk assessment of emissions has been developed and successfully introduced. Based on such risk assessment, environmental regulators become in position to identify all major sources of emissions (installations) with most significant environmental effect, which are then subject for setting the emission limits. In this way, the list of emission sources to be controlled will be less, while the level of control for the major sources will be stricter. Many environmental authorities also undertake detailed dispersion modelling and source attribution using information from modernized state air quality monitoring networks. This information is used together with an overview of major sources of emissions (installations) with significant environmental effectives and risk assessment methodologies to limit the lists of emission sources to be controlled and increase control over the major sources.

It is recommended to develop and adopt a methodology for distinguishing emissions with «significant environmental impact» and «major pollution sources» and increase the focus on those emission sources in the permit while relaxing the control of the non- major/significant sources.

Wider application of technology-based approach when setting ELVs

In Kazakhstan, the compliance of the permitted air emissions to Environmental Quality Standards (EQS) is legally bound. The only criteria for setting of the air emission limits are compliance to the ambient air quality standard in the residential area/ sanitary zone. Emission limits are often set based on the actually measured emissions. As a result, industrial facilities are longing to obtain the largest possible allowances, based on maximum production output. Companies are also forced to ensure the required ambient air quality at the "end of the pipe".

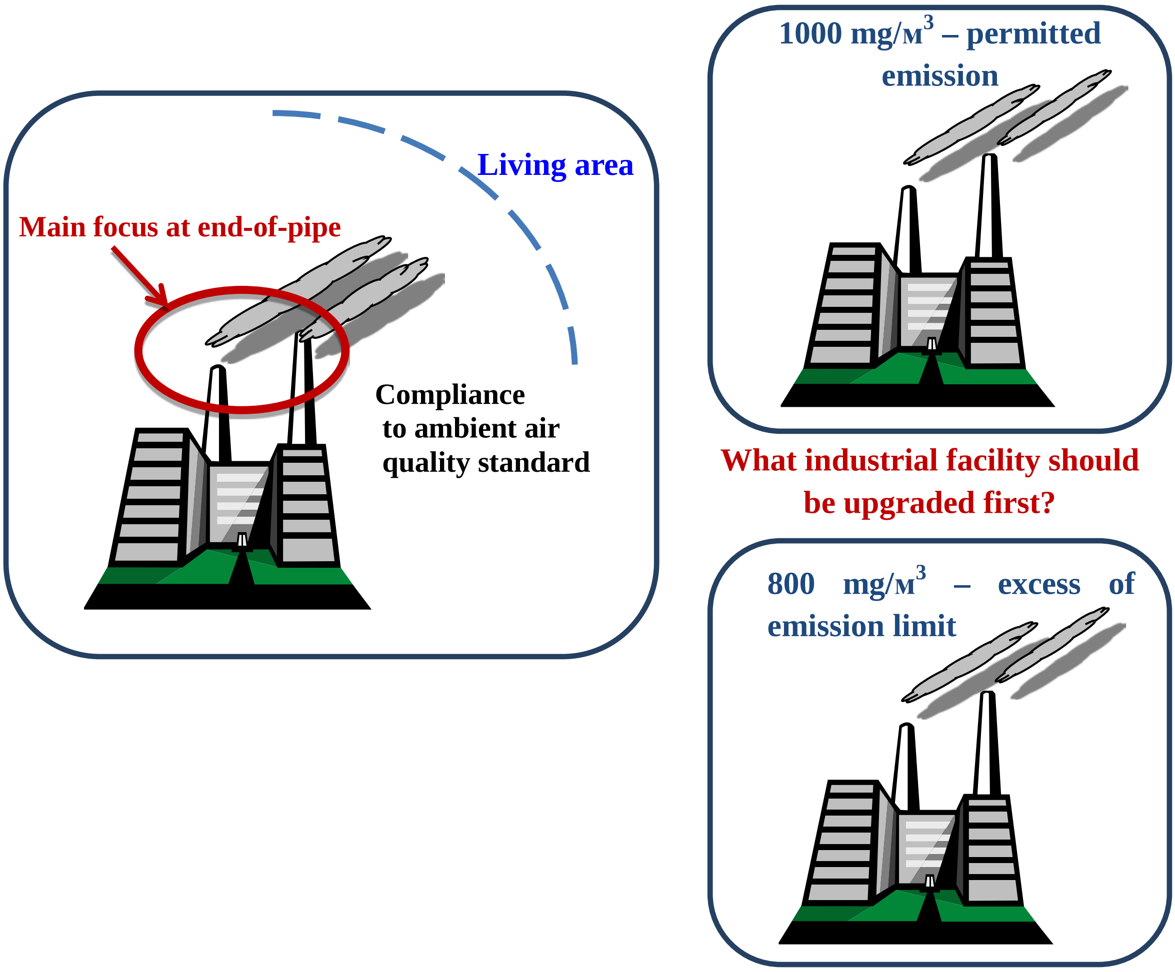


Figure 23. Present dilemma with granting of industrial facilities with environmental permit

Suppose there are two companies with similar processes, but with different quantities of emissions. A paradox can occur when the company with larger air emissions is granted an air emissions permit, while the company with lower emissions is not. This may happen because the company with fewer emissions is closer to a living area, or there is no other source of emissions in the immediate area that could be attributed to the background pollution situation in a residential area.

In EU countries, the ambient air quality standard is considered to be the minimum environmental requirement. At a minimum, the ELVs prescribed by the permits should not cause the air quality standard to be exceeded but as the ELVs are process-related and elaborated with reference to BATs for a given process or installation, the resulting emissions will often be much

lower than the permitted ELVs and with a focus on continuous process optimization and environmental impact reduction.[34]

The present system in Kazakhstan to establish emission limits has the ultimate objective to meet the ambient air quality standards inherited from the Soviet times. This system does not place any requirement to efficiency of production process, it focuses the attention of both the environmental managers and regulators at the “end of pipe“ technologies which are more expensive than process integrated technologies and does not support wider application of Best Available Technologies. More importantly with the current system, the air quality standards are not being met in many residential areas in Kazakhstan.

It is therefore recommended to speed-up the development of process-specific ELVs and move to a gradual transition of applying ELVs that are (i) based on Best Available Techniques; and (ii) allow meeting ambient air quality standards. This is also best done on a sector-by-sector basis in close consultation with industries and through usage of pilots.

Set the concentration based ELVs for air emissions

Currently, ELVs are specified for the maximum mass flow rate of pollutants (g/sec) from a particular emission source (installation), as well as for the annual quantity of emissions (tons / year). The flow-rate of emissions (g/sec) is not a convenient index of the process performance efficiency.

In the EU, environmental regulators hold control over concentration of a pollutant in emissions and quantities of emissions (t/year). The ELVs are specified in mg/m^3 and the advantages of this method are as follows:

- it better describes the efficiency of the technology and equipment applied;
- it gives better possibility for benchmarking and comparisons;
- it makes the regulatory control simpler.

The present system in Kazakhstan is not suited for the process specific emission limit values. To relate the flow-rates of air emissions to efficiency of production process, one should apply additional factors. Direct benchmarking of maximum discharges and comparisons of different industrial facilities are hardly possible without additional assumption.

It is therefore recommended to apply the EU’s measurement unit in concentrations of the pollutant for ELVs (mg/m^3) instead of the conventional maximum mass flow rate of pollutants (g/sec). Industrial facilities will most likely endorse this initiative as they mostly measure concentration of emissions during the self-monitoring.

Alignment of the lists of polluting substances (air)

[34] The EU directive presumes that setting ELVs for a specific installation should be based on a combination of air quality standards (AQS), BAT’s, in accordance with the relevant technical guidance (BREF) and specific characteristics of the location. The combined approach requires careful case-by-case evaluation, to ensure that ELVs that are ultimately included in an integrated permit and satisfy both the BAT and AQS criteria and comply with local conditions.

Kazakhstan has several lists of pollutants subject for mandatory control, including (1) a list of pollutants for mandatory setting of emission limits, (2) a list of pollutants subject to mandatory environmental fees, and (3) a list of ambient air quality standards.

The existing list of pollutants for mandatory setting of ELVs is not followed since industries' awareness about it is fragmented. The co-existence of alternative lists of pollutants complicates the emission limit setting process. Industrial facilities are especially concerned with the disparity between the list of pollutants subject for mandatory emission limit setting and list of pollutants subject for environmental fees.

In EU countries, the list of substances subject for setting emission limits is stipulated by Directive 2010/75/EU ANNEX II List of polluting substances (Air). In Kazakhstan, redundant paperwork is often required for application submission of the environmental permit and review, as industrial facilities do not carefully follow the regulation on the list of mandatory pollutants for setting emission limits. It should be noted though that recent regulation on the list of mandatory pollutants for setting emission limits in Kazakhstan does not differ substantially from similar EU regulation. The table below compares the two lists.

Table 18. List of polluting substances in Kazakh and EU legislation

CURRENT PRACTICE	**EU COUNTRIES**
A list of pollutants for mandatory emission limits setting (Government's Resolution, 30/06/2007).	*Directive 2010/75/EU ANNEX II List of polluting substances (Air)*
Sulfur dioxide and other sulfur compounds	Sulphur dioxide and other sulphur compounds
Nitrogen oxide and other nitrogen compounds	Oxides of nitrogen and other nitrogen compounds
Carbon monoxide	Carbon monoxide
Volatile organic compounds	Volatile organic compounds
Metals and their compounds	Metals and their compounds
Arsenic and its compounds	Arsenic and its compounds
Cyanides	Cyanides
Chlorine and its compounds	Chlorine and its compounds
Fluorine and its compounds	Fluorine and its compounds
Saturated hydrocarbons	-
Mercaptans	-
Hydrogen Sulphide	-
Black Carbon	-
Dust, including asbestos dust	Dust including fine particulate matter
	Asbestos (suspended particulates, fibres)
Polychlorinated dibenzodioxins and polychlorinated dibenzofurans	Polychlorinated dibenzodioxins and polychlorinated dibenzofurans
Other pollutants of hazard classes I-II for which the sanitary maximum allowable concentrations in	-

CURRENT PRACTICE	EU COUNTRIES
sanitary zones are established	
-	Substances and mixtures proven to possess carcinogenic or mutagenic properties or properties which may affect reproduction via air

It is therefore recommended to collate existing lists of pollutants used for permitting and reporting purposes, as well as setting environmental fees. The unified national list of pollutants should be harmonized with the list of pollutants in ANNEX II List of polluting substances (Air) in Directive 2010/75/EU to the Kiev Protocol. However, one note of caution is warranted at this point. Substances classified as hazardous should not be subject to environmental fees, but rather outright bans. By imposing fees – this creates an environment in which installations are given a "license to pollute" and in the case of hazardous substances this should not be the practice. There are several interesting examples from other countries on how to appropriately design pollution fees for specific objectives such as phasing out fuel subsidies (Mexico and Morocco) and the adoption of carbon taxes (Mexico).

The study did not investigate whether the present system of environmental fines is pervasive or selective, but in any case, the current system of pollution charges does not lead to companies investing in pollution reduction, which should be the objective. This report does not contain recommendation on changing the method for calculating environmental fees. Instead, the report focuses on key pollutants for establishing Emission Limit Values for industry and to start monitoring both – actual air quality as well as the actual industrial emissions. It also advocates for policy to be based on those outcomes as environmental policy is currently based on a calculated and unreliable emissions estimate and any revision of environmental fees should be based on actual monitoring and benchmarked calculations of emissions rather than the current less-reliable emissions estimates. For further discussion on environmental fees, see the report: "Minimizing Environmental Impacts of Industrial Growth: Case study of petrochemical industry in Kazakhstan" (World Bank, 2006).

12 Monitoring and Inspection of Industrial Emissions

12.1 Regulations and Procedures for Monitoring of Air Emissions

The purpose and objectives of environmental self-monitoring by industrial facilities are outlined in the Environmental Code.[35] According to this document, there are several general reasons for industrial facilities to perform self-monitoring of environmental situation:

1. obtaining information for decision-making on environmental policy, environmental quality targets and environmental management of production processes, potentially having an impact on the environment;
2. ensuring compliance with the environmental legislation of the Republic of Kazakhstan
3. minimizing the impact of production processes on the environment and human health;
4. efficient use of natural resources and energy;

[35] A number of Governmental Acts and Regulations provide requirements for self-monitoring of air emissions by industrial facilities (listed in Annex 5. Inventory of Relevant Regulations).

5. proactive response to emergency situations;
6. increased environmental awareness of management and workers;
7. informing the public about the environmental performance of industrial facilities and public health risks;
8. increase the level of compliance with environmental requirements;
9. increase effectiveness of the environmental management;
10. consideration of environmental risks of investing and lending.

It is unusual that environmental self-monitoring is purposed to meet so many objectives and that the compliance to environmental regulations is not seen as the ultimate objective for the self-monitoring as well as the contribution to transparency and public participation in environmental decision-making.

Self-monitoring is to be performed at industrial facilities of classes I, II, III and includes:

- monitoring of emission sources (installations);
- operational monitoring (monitoring of the production process in terms of the installation's emissions);
- monitoring of environmental impacts (especially for sensitive ecosystems at the phase of start of operation of object, or after the accidental air emissions).

Environmental self-monitoring of the industries has to be carried out in accordance with the emissions monitoring plans that industrial facilities have to develop and get approved by the authorities as a part of the permits. The Environmental Code requires that the environmental monitoring plan includes the following items:

1. a list of pollutants that should be monitored;
2. duration and frequency of self-monitoring and measurements, as well as their criteria;
3. description of the monitoring methods;
4. sampling and measurement points;
5. data collection, analysis and reporting procedures, including the so-called 'Plan of control for ELV compliance';
6. routines for ensuring measurements accuracy.

The figure below outlines procedures for implementation of air emissions self-monitoring (industrial facilities classes I-III):

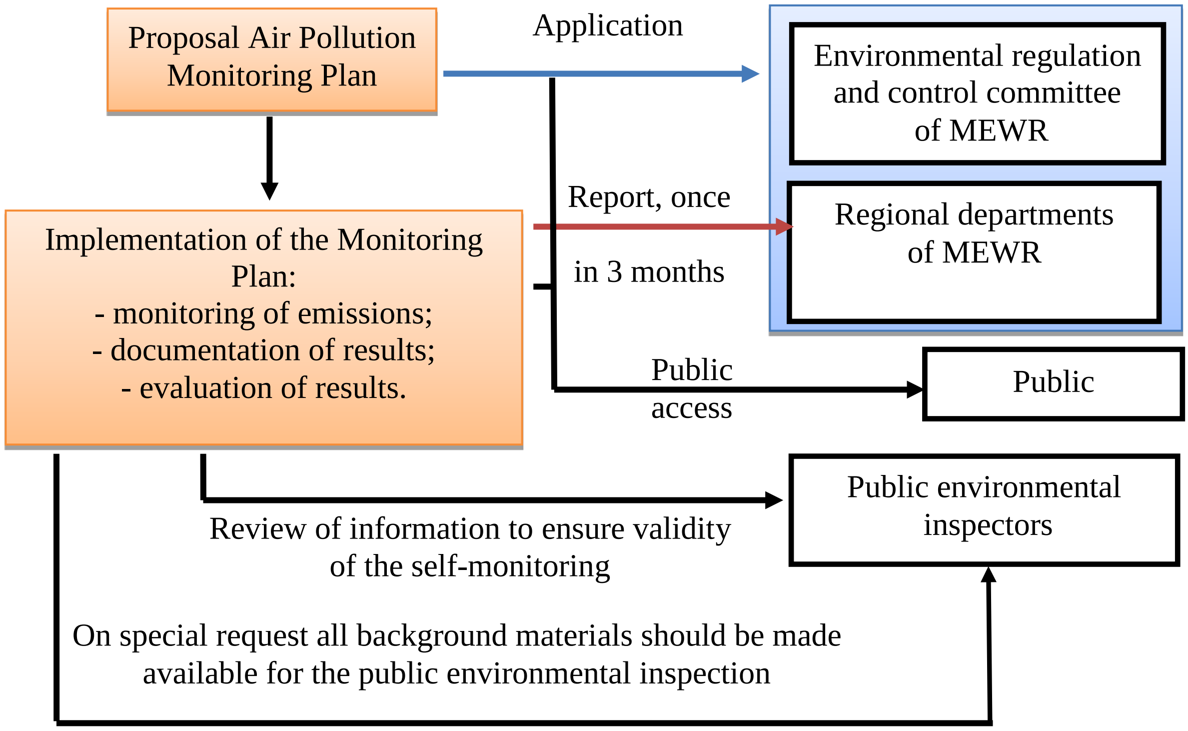


Figure 24. Implementation of air emission self-monitoring

Self-monitoring should be performed 'to the extent which is minimum required to comply to the environmental legislation of Kazakhstan and with due consideration to technical and financial availabilities of the industrial facility'. This implies that the Environmental Code does require the industrial facilities to go beyond the existing minimum requirements for environmental self-monitoring. Moreover, it offers the possibility to adjust the scope the monitoring activities due to technical or financial circumstances of the industries.

12.2 Monitored Parameters and Methodologies

The general requirements for content and procedures of the self-monitoring plan and reporting requirements are set out in the Environmental Code.[36] List of the parameters to be monitored should be proposed by the industry facility in its environmental monitoring plan. The permit application is required to contain a section on the control of the Emission Limit Values by the industries and should include a list of monitored substances and inventory of instrumental monitoring techniques. In the event that industries cannot use actual monitoring to determine the emissions, the rationale for the use of the calculated balance methods and specific emission factors should be provided.

Industrial facilities are required to list all the reference methodologies which they intend to apply in the monitoring plan as well those emissions to be actually monitored ensure compliance to ELVs, with main focus at the emission sources that provide the greatest exposure to air pollution.

[36] Guidance on the choice of monitored parameters is present in sub-laws. The "Recommendations for the design and elaboration of the Maximum Permissible Emissions (MPE) for enterprises" (211.2.02.02-97).

The ‘Methodology for Emission Limits Setting’, approved on 16/04/2012 is the key document with recommended methodologies by the Ministry of Environment and Water Resources for taking samples, analysis and calculations of emissions. This document provides reference for documentation of results of environmental monitoring and is show in the following table:

Table 19. MEWR’s template for sampling, analysis and calculations of emissions

N emission source at the map of industrial facility, N of control point	Production workshop or area, control point	Parameter monitored	Frequency of monitoring	Frequency of monitoring in the periods of maximum emissions, times/day	ELV		Responsible	Methodology of air monitoring
					g/sec	mg/м3		
1	2	3	4	5	6	7	8	9

It is not clear, however, what the precise criteria are to select the major installation’s emissions. This makes the choice of the parameters to be monitored uncertain. Furthermore, industrial facilities of class I of environmental exposure with a large number of fugitive emissions are suggested to monitor air quality at the selected ‘control’ points, which are normally located at the boundary to living and sanitary zones rather than at the source of the emissions. The official reason for this is twofold: 1) to self-control production processes; 2) to share responsibility for the ambient air control if a company is forming a company town. However, industries consider this requirement as an extra burden, a remnant from ‘an old system when companies were responsible for the nearby settlements or towns’. Internationally, it is the government’s responsibility to ensure clean air for and companies responsibility to adhere to the Emission Limit Values in their permit. The Methodology for Emission Limits Setting does not specify in sufficient level of details the choice of points for monitoring, its frequency, methodologies to be applied, verification methods, averaging of values, etc.[37]

There are a number of air emission calculation methodologies for few of the industrial processes in Kazakhstan. These methodologies can be used for choosing emission sources and the list of pollutants at industrial facilities. In cases where the existing air emissions methodologies are not applicable, an industrial facility is obliged to provide specific methodology for that facility itself. Such specific methodology should apply analytical methods, including mass-balances, chemical reactions, reference to similar industrial facilities and relevant publications. Most commonly used are old Soviet or newer Russian reference guidelines and the software "ERA", which includes functions for calculating emissions of pollutants and their dispersion - based on a Russian calculation method.

[37] It is also possible to apply other methodologies: (i) RND 211.3.01.06-97 ‘Guidance for control of air emission sources; (ii) CT RK 1517-2006. Nature Protection. Air. Methods for estimations and calculation of quantities of air emissions. Although it is possible to choosing between the recommended methodologies, the procedure for making the choice is not clarified.

However, the Methodology for Emission Limits Setting states that ‘whenever it is technically possible, air emissions inventory should be performed by direct measurement, otherwise it should be performed by calculations’. Industrial facilities should elaborate their methodology for calculations and estimates (e.g., mass balances, emission factors, etc.), if direct measurements are not expedient or feasible. It should also prove why it cannot perform direct measurements. In reality, it appears from the interviewed industries that calculation methods prevail and moreover many regulators would normally recommend to use theoretical/calculation methods and to compare the results; although formally calculations would not be needed if there are direct measurements/monitoring.[38]

The interviewed Kazakh environmental managers from industrial facilities and their environmental consultants for the development of environmental permit applications consider the absence of guidelines for environmental monitoring as a fundamental obstacle to effectively plan environmental self-monitoring. The presently available in Kazakhstan methodologies describe some elements of air emissions monitoring but they do not establish any systematic and clear procedure for self-monitoring. In the EU countries, there is one guidance document, the EU’s BREF on Monitoring, which systematically prescribes in sufficient level of details the methodologies for performing environmental self-monitoring by industries. Also, the requirements for direct monitoring by industries are based on a risk-based approach to match risk of environmental damage with appropriate monitoring regime (likelihood of exceeding ELVs and resulting harm to the environment). Industrial Particulate Matter emissions are mostly measured directly and continuously.

An attempt to unify methods and approaches for environmental monitoring programs has been recently noticed. The head of the regional department for monitoring, setting emission limits and environmental management of Western Kazakhstan region has developed regional guidelines, ‘Recommendations for development of industrial self-monitoring programs’ (http://online.zakon.kz/Document/?doc_id=31028370). Although there is a suggestive structure for the industrial environmental monitoring program and its content, all major issues regarding the methodology for self-monitoring remain open, i.e., how to select the monitored parameters, frequency, sampling methods, etc.

12.3 Reporting

Every 3 months industrial facilities of classes I-III of environmental exposure are obliged to submit reports on air emissions, including the actual values and their analysis. This report is less detailed than the above template; it includes the following information:

- General information about the process and emission source and frequency of monitoring;
- Information about the laboratory and its attestation;
- The pollutant and its emission limit;
- Actual measurements or estimates;

[38] In case of direct measurements/monitoring, an industrial facility employing its own (accredited) laboratories to conduct self-monitoring should officially contract a third-party (independent) laboratory to perform at least 10% of the analyses to ensure quality control. However, there is no reference to this requirement in the regulatory framework.

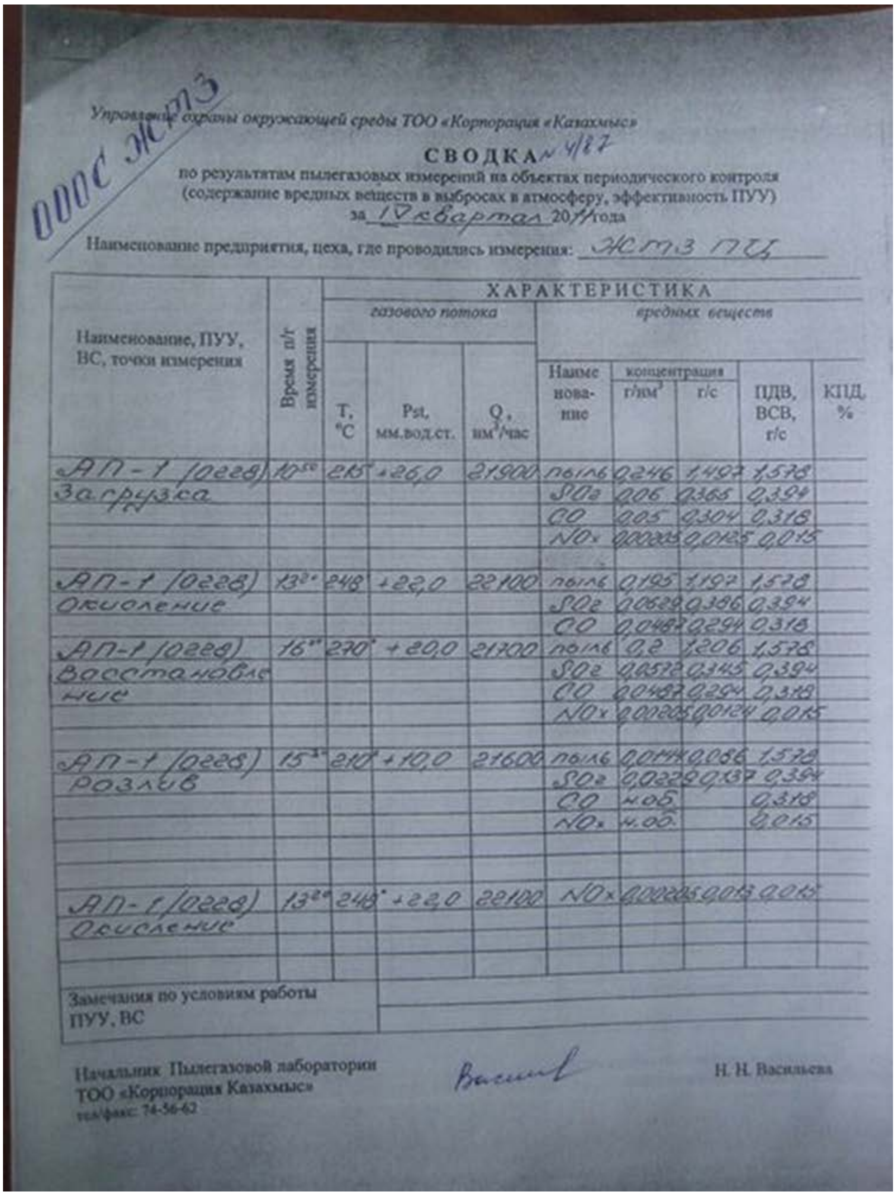
- Deviations and measures to prevent them.

The standard for ‘Template of Initial Accounting’ is shown in the table below.

Table 20. Template of initial accounting (POD-1)

Data of measurement	Point and location	Gas properties, effluents from emission sources					Pollutant	Concentration, g/nм^3
		Temperature	Pressure or vacuum, kgs/м^2	Gas velocity, м/s	Gas humidity (absolute) g/nm^3 of dry gas	Volume of gas, nм^3/hour		

These environmental monitoring reports do not provide information about operational modes in which the equipment was functioning. This greatly complicates benchmarking and control of the actual emissions, as well as their comparison with ELVs. It would be possible to retrieve the required information from the primary data and production statistics, but this is not a common practice. The figure below shows an example of an environmental self-monitoring report. It shows that the template used slightly differs from the recommended POD-1 form. Emissions from a mining company are measured upon 4 parameters once in 3 months. No deviations from the permitted ELVs are detected. The company measures both flow of emissions and concentrations, but the latter are not reported to the authorities.



ОООС ЖМЗ

Управление охраны окружающей среды ТОО «Корпорация «Казахмыс»

СВОДКА № 4/27

по результатам пылегазовых измерений на объектах периодического контроля
(содержание вредных веществ в выбросах в атмосферу, эффективность ПУУ)
за IV квартал 2011 года

Наименование предприятия, цеха, где проводились измерения: ЖМЗ ПЦ

Наименование, ПУУ, ВС, точки измерения	Время п/г измерения	ХАРАКТЕРИСТИКА газового потока: T, °C	Pst, мм.вод.ст.	Q, нм³/час	ХАРАКТЕРИСТИКА вредных веществ: Наименование	концентрация г/нм³	концентрация г/с	ПДВ, ВСВ, г/с	КПД, %
АП-1 (0228) Загрузка	10⁵⁰	215	+26,0	21900	пыль	0,246	1,497	1,578	
					SO2	0,06	0,365	0,394	
					CO	0,05	0,304	0,316	
					NOx	0,00205	0,0125	0,015	
АП-1 (0228) Окисление	13²⁰	248	+22,0	22100	пыль	0,195	1,197	1,578	
					SO2	0,0629	0,386	0,394	
					CO	0,0482	0,294	0,316	
АП-1 (0228) Восстановление	16"	270	+20,0	21700	пыль	0,2	1,206	1,578	
					SO2	0,0572	0,345	0,394	
					CO	0,0482	0,294	0,318	
					NOx	0,00205	0,0124	0,015	
АП-1 (0228) Розлив	15³⁰	210	+10,0	21600	пыль	0,0144	0,086	1,578	
					SO2	0,0229	0,137	0,394	
					CO	н.об.		0,318	
					NOx	н.об.		0,015	
АП-1 (0228) Окисление	13²⁰	248	+22,0	22100	NOx	0,00205	0,013	0,015	

Замечания по условиям работы ПУУ, ВС

Начальник Пылегазовой лаборатории ТОО «Корпорация Казахмыс» тел/факс: 74-56-62 — Н. Н. Васильева

Figure 25. Example of self-monitoring report for the IV quarter of 2011

In parallel to environmental monitoring reports which are submitted to MEWR or its regional departments, industrial facilities have to report separately on emissions to the national statistics office. Statistical report on air emissions (2-TP air) should be submitted once in half a year. This statistics template includes the actually measured or estimated volumes of emissions of various air pollutant (t/year or/half year), which are collected from initial reports for measurements or estimates. If the report suggests deviations from the by-gone period, an explanatory note will be required.

The figure below presents communication flows between industrial facilities, public authorities and public, as required by regulations:

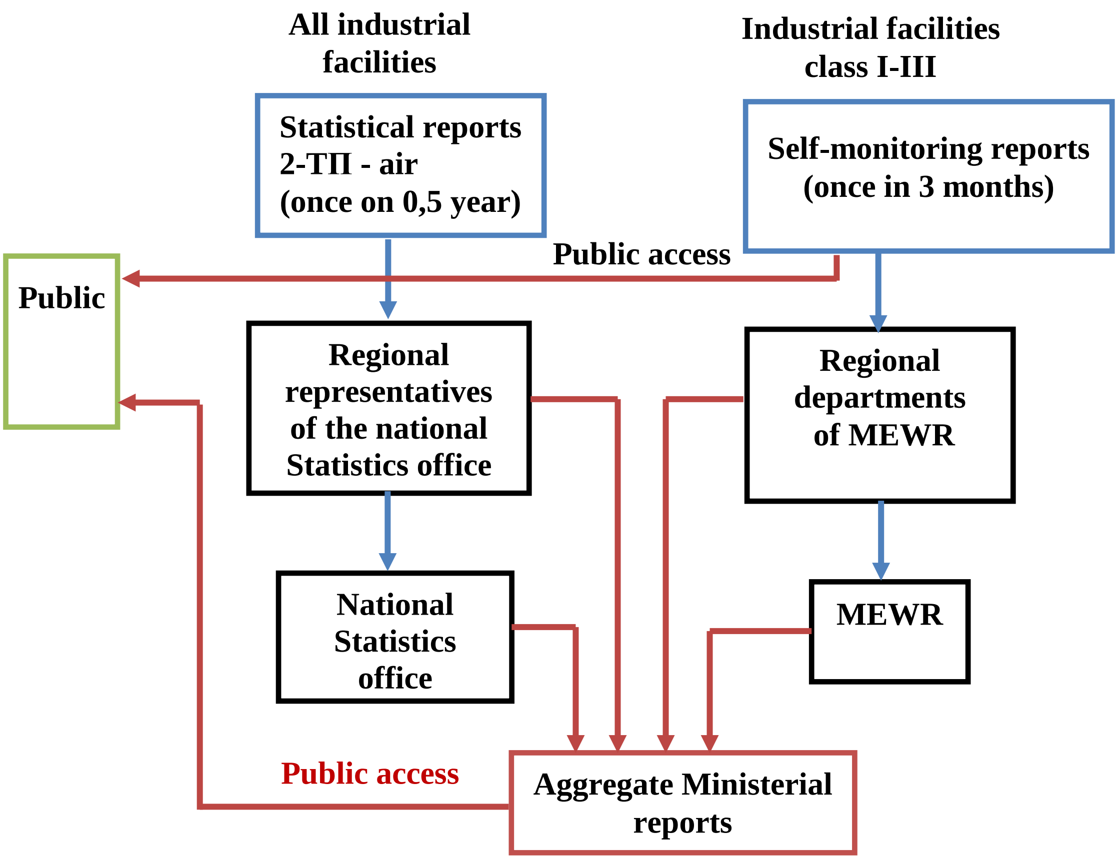


Figure 26. Communication flow between industrial facilities, public authorities and the public

It should be mentioned that the Environmental Code of Kazakhstan (article 130) places an obligation to ensure public access to the results of environmental self-monitoring and environmental permit compliance control. However, it does not suggest any routine for regular publication of environmental self-monitoring information, so that in practice, publishing of information on air emissions is not mandatory. The access to the information however is possible upon the request in written or electronic form. The industrial facilities would usually be consent to respond to the information request, but a handling fee for obtaining the reported information may be charged. In general, such information requests are not a common practice in Kazakhstan.

As it can be seen, all companies have to provide statistical reports, 2-TP (air), regardless of the quantity of emissions, while environmental monitoring reports are not mandatory for the industrial facilities of class IV of environmental exposure. The table below summarizes the environmental reporting requirements by Kazakh authorities (Statistics report 2-TP (air) and Environmental Monitoring report) as specified by Kiev Protocol to Aarhus convention on Pollutant Release and Transfer Registers.

Table 21. Environmental reporting requirements of industries for the different purposes

Reporting requirements:	**Statics report 2-TP (air)**	**Environmental monitoring report**	**International PRTR protocol**
Frequency	Once half a year	Once in 3 months	Annually
Coverage	All industrial facilities	All industrial facilities classes I-III	64 types of industrial activities, according to the Annex I Each signatory may add specific reporting requirements to another type of industrial facilities
List of pollutants to be controlled	A list of the reported compounds is determined by the template №2-TP (air)	No methodology for identification of compounds to be monitored	86 pollutants are listed in the Annex II to the Protocol Each signatory may add reporting requirements on specific pollutants
Type of information presented by industrial facilities	Actual emissions, total for industrial facility: - t/half year, - t/year	Actual emissions, including: - Emission source; - ELV (g/sec, t/year); - Actual emission (g/sec, t/year); - other relevant information	Actual emissions, t/year, as well as other information according to article 7 of the Protocol

Internationally, authorities focus on streamlining reporting requirements for industries as reporting obligations for industries should be made as easy as possible to allow industries' focus on actual reduction of emissions.

Although it is a legal requirement (Environmental Code and a number of sub-laws) on public access to information (see Figure 24) - only a few Kazakh companies have published their environmental monitoring plans on the internet. A brief review of the 2010 environmental monitoring plans for TOO 'Kazakhoil Aktobe' of AO 'KazMunayGaz' shows that it was approved for just 1 year, not for the 5 years of the permitted period. Some of the monitored parameters are measured once every 3 months, some of them are estimated and none are measured continually. However, it is not clear whether this monitoring plan is representative for the average of industries or is considered to be a good practice example as it is published on the internet.

12.4 Verification and Inspection of Air Emissions Data

The Environmental Code specifies that **verification** of air monitoring of industrial emissions by authorities is performed in the form of desk-top verification of the environmental authorities of the reports submitted by the industries and by the inspections. In parallel the emission monitoring report is to be put in a national registry, which contains main statistics of air emissions, environmental profile (passport) of an industrial facility, as well as previous monitoring reports.

The desk-top assessment is usually done once in 3 months, because the progress reports should be issued quarterly. It includes completeness test and compliance assessment of self-monitoring reports[39]. Through the completeness tests, environmental regulators verify if all the information required by the permit is present. Once this is done, environmental regulators typically compare the reported values with ELVs. They may also be compared with historic figures. For environmental regulators, it does not matter how close the measured or calculated emissions are to ELVs – most important is not to exceed them. Industrial facilities could be requested to provide environmental regulators access to input information in order to validate quality and relevance of the performed environmental monitoring.

The Kazakh Environmental Code has also clarified and simplified procedures for environmental **inspections**, which can be planned, unplanned, counter inspection, or a raid inspection. Planned inspections could be carried out only once a year. If enterprises do not violate environmental laws for three years, inspections are only held once every three years. Usually inspections are no longer than thirty working days, but they may be extended by the MEWR in special cases. Compliance inspections are being performed by local departments of the MEWR.

Prior to facility visits, environmental regulators would collect information and reports on recent environmental monitoring activities. This is done to locate essential sources of emissions (installations) where the control measurements are to be performed. These reports are also used as a reference to the compliance control.

The MEWR has 16 of their own labs used for verification and validation of company's environmental monitoring reports and measured results are compared with the industry reports. In the event of deviation with the approved standards, environmental authorities may require an environmental compliance audit of an industrial facility.

By the end of environmental inspections, a package of documents is to be issued. This package may consist of the following documents in the worst case: a) environmental inspection protocol, b) protocol on administrative violations, c) decision to impose an administrative fine.

The interviewed experts indicated that the term and conditions of the air emissions permit are subject for strict compliance control. If an inspection identifies deviations of the actual emissions from the approved ELVs, the permit should be corrected, or fines will apply. If process conditions, production level have been changed and this has influenced the quantities of emissions, a company needs to update its permit. Normally, this happens relatively seldom; typically companies would not report an excess of the ELVs, or inspections would not find significant deviations between the ELVs and actual emissions. On subjective opinion of interviewees, the company would normally initiate internal actions to eliminate the problem (e.g., reduce production output or repair filter unit), rather than to report to environmental regulators on excess of emissions. As there is no uniform benchmarked relation between production and emission data, reducing production output is a successful measure to comply with ELVs.

A more widespread situation happens if an industrial facility does not meet any of the permit conditions, such as a schedule for implementation of environmental mitigation measures. This may

[39] Environmental action plans are also a subject for strict controlled upon compliance to formal permit requirements, such as status of implementation, investments, etc.

be a reason for cancellation of the permit. In this case, the industrial facility will be forced to reapply for the air emission permit again, although no actual changes in the emissions would take place. During the period of the resubmission of the permit application, the industrial facility will operate without a valid permit and pay penalties.

Both industrial facilities and MEWR experience complications in how to handle situation in the event of the excess of emissions as there is no longer possibility to obtain the so-called ‘temporary permits’ procedure for gradual elimination of air emissions. Since 2013, environmental violations are considered as a crime, but so far there are no lawsuits against the companies. An absence of well elaborated procedure for handling excess of emissions gives incentive both the industrial facilities and environmental regulators for ineffective ‘site-specific, exceptional solutions’. One good example of this challenge is that often industrial facilities would blame ‘background pollution’ to be the cause of excess of a pollutant concentration at the sanitary zone/residential area. To assess the contribution of various sources of emissions (installations), to determine what level of emissions should be to ensure normal sanitary conditions, the interviewed MEWR representatives indicated that it would be useful to develop independent ambient air pollution dispersion models for the major industrial centers of Kazakhstan. In addition, as discussed earlier, emission monitoring requirements should be transferred from the sanitary zone/residential area dispersion calculations to actual measurements of emission sources.

Information on the procedure for quality control quality for the 2-TP (air) reports submitted to the regional departments of the public statistics office is missing. For those components of air emissions which are subject of environmental fines, there are procedures for verifying the fine’s estimate - nevertheless these procedures do not include verification of primary data on quantities of air emissions.

12.5 Air Emissions Control - Industry's Point of View

The study included direct contacts and interviews with the companies of class I of environmental hazard to identify their viewpoints on the air emissions permitting, monitoring and reporting in Kazakhstan[40].

Figure 27. Example of a capital intensive air pollution control measure recently implemented at one of the visited Kazakh metallurgical works – bag filter.

The companies interviewed are large mining, metallurgical and power generation companies, and part of large industrial groups. Most of them have introduced environmental management systems according to the ISO-14000 standard. However, these systems do not underpin CP/GP improvements and the adoption of BATs. Environmental managers were not familiar with "Cleaner Production", most of environmental activities are still focused on the "end-of-pipe" solutions.

In general, most companies consider their environmental situation as acceptable and as meeting the related norms and requirements of Kazakh legislation. They also affirm that they operate under valid environmental permits and do not have official environmental claims from environmental regulators.

At the same time, however, many of the companies acknowledged that they face environmental challenges and the necessity to improve the environmental situation. The reasons are worn-out, obsolete equipment, lack of money, necessity of full re-equipment of productions lines. The companies therefore have an urgent need to retrofit their production and they are keen to put their efforts and investments to meet this need at first hand.

Another key concern was frequently changing environmental requirements. Companies still have to obtain or renew permits frequently and report for far too many components of pollutants. Many of the interviewed environment managers were interesting to compare number and type of pollutants in consideration between similar Kazakh and Norwegian industries.

The common opinion expressed was that each year, environmental requirements become stricter – additional reports, higher fines, and amendments to environmental regulations are being

[40] The interviews were mainly conducted as a part of the combined training and capacity building seminar Cleaner Production and Best Available Techniques held in Astana 22/05/2013. Annex 6 contains brief overview of the seminar.

introduced without prior consultations with the companies. In addition there is a lack of clarity on the methodology for preparing waste management plans and a lack of certainty on the CO_2 trading system. Often new regulations are not supported with the required sub-laws. On the opinion of the industries, the authorities' intrinsic interest is to collect environmental fines rather than stimulating emissions reductions which would result in a lower level of environmental payments. Funds collected through environmental fees never results into (co-) funding of environmental activities, which is seen as one of the fundamental barriers for continual environmental improvements.

All industries had an engineer-ecologist or environmental unit who were engaged in drawing up plans for environmental activities, the application and receipt of environmental permits and preparation of environmental reports. Thus, the main part of environmental management in industries is related to environmental reporting and reviews of industrial sites. Many environmental departments complain about: "too much environmental reporting, no time for actual work and a lack of resources". Large companies may have an internal laboratory which performs control of environmental emissions. In some companies, the role of environmental responsibility is somewhat limited to only information collection, whereas 'environmental decision-making', such as environmental reporting and preparation of action plans is coordinated by an environmental department of their parent company.

There are only few Kazakh industries performing continuous emission measurements. Those are mainly oil and gas companies of 'western origin', who monitor continuously process air emissions or process parameters due to their 'image' concerns or production needs. The interviewed industries perform only single measurements. While the permit requires one measurement in 3 months, often the most essential air emissions measurements are taken more frequently, e.g. once in 5 days, in order to control process conditions.

Interviewed companies are anxious to have realistic lists and descriptions in environmental actions plans, as they are very tightly associated with permits. As environmental inspectors would formally check implementation of these plans, and if delayed, which is highly probable, a company may lose its permit. In this case, air emission applications should be renewed. Funds which are incorporated in the action plan are also subject to strict control. Requirements for regulatory bodies focus on the implementation of formal bureaucratic requirements. If there is a formal breach, the company may be penalized, which becomes more clear with the following example: 'Should 1 million of Euro be planned for environmental investments, or should a company spend only 800 thousand Euro in a monitoring program, a problem may arise during environmental reporting even when the environmental objectives of the investment have been reached. The companies mainly include O&M programs, rather than real actions into these plans'. In the opinion of companies, environmental regulators should focus on fewer key environmental measures.

The general impression was that environmental managers of large holdings and groups are aware of CP/GP and BATs and are more involved in consultations with the Ministry on the development of environmental policies than their colleagues from smaller production companies. The interviewed companies were aware that the Green Economy Concept has been approved by the Government and endorses BATs introduction. However, this is perceived as a future risk, as BATs are seen as a heavy cost factor. Simple compliance with ELVs is seen as more comfortable task for the corporate environmental management systems.

Previously, the law has stimulated implementation of ISO 14000, with an incentive to reduce environmental payments for those industries who successfully implemented the ISO. However, when tax benefits were cancelled, many companies have decided not to prolong their ISO 14000 certificate.

To conclude, companies perceive air emissions control and industrial improvements as separate objectives. They are not content with the present system of self-control and reporting, but they are even more anxious about a change-over to a new system of integrated permits, which is a ‘terra incognita’ to a certain extent. There is very little awareness about CP/GP and BATs within Kazakh companies. While current Kazakh environmental regulations do not call for CP/GP improvements, companies are pushed to utilize end-of-pipe techniques to reduce environmental pollution and emissions.

12.6 EU Monitoring Principles

Parameters to be monitored are given in the permit. The permit should refer to a monitoring plan suggested by the facility and approved by the environmental authorities. The permit and the monitoring plan together regulate and describe parameters to be monitored, emission limit values and monitoring principles. Since the monitoring plan is integrated with the permit it is important to understand the permitting procedure and the development of a monitoring plan as part of the permit application.

12.6.1 Permitting procedure

All industrial facilities listed in Annex I in the Industrial Emissions Directive need to have a valid emission permit issued by the environmental authorities in place prior to start operations. In general the following steps explain the permit procedure:

1. *Preparation: The installation prepares and submits application*
   Prior to start operation in a new installation or in an installation with significant changes, an emission permit must be in place. The permit application is normally prepared with external expertise by a consultant and in communication with the environmental authorities in the preparation period. The application consist of 11 chapters predefined by environmental authorities: about installation, location, production, emission to water, emission to air, waste, noise, precautions and risk assessment, internal control and emission control systems, signature, attachments. For each emission parameter a review of relevant BREF documents is required.

2. *Review: The environmental authorities review the permit application*
   When receiving a permit application, the environmental authorities initially review the application to check if required information is complete and at a sufficient standard. If the environmental authorities find the application insufficient additional information is requested from the applicant before further steps are made.

3. *Hearing:* The permit application is sent to relevant neighbors, authorities and NGOs. As a minimum the hearing should be announced in one national newspaper and one local/regional

newspaper. The application should be available in hard copy in the local administrative center (ex. municipality administration building) and upon request to the environmental authorities. New in the IE directive compared to the IPPC directive, is that NGOs are recognized as formal stakeholders, meaning that they should be included in the hearing process.

4. *Comments*: The environmental authorities send all input from the hearing to the applicant and ask for comments.

5. *Case handling:* The environmental authorities review the application, input from hearing and comments from applicant, and issue a preliminary permit to be commented by applicant. The environmental authorities also make a general risk analysis of the installation and place it in a risk category (1-4). The risk analysis embraces several aspects, as type of process, type of fuels, location of the installation and it surroundings, etc. The ELVs and monitoring requirements are normally settled in this phase through an overall decision based on the following:
   - Risk category and outcome of risk analysis;
   - Recommendations in BREF documents (Technology/process specific BREFs combined with BREF on the General Principles of Monitoring);
   - Comparison with requirements given in permits of similar domestic and international installations.

   ELVs included in an integrated permit should satisfy both the BAT and the relevant air quality standard criteria, and comply with any applicable statutory ELVs. Where compliance with air quality standards requires stricter ELVs than would be derived from consideration of BAT, the air quality standard should take precedence. The stricter ELVs must be then included in the permit and industry may need to implement additional measures to meet them.

   Monitoring requirements are not necessarily given in the permit directly, but appended in a monitoring program or monitoring plan prepared by the applicant and approved by the environmental authorities.

6. *Negotiation:* Negotiation between the environmental authorities and applicant may take place during or after the case handling, but the environmental authorities always have the final word before a permit is issued. Discussions during the negotiations may for example be regarding level of ELVs, or monitoring frequency in the monitoring program.

7. *Issuing:* The environmental authority prepares and issue a final permit (new hearing period)

12.6.2 Monitoring principles – ELVs

The monitoring principles are, as described, decided through the permitting procedure. The Industrial Emission Directive gives parameters and their ELVs for major industries and energy production. The ELVs in the Directive are a minimum requirement and the competent authority in a member state should not approve ELVs higher than given in the Directive.

Several industries and activities under the industrial emission directive do not have specified ELVs in the Directive itself. For these industries and activities, the recommendations for ELVs are given in the BREF documents. The term “recommendation” is an important distinction between the

ELVs in the Directive and in the BREFs. The competent environmental authorities should not approve ELVs higher than stated in the Directive, while ELVs in the BREF documents are to be considered as recommendations. This does not imply that the ELVs in the BREFs should be neglected; the competent authority is responsible for settling the values at a sensible level.

An example below shows a coal fired combined heat and power plant with installed capacity above 300MW. The industrial emissions directive and the Large Combustion Plant BREF states the following ELVs:

Table 22. ELV comparison between IED and LCP BREF

Parameter	**Industrial Emission Directive [mg/Nm^3]**		**LCP BREF [mg/Nm^3]**		**Comment**
	New	**Existing**	**New**	**Existing**	
NOx	150	200	90-150	90-200	PC coal
	200	200	50-200	50-200	PC lignite
	150	200	50-150	50-200	Fluidized bed
SO_2	150	200	20-150	20-200	PC
	200	200	100-200	100-200	Fluidized bed
Dust	10	20	5-10	5-20	All

As the table shows, the Directive gives final upper ELVs, while the BREF gives recommendations of in what area the competent authority should set the ELVs, based on the best available techniques and taking into account geographical and local conditions. For example, a new pulverized coal power plant would not be allowed a SO_2 ELV above 150 mg/Nm^3, but the environmental authorities should consider stricter restrictions since the BREF recommends ELV as low as 20 mg/Nm^3. This implies that the available technology for SO_2 cleaning can remove significantly more than the Directive gives as a minimum. The environmental authorities should therefore discuss the ELV thoroughly with the applicant and require that the applicant evaluates whether a lower ELV is possible.

12.6.3 Monitoring principles – frequency

The decision of whether an installation should measure certain parameters continuously or if regular/occasional measurements are sufficient, is largely based on a risk assessment. For some specific parameters and industries this is regulated by the Industrial Emission Directive, for example NO_x and SO_2 are required to be monitored continuously in combustion plants of 100MW or more.

But in general, the measurement frequency is settled through a risk assessment. For each parameter, the likelihood of exceeding the ELV from the installation and the health and environmental consequences must be assessed.

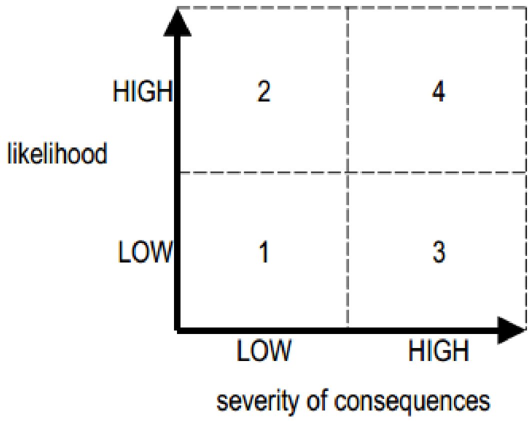


Figure 28. Categorisation of facilities based of likelihood and severity of consequences of unexpected emissions
(from the Reference Document on the General Principles of Monitoring)

The corresponding monitoring regimes dependent on this risk assessment that industries would need to specify and adhere to as part of the permit are:

1. Occasional – Once per month to once per year – The main purpose is to check the actual emissions at predicted or usual conditions.
2. Regular to frequent – Once to three times per day to once a month – Frequency needs to be high in order to detect unusual conditions or an incipient decrease of performance and rapidly initiate corrective actions.
3. Regular to frequent – Once per day to once per week – Accuracy needs to be high and uncertainties of the monitoring chain minimized in order to ensure no harm of the receiving environment.
4. Intensive – Continuously or high frequency sequential sampling is appropriate (3 to 24 per day) – This is used when unstable conditions are likely to lead to exceedence of the ELV. The purpose is to determine emissions in real time and/or exact period of time, and the level of the emission.

In the BREF for General Principles of Monitoring a table of items influencing the likelihood of exceeding the ELVs and the consequences is given to guide decision makers when deciding risk category. This Table is presented below. It should be mentioned that the decision of risk category is an overall decision made by the environmental authorities, and the table is only given as guidelines as part of the BREF.

In the following paragraph some examples of industries and their monitoring programs are given.

12.6.4 Monitoring programs

Monitoring programs are prepared by the industry itself. They know their own processes and know what is feasible at their plant. Monitoring is not just for environmental emission reporting, fluctuations and abnormal emissions may indicate that process measures must be taken into

considerations. Monitoring is therefore necessary and desired by most industries/installations independent of the requirements from the environmental authorities.

Though the industry/installation itself prepares and suggest a monitoring program, it must be approved by the environmental authorities. A suggested monitoring program of insufficient standard will be declined by the environmental authorities and improvements must be done by the industry/installation. Three examples of monitoring programs for Norwegian industry and district heating installations are given in the next pages.

Table 23. Categorisation of facilities according to Reference Document on the General Principles of Monitoring

Items to consider and corresponding risk scoring level	**LOW LEVEL** **1**	**MEDIUM LEVEL** **2 – 3**	**HIGH LEVEL** **4**
Items influencing the likelihood of exceeding the ELV			
(a) number of individual sources contributing to the emission	Single	Several (1 - 5)	Numerous (> 5)
(b) stability of operating process conditions	Stable	Stable	Unstable
(c) buffer capacity of effluent treatment	Sufficient to cope with upsets	limited	none
(d) treatment capacity of the source for excess emissions	Able to cope with peaks (by dilution, stoichiometric reaction, oversize, spare treatment)	Limited capabilities	No capabilities
(e) potential for mechanical failure caused by corrosion	No or limited corrosion	Normal corrosion, covered by design	Corrosion conditions still present
(f) flexibility in product output	Single dedicated production unit	Limited number of grades	Many grades, multipurpose plant
(g) inventory of hazardous substance	Not present or production dependent	Significant (compared to ELV limits)	Large inventory
(h) maximum possible emission load (concentration x flowrate)	Significantly below the ELV	Around the ELV	Significantly above the ELV
Items for assessing the consequences of exceeding the ELV			
(i) duration of potential failure	short (< 1hour)	Medium (1hour to 1 day)	Long (> 1 day)
(j) acute effect of the substance	No	Potential	Likely
(k) location of the installation	Industrial area	Safe distance between residential area	Residential area nearby
(l) dilution ratio in the receiving media	High (e.g. above 1000)	Normal	Low (e.g. less than 10)

Example: Norcem Brevik – Cement plant

Norcem Brevik is a cement plant located on the south east coast of Norway. The plant incinerates various waste fractions in combination with conventional fuels. The following monitoring plan is given in their publicly available permit.

Parameter	ELV – concentration [mg/Nm³*]	ELV – accumulated [tons/y]	Monitoring frequency
Dust/PM	30	50	Continuously
HCl	10	25	Continuously
HF	1	0.25	6 months
NOx as NO_2	800	2200	Continuously
SO_2	-	300	Continuously
TOC	30	-	Continuously
Kadmium/tallium	0.05	-	6 months
Mercury	0.05	30	6 months
Heavy metals**	0.5	-	6 months
Dioxines and furans	0.5 ng/Nm³	-	6 months

* Averaged over 24h
**Sb, As, PB, Cr, Co, Cu, Mn, NI, V

Example: RHI Normag – MgO-plant

RHI Normag is a magnesium plant located on the south east coast of Norway. The plant has permission to combust waste oil and some conventional fuels. The monitoring program varies whether waste oil or conventional fuels are used:

Parameter	ELV – concentration [mg/Nm³*]		Monitoring frequency
	Waste oil	Bio oil and heavy oil	
Dust/PM	10	10	Continuously
NOx as NO_2	200	200	Continuously
CO	100	100	Continuously
SO_2	50	NA	Continuously
TOC	10	NA	Continuously
HCl	10	NA	6 months
HF	1	NA	6 months
Kadmium/tallium	0,05	NA	6 months
Mercury	0.3	NA	6 months
Heavy metals**	0.5	NA	6 months
Dioxines and furans	0.1 ng/Nm³	NA	6 months

* Averaged over 24h
**Sb, As, PB, Cr, Co, Cu, Mn, NI, V

Waste oil is defined as a waste fraction which requires a stricter monitoring plan with more parameters to be monitored. Combustion of bio and heavy oil require monitoring of only dust, NOx and CO.

The monitoring of CO_2 is similar as for the cement plant, monitoring of fuel consumption and calculation of CO_2 emissions based on carbon content in the fuel.

Example: Hoff – district heating central

At Hoff district heating central, light fuel oil is combusted to produce district heating to citizens in Oslo, Norway. The boiler capacity is 110MW which requires the central to have a permit in accordance with the Industrial Emission Directive. The following monitoring plan is given in their public available permit:

Parameter	ELV – concentr. [mg/Nm^3]	ELV – accumul. [tons/y]	Monitoring frequency	Averaging	Number of tests/ samples
NOx as NO_2	200	24.8	Continuously	-	-
SO_2	100	12.4	Calculated	-	-
Dust/PM	10	1.2	Annually	1h	2
CO	50	6.2	Annually	1h	Continuously
Soot number	-	-	Annually	-	2

The district heating central has several different monitoring requirements:

- NOx is measured continuously through the year.
- SO_2 is calculated based on the amount of sulfur in the fuel. In many monitoring program SO_2 is excluded and a maximum limit of sulfur in the fuel is given instead.
- Dust is measured annually by analysis of 2 filter samples exposed to flue gas in one hour each.
- CO is measured annually by a direct reading field instrument.
- Soot number is measured annually by 2 samples with a soot pump.

The measurements are executed in the stack after flue gas treatment. The continuously measurement equipment should be verified annually by a third party (Annual Surveillance Test) and should be calibrated every third or fifth year dependent on equipment and permit conditions. All other measurements should also be executed by a third party. The third party should be accredited and use of a correct measurement method is therefore under the responsibility of the executer.

Releases of CO_2 and other compounds are monitored as well under the ETS (European Trading Scheme). But ETS-releases are handled by a separate ETS-permit with a separate monitoring plan. Normally CO_2 is calculated based on fuel consumption and the carbon content in the fuel. EU has developed emission factors for several conventional fuels[41] and for other fuels analysis of the carbon content is needed. The required monitoring is covered through monitoring of use of fuel. This can be monitored by flow-meters (oil, gas), by weight before combustion (solid fuels) or invoices from the fuel supplier (all kind of fuels where the supplier performs measurements).

[41] This is regulated by the EU ETS Phase 3 Commission Regulation 601, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:181:0030:0104:EN:PDF. The factors are given in Annex VI in the EC Regulation 601. They were initially from the IPCC 2006 Guideline.

CO_2 emissions are monitored through fuel consumption by a flow-meter and verified by invoices from the oil supplier (based on the flow-meter in the trucks delivering the oil). Light fuel oil, as a conventional fuel, has been given a standard emission factor by the ETS-regulations (EU).

12.7 EU Emissions Trading System

The European Union Emission Trading Scheme (EU ETS) is a market-based system applying the polluter-pays-principle for greenhouse gas emissions. The main purpose of the EU ETS was to allow the European Union to achieve its emission reduction target under the Kyoto Protocol at a cost of below 0.1 % of GDP, significantly less than would otherwise be the case. The system is also planned to be central in meeting the EU's ambitious emission reduction targets for 2020 and further into the future. All companies under scheme can buy and sell allowances based on their emissions.

The EU ETS covers the 27 member states of the EU, as well as Norway, Liechtenstein and Iceland (members of the European Economic Area) since early 2008.

12.7.1 Implementation phases

The EU ETS is currently in the third phase of implementation. Phase 1 (2005-2007) was defined as a learning-by-doing pilot phase and Phase 2 (2008-2012) was the first commitment period of the Kyoto Protocol. Phase 3 (2013-2020) has the objective to increase the predictability and encourage long time investments, and by this contribute to achieving EUs climate and energy targets for 2020. By 2020 the number of emission allowances will be 21% below the 2005 level.

12.7.2 Allowances assigned free of charge and allowance trading

The EU ETS currently covers as many as approximately 11 000 energy intensive installations in power generation and manufacturing, accounting for around 50 % of the EU’s total CO_2 emissions[42]. Before each new phase, the companies apply for allowances free of charge to the authorities based on their historical production in the baseline period. For Phase 3, the baseline period was optional, 2005-2008 or 2009-2010. The companies are assigned a certain amount of allowances free of charge which they may choose to compensate for own emissions or sell on the market. Annually the companies must compensate for their emissions by transferring allowances from their allowances accounts to the authorities. The transferred allowances are normally a combination of allowances assigned free of charge and allowances bought on the carbon market. An installation with a high share of renewable fuels may have more allowances than needed and can consequently sell allowances.

From 2013, at least 50% of allowances will have to be purchased at an auction and the aim is to reach full auctioning by 2027. Exceptions can be made for specific energy intensive industries, which may be damaged by needing to buy all allowances.

[42] Outside the ETS, CDM/JI-credits are given to companies implementing GHG emission reducing measures geographically outside the ETS. The CDM/JI credits are tradable on the carbon market equally to ETS allowances and companies within the ETS can therefore compensate for their emissions by both allowances and CDM/JI-credits. Historically CDM/JI-credits are less expensive than ETS allowances.

12.7.3 Monitoring of emissions

Companies must apply the EU's Monitoring and Reporting Guidelines for monitoring of CO_2 emissions. The most common method to determine the CO2 emission is to calculate the emission based on fuel consumption and carbon content in the fuel. Fuel consumption can be determined by measuring equipment at the installation or by invoices from fuel vendors. For standard tradable fuels, the carbon content is predefined in emission factors by the European Commission[43]. For other fuels the company is obliged to analyze representative samples and amounts in order to determine a company specific emission factor. Companies are also obliged to conduct a risk assessment and make an uncertainty budget to assure that reported emissions are at an acceptable uncertainty level. Some companies also have obligations regarding monitoring and reporting of CH_4 and N_2O emissions, but the main greenhouse gas in the ETS is CO_2.

12.7.4 Verification of emissions

The emission calculations done by each company should be verified by an accredited third party before emissions are reported to authorities. The third party will verify that companies follow their monitoring procedures and that the calculated emissions are correct and with an acceptable uncertainty. The 3rd parties have to be nationally accredited.

12.7.5 Synergy of the ETS with IPPC permitting

Currently the ETS and IPPC (IED) are separate permits in most EU countries. An IPPC-installation is not necessarily an ETS installation and vice versa (Annex 1 in the respective directives/regulations). Companies need to apply for two separate permits to environmental authorities and the two permit applications are also normally handled in two separate departments within environmental authorities.

However, there may be some synergy between the schemes. One synergy could be a common PRTR system including both IPPC-parameters and ETS allowances. From an information management and industrial monitoring and reporting standpoint, this has its appeal. Another synergy could be in conducting of inspections/audits, where the ETS-permit and IPPC-permit could be audited in one installation visit.

12.8 International Conventions with regards to Industrial Air Monitoring

There are several international conventions and protocols concerning emissions to air and monitoring of emissions to air. The most comprehensive protocol with regards to collecting several types of polluting releases is the PRTR Protocol under the Aarhus Convention. The PRTR Protocol requires ratifying states to monitor, collect and publish emission data from installations described in Annex I of the protocol (largely in compliance with installations under Industrial Emission Directive). The pollutants covered in the PRTR Protocol are listed in Annex II of the protocol, and

[43] Regulated by the EU ETS Phase 3 Commission regulation 601. The factors are given in Annex VI of the regulation. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:181:0030:0104:EN:PDF

includes pollutants covered in several other conventions and protocols. This is because the PRTR Protocol is under the Aarhus Convention and the main purpose is public access to information and public participation. Other protocols normally have requirements and goals regarding emission reductions for the ratifying parties, but the main goal of the PRTR Protocol is collecting and publishing of emission data.

The European Environmental Agency (EEA) collects emission data from all EU and European Economic Area member states, and Serbia and Switzerland, and publishes the data. This is also described in section 13.3. In the process of validating the emission data, the EEA compares reported emission under the PRTR Protocol with emission data collected under several other conventions and protocols to avoid inconsistent reporting. For air emissions the overlapping conventions are Convention of Long Range Transboundary Air Pollution and the United Nations Framework Convention on Climate Change.

The Convention of Long Range Transboundary Air Pollution (1979) addresses some of the major environmental problems of the UNECE region. The Convention has been extended by eight protocols that identify specific measures to be taken by ratifying parties to cut their emissions of air pollutants. The eight amending protocols are as follows (shortened names of the protocols):

- Protocol on long time Financing of EMEWR (1984)
- Protocol on the Reduction of Sulphur Emissions (1985)
- Protocol concerning the Control of NO_x (1988)
- Protocol concerning the Control of Emission of VOCs (1991)
- Protocol on Further Reduction of Sulphur Emissions (1994)
- Protocol on Heavy Metals (1998)
- Protocol on POPs (1998)
- Protocol to Abate Acidification, Eutrophication and Ground-level of Ozone (1999)

Kazakhstan ratified (“accession” – same legal status as ratification) the Convention of Long Transboundary Air Pollution in 2001, but has not ratified any of the eight amending protocols.

The United Nation Framework Convention on Climate Change (1992) main purpose is to reduce the releases of greenhouse gases (GHG). The most binding protocol under the Convention is the Kyoto Protocol (1997) which concerns GHG emission reduction goals for developed ratifying countries. Through the Emission Trading Scheme (ETS) GHG emission data are monitored and reported to the environmental authorities. The Convention and the Kyoto Protocol is ratified by Kazakhstan and Kazakhstan is undertaking voluntary quantitative obligations to reduce their GHG emissions.

In general, the monitoring requirements followed by the PRTR Protocol are sufficient to register annual emitted amounts of the pollutants under the protocol. Additional data collections through monitoring regimes under other conventions or protocols are important for quality assurance.

12.9 Recommendations for improvement of industrial emissions monitoring system

Without regular, methodological and accurate compliance monitoring, timely and correct reporting and quality assurance of its results, neither environmental regulators, nor industrial facilities will be able to take informed decisions about achieving environmental compliance and setting wider environmental objectives. The conditions established in the permit must be clear in defining the methodology of self-monitoring and reporting. It is equally important to ensure that conditions concerning data management, reporting and verification are well defined, while any deviations are noted and properly addressed.

Good practice entails matching the self-monitoring and reporting methodology to the emissions characteristics, risks to environment and health, practical aspects of taking measurements and the costs. In fact, Kazakh environmental regulators are well informed and experienced in conduction of state environmental control. The challenge is to further promote self-monitoring by industrial facilities. To strengthen industry's ability and motivations for proper organization of self-monitoring and reporting it is necessary to streamline existing regulations and reinforce the methodological basis and guidelines.

This section compares the differences and gaps regarding industrial environmental monitoring, reporting and verification in comparison with good international practices which could be abolished or streamlined through introduction of specific and realistic policy actions.

12.9.1 Strengthen the methodological base for monitoring of air emissions

Environmental self-monitoring is mandatory for industrial facilities attributed to classes I-III of environmental exposure. However, the requirements for the content and methodology of environmental monitoring, including sampling, averaging, analysis and data management are not explicit and blurred by several regulations. The applicants for environmental permits face methodological gaps when assessing the scope for environmental monitoring. Risk assessment has been introduced to sanitary control and the corresponding risk assessment methodology adopted[44], but it does not apply yet to monitoring of air emissions.

There is a lack of a detailed methodology for air emissions monitoring and insufficient attention to quality assurance and quality control as part of self-monitoring. It is difficult to interpret results of direct measurements and relate them to operational conditions of industrial facilities. Owing to this, environmental regulators let industrial facilities to verify direct measurements with theoretical calculations. In general, environmental regulators are keen to keep on widely applying the assumed or calculated values in the environmental monitoring reports rather than move towards more and more actual monitored and verified air emissions.

The EU's BREF 'General Principles of Monitoring' provides detailed reference both to industrial facilities and environmental regulators on how to prepare effective environmental monitoring plan, including methodologies for sampling and measuring, averaging, storage, data

[44] Resolution #71 of the Minister of Health Care from 05/02/2010.

management, etc. In EU countries, environmental regulators are available for guidance and advice on design of environmental monitoring systems.

It is recommended to update and combine into one document the methodology defining the content of self-monitoring program of air emissions. The combined methodology should describe the following parameters[45]:

- Monitored parameters, sampling points and measurement locations, access to sampling points;
- Timing considerations (period, duration and frequency') of monitoring and measurements;
- Monitoring methods, including sensibility of available measurement methods with regard to the ELVs set in permit;
- Methods and frequency of record-keeping, data analysis, and reporting;
- Compliance assessment procedures and internal procedures of self-correction (including the internal non-compliance response tools);
- Quality assurance and quality control arrangements, including details of any accreditation or certification of analysis;
- Actions in emergency situations, such as incidents and/or accidents;
- Internal measures to ensure environmental compliance, including allocation of environmental responsibilities to the facility's personnel at all levels, the system of internal audits (self-inspection), corrective actions, and staff training;
- Institutional arrangements put in place to implement the program.

The scope of self-monitoring program should be defined based on a combination of sector-specific and individual risks for an industrial facility. The risk evaluation should be based on the principles of the EU BREF 'General Principles of Monitoring':

- The likelihood of exceeding the ELVs, or not being in compliance with any other requirement set in the permit;
- The consequence of non-compliance.

12.9.2 Alignment of air monitoring reporting requirements to Annex II to the Kiev Protocol

Industrial facilities in Kazakhstan are obliged to report on air emissions to the public statistics office, using the so-called 2-TP (air) template. The public statistics office has its own list of pollutants to be monitored and reported by industrial facilities for statistical purposes. The quantities of emissions are presented in tons per year.

In EU countries, the basic list of pollutants to be reported corresponds to the Annex II to the Kiev Protocol (86 compounds). National authorities may extend this list with additional compounds. However, in Kazakhstan, the difference between the lists of pollutants subject for environmental and statistical reporting in Kazakhstan makes approximation to the European PRTR system complicated.

[45] "Modernizing environmental self-control by industrial operators in Kazakhstan", OECD. Policy recommendations, 2006.

It is therefore recommended to unify the lists of pollutants which should be used for reporting purposes and possibly harmonize the national the list of pollutants used for submission of the 2-TP (air) report to the public statistics office with the list of pollutants in the Annex II to the Kiev Protocol.

12.9.3 Improving the template for self-monitoring report

Industrial facilities of classes I-III should submit reports on environmental self-monitoring on a regular basis. The template for the environmental monitoring reports is approved by the Decree of the Minister of Environment of the Republic of Kazakhstan. However, this template does not contain any process related or operational information on the moment the measurements were carried out, so that it is difficult to interpret the information reported.

The template for environmental self-monitoring report does not present the results of the measurements in context with the observed production and process conditions. Industrial facilities hence cannot benchmark the corporate environmental performance using the measured values. In turn, environmental regulators cannot make accurate judgments on the state of environmental compliance of industrial facility without knowing the load factor on equipment and other essential features of the production process at the time the measurement was taken.

Environmental regulators thus tend to rely on theoretical methods for assessing air emissions, which could be less accurate and more subjective than the direct measurements.

In EU countries, industrial facilities have to describe production output and process conditions on the moment the measurement is being taken.

It is recommended to include a specific section on operation of equipment and production output in the self-monitoring report template. The information on production out and mode of operation of equipment should be related to the point and time of the measurement. The template can be aligned with the template for self-monitoring report with the OECD recommendations (see OECD. Technical Guide on Environmental Self-Monitoring in countries of Eastern European, Caucasus and Central Asia, 2007).

12.9.4 Differentiate the scope of self-monitoring and air emissions reporting

All industrial facilities in Kazakhstan should submit the air emissions reports to the public statistics office (2-TP (air) reports). This rule applies both to the largest and smallest polluters. The 2-TP (air) reports include information on all sources of emissions (installations) within an industrial facility, regardless of the quantity of emissions and hazard to environment. Many of these reports contain information on miserable flows of emission. The preparation, submission and management of these reports is a laborious process, both for environmental managers of industrial facilities and officers of the public statistics office.

Competent authorities often consider that industrial facilities have to monitor and report on maximum possible number of emissions without balancing the scope of environmental monitoring

with its costs. This leads to generation of a large number of air emission reports with information about minor emission sources and the preparation and processing and archiving of these reports consumes a large amount of time and resources. The present system makes it difficult to keep attention of both environmental managers at industrial facilities and environmental regulators on monitoring of the most significant sources of emissions (installations).

In EU countries, information on air emissions is submitted, managed and published on internet through the unified PRTR system. Small-scale industrial facilities are granted with simplified self-monitoring requirements that reduce the time and cost burden.

It is therefore recommended to develop a methodology to:

- determine the 'significant' emission sources on which the most detailed information should be included in the environmental reports;
- identify those industrial facilities which could enjoy the reduced scope of environmental reporting due to their size or insignificant air emissions;
- develop a template for the reduced scope of environmental reporting.

12.9.5 Ensure outreach and consultation with relevant industries and develop industrial sector strategies

To date, there has not been wide public participation in preparation of environmental regulations in Kazakhstan. Industrial facilities claim that several of the basic policy documents developed by MEWR with the purpose to optimize the present permitting, monitoring and reporting systems fail to bring the required effect. This is because they were not underpinned by sub-laws, regulations and methodologies, but also because the industry's point of view has not been duly considered.

In EU countries, interested parties should be given an opportunity to comment on new regulations before the competent authority reaches its decision. The complexity and sector-specificity of environmental issues associated with industrial production also requires a consultative, if not cooperative, approach to policy making and instrument design. ”Industrial sector strategy” presents such an approach and has been successfully applied in many countries for each of the present industrial sectors. Such sector strategies are developed by government and the relevant industry associations together and consist of a set of policy instruments tailored to address the sector specific barriers to meeting regulatory requirements. The four steps in developing an industrial sector strategy are: (i) government commitment to developing an industrial sector strategy and selection of sectors; (ii) consultation and coordination; (iii) data collection and analysis; and (iv) introduction of sector policy instruments. Appendix E Steps for Developing an Industrial Sector Strategy describes this in more detail and based on a World Bank study suggesting tools for policy makers to support cleaner industry in Turkey.[46]

The Government would benefit from collecting detailed information on a sector by sector basis on compliance, production processes, key drivers and barriers. Such data are necessary for sound

[46] World Bank, Towards Cleaner Industry in Turkey, tools for Policy Makers, 2009.

policy making and instrument design not only for Integrated Pollution Prevention and Control (IPPC) installations, for which a detailed inventory is needed, but also for small and medium enterprises.

The Government may also consider piloting the industrial sector strategy approach in one or two industrial sectors, which is recommended for a successful implementation of industrial sector approach and would allow for a transition period for the most important revised environmental policy acts so that industry has been given the possibility to prepare for the changes and due to the close consultation and feedback the policy has better chances to be successful. This will also create an early success which increases the chances of the full policy to be successful. Some favorable conditions, namely strong sector associations, the Government's increasing inspection and enforcement pressure, and recent experience with consultative resolutions to industrial waste management, suggest this approach would yield beneficial results.

13 Industrial Emission Registration System

13.1 Access to information on air pollution releases in Kazakhstan

The Environmental Code in Kazakhstan (article 130) requires public access to environmental information. It indicates that public participation is one of the basic principles of sustainable development in the Republic of Kazakhstan. Industries are required by the Environmental Code to provide public access to the procedures and results of environmental monitoring. Most countries in western and central Europe make the information from industrial emissions monitoring and registration easily available through a pollutant registry with the Environmental Protection Agency or Ministry's website, however such publicly accessible database/registry does not exist in Kazakhstan.

The Environmental Code in Kazakhstan endorses public access to environmental information. It indicates that public participation is one of the basic principles of sustainable development in the Republic of Kazakhstan. Public authorities are therefore requested to ensure appropriate public access to environmental information and to improve the quality, efficiency and relevance of the material submitted. The collection, recording and storage of environmental information is carried out by the State Registry for Environmental Information. The Registry contains:

- Register of natural resources;
- Register of pollutant release and transfer;
- List of environmentally hazardous industries;
- Environmental monitoring data;
- Information on environmental impact assessment and state environmental expertise of the planned activity agreement;
- Standards and regulations in the field of environmental protection and natural resource management and others.

The Public Statistics Office of the Republic of Kazakhstan keeps records of some of the indicators for environmental protection. The office publishes annually compendium titled "Environmental protection and sustainable development of Kazakhstan".

Access to environmental information related to the procedure of environmental impact assessment and to the decision-making process of planned economic activities is carried out in an order that regulates public access to environmental information at the stage of EIA, that is «The rules of public hearings» approved as a directive of the Minister of Environmental Protection № 135 from May 7, 2007 . Information may be requested in writing or electronic form and a fee for providing the information may be charged.

Certain information is distributed by environmental authorities by internet or by using other tools of communication, specifically related to the following:

- Environmental Status Reports;
- Drafts and final version of legal acts and international agreements on environmental protection;
- Drafts and final versions of documents related to state policies, programs and plans of the environmental protection field;
- Reports on the results of control, inspection and enforcement activities;

In addition, corporate '2-TP' air reports may be purchased from the public statistics office. More specific information, like self-monitoring reports can only be obtained upon permission of the company's management.

In general, MEWR considers that it does not have right to publish reports/permits of the companies. Information on the environmental impact of major polluters is not transparent and publically available. There are no regulations which establish a procedure for regular reporting on environmental pollution (and their impacts) in a consistent and standardized format. Public access to environmental monitoring plans and the results of environmental monitoring may or may not be provided at the request of the parties concerned.

Currently, public access to information about the environment in Kazakhstan is done in several ways. For example, monthly bulletins about a state of the environment are published on the website of MEWR. Aarhus Centers publishes annual statistics "Environment and Sustainable Development". However these documents do not compliant to the requirements of the Kiev Protocol, as information is presented in an aggregated form and it is impossible to determine which of the emission sources contribute most to the pollution of a particular environment. Moreover, the list of pollutants, for which the information is submitted, is limited and the methodological basis is not specified.

According to the MEWR there are about 130 non-governmental organizations (NGOs) engaged in environmental protection. MEWR has established a Public Environmental Council - a collective and permanent acting body consisting of representatives from the Ministry of Environment and Water Resources, NGOs and the business sector, as well as leading scientists and public figures. Personal membership is approved by the Minister of Environmental Protection.

The main goal of the Council is to develop proposals and recommendations for the implementation of government policy in environmental protection, ecological safety and environmental management. Members of the Council participate in the extended meetings of the Board of Ministry of Environment and Water Resources and make recommendations on the draft documents discussed at the meetings. Decisions of the Council have a recommendatory nature.

Cooperation of regional environmental authorities with NGOs should be based on formal cooperation agreements on various issues, involving them to the work of Ecological Inspection, organization of round tables, seminars and conferences. Public participation in decision-making on especially important projects, according to the Environmental Code, is carried out through public hearings, which held as a part of the EIAs. Submission of the permit application requires publication of appropriate notice in mass media, indicating the address where interested organizations can familiarize themselves with the main conclusions of the EIA.

13.2 Pilot projects on Emission Registration

As a signatory to the Aarhus Convention, Kazakhstan should not only modernize and expand its environmental regulatory system, but also make information on environmental emissions publically available to allow for more transparent decision-making and increase support for policies targeted at industrial pollution reduction. The Aarhus Convention grants the public rights regarding access to information, public participation and access to justice, in governmental decision-making processes on matters concerning the local, national and trans-boundary environment. It focuses on interactions between the public and public authorities. The Convention, as an international treaty, has direct applicability in the Kazakh legal system. One of the most important practical instruments of the Aarhus Convention is the Pollution Release and Transfer Registry.

Despite the fact that Kazakhstan has adopted a number of decrees and regulations on the establishment of registers in the Environmental Code (Chapter 21-22), there is little progress in the creation of a public electronic register.

A number of projects for promotion and implementation of the Aarhus Convention and the Protocol on Pollutant Release and Transfer Registers (PRTR) were implemented in Kazakhstan in the recent years. Most of projects aimed at capacity building of governmental and public organizations. Some of these initiatives are referred to below.

The first step was completed in 2005 when a working group for preparing an action plan to practical adoption of a document ‘Environmental Monitoring of Industrial Facilities in Kazakhstan. A Concept of Reform’ was established.

At the meeting of the Working Group on PRTR to the Aarhus Convention in November 2008 in Geneva, a project called "Drawing up the pilot register of emissions and transfer of pollutants at subnational level. Experience of creation" was initiated in Kazakhstan.

The project was realized by non-governmental organizations of Kazakhstan on the basis of DEMO PRTR with financial support of the OSCE Center of Astana in cooperation with the European Eco-Forum and the Ministry of Environment and Water Resources of Kazakhstan. MEWR suggested the creation of a pilot PRTR-project based enterprise reporting of the East Kazakhstan region, where pollution problems are expressed particularly acute. In 2009, a pilot version of the PRTR registry in Ust-Kamenogorsk was developed.

The pilot PRTR is based on the reports received by public statistics office, namely 2 TP-air, 2-TP-water management, 3 TP-hazardous (toxic) wastes, annexes to them, as well as information letters from enterprises. The pilot PRTR of the East Kazakhstan region translated into Kazakh and English languages. The website www.kz-prtr.org is open to all stakeholders and provides information about pollutants in electronic format. Data are available only for 2008.

The Aarhus Centre of Kazakhstan has developed a database of industrial facilties in Kazakhstan (http://aarhus.kz/index.php?option=com_content&task=view&id=589), which includes:

- Title of industrial facility;
- Type of production activity;
- Class of environmental exposure;
- Address of industrial facility, contact details.

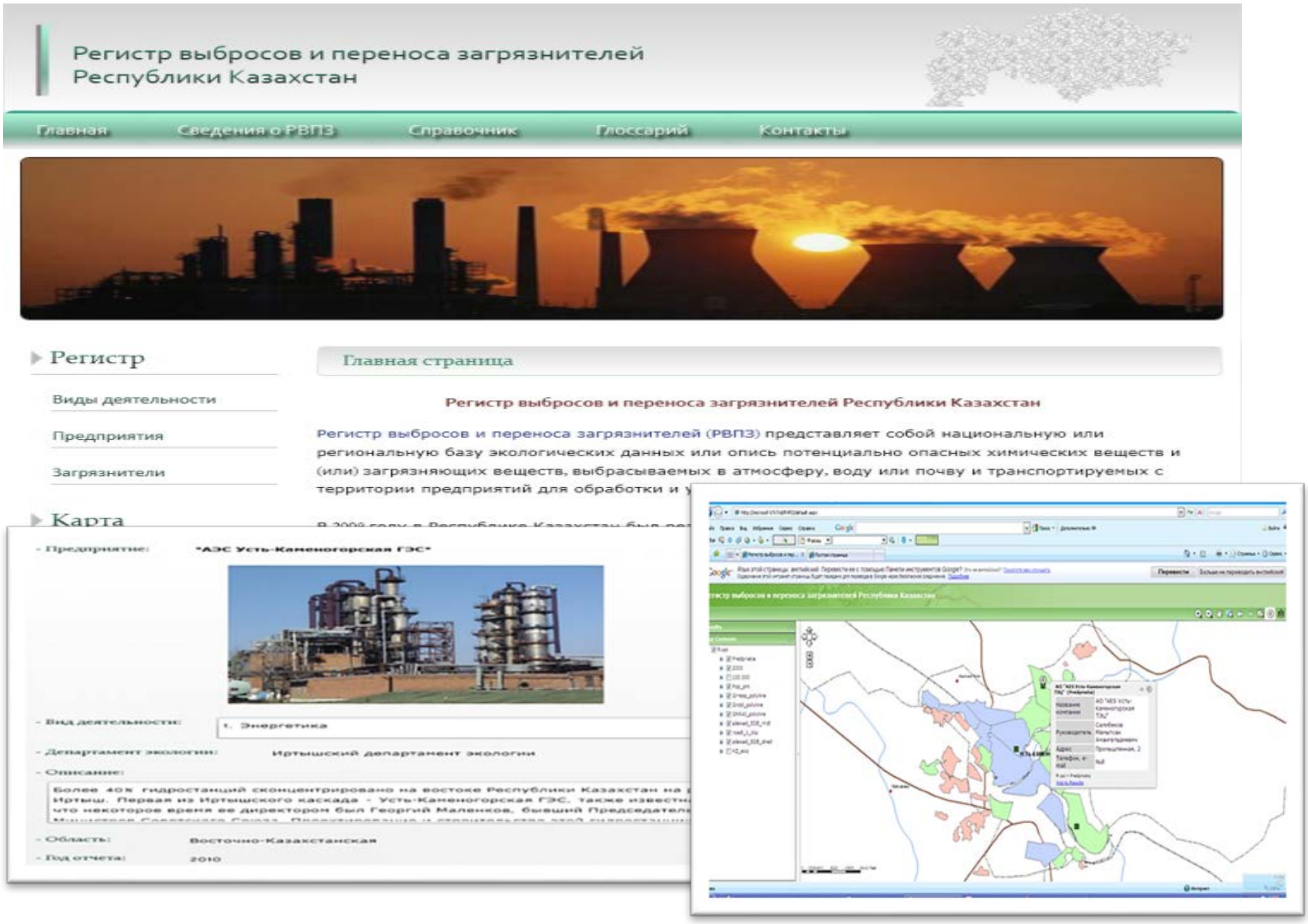


Figure 29. Trial version of the PRTR web-portal in Kazakhstan

Since February 2011, the National Aarhus Centre, Information-Analytical Centre of MEWR and the OSCE Centre in Astana are implementing the project "Promotion of the Protocol on Pollutant Release and Transfer Registers to the Aarhus Convention in Kazakhstan." This project aims to further enhance the results of previously implemented projects for promotion of the PRTR Protocol.

The portal includes the following sub-systems:

- Registry;
- Maps;
- Data input;
- Administration

The sub-system ‘Registry’ includes a database with a list of industrial facilities, their location, information on the quantity of their emissions on an annual basis. The emissions could be sorted upon exposure to air, water and soil, upon type of industrial activity, upon type of emission source (stationary or mobile). The Registry also includes detailed information about profile and contact details of an industrial facility.

- The sub-system ‘Maps’ offers possibility to retrieve the required information with the help of maps and graphical tools.
- The sub-system ‘Data Input’ is purposed to put in the required data, including industrial facilities and emission values.
- The sub-system ‘Administration’ is aimed at administration of the data base and editing any information, which is present in it.

The trial version is not yet on the internet. The work is currently underway to develop a database and launch the web portal on Internet. However, there is no information if any specific deadline for this project is set.

In principle, Kazakhstan has both legal and regulatory framework for launching the national PRTR and there is a system of environmental and statistical reporting of industrial emissions. However, substantial further progress with PRTR development in Kazakhstan is likely to be achieved only if certain fundamental reforms are performed, particularly:

- Alignment of environmental monitoring and reporting systems;
- Develop procedures, requirements and obligations for maintaining PRTR database.

Developing a national PRTR should be supplemented with the regulatory framework of Kazakhstan regulations that clearly define the powers and duties of the authorities responsible for maintaining the PRTR and the obligations of industries/facilities that provide the reports. The individual elements of the system of monitoring and recording of polluting emissions will require changes and additions in accordance with the obligations under the Protocol.

13.3 Reporting obligations for industries under good international practices

To facilitate easy reporting and have a well-functioning data handling system is crucial for the environmental authorities to assure all installations monitor and report according to their obligations. Reporting should be easy for the industry for them to focus more on improving their environmental performance rather than reporting about it. In this context the term “easy” does not indicate that the obligations should be easy to comply with, but that the reporting obligations should be clear, easy to understand and not extremely time-consuming. The self-reported data is an important tool for the environmental authorities to keep overview of the environmental performance

in the industry. A self-reporting system is largely based in trust between the industry and the environmental authorities, and should therefore be accomplished by audits and supervision.

The Ministry of Environment and Water Resources showed great interest in the Norwegian reporting system and database for reported data. Norway has an integrated reporting system, where the industrial facilities annually report their emissions on a concentration level (according to permit obligations) and on accumulated emissions (for PRTR and statistics use). Self-reporting by the industry was introduced in Norway in 1992 and, after 20 years of experience-based improvement, is an example of good international practice. Several other countries also have good well-functioning reporting system that also can be referred to as good practice, but the corner stones of the different systems are similar.

In Norway, all industrial facilities with an emission permit under the Law on Pollution are obliged to report their emissions to the competent environmental authority. The report is delivered electronic through a general public reporting system named Altinn and must be submitted by the installation annually by the 1st of March. The electronic report is predefined by the competent authority (Norwegian Climate and Pollution Agency) and the report lay-out is similar to answering a questionnaire. This gives several advantages both for the environmental authorities and the industry. The reporting is time effective for the industry because a written report is not required and the questionnaire requests only the information needed by the environmental authorities. Even though an individual questionnaire must be prepared for each facility, questionnaire reporting may be time effective for the environmental authorities as well. Through this system environmental authorities collect only necessary data, and it assures that industry report the information requested by authorities.

The figure below shows the emission registration steps, from monitoring at the installation, reporting to environmental authorities, data validation at competent authorities, to publishing at N-PRTR and forwarding of data to E-PRTR.

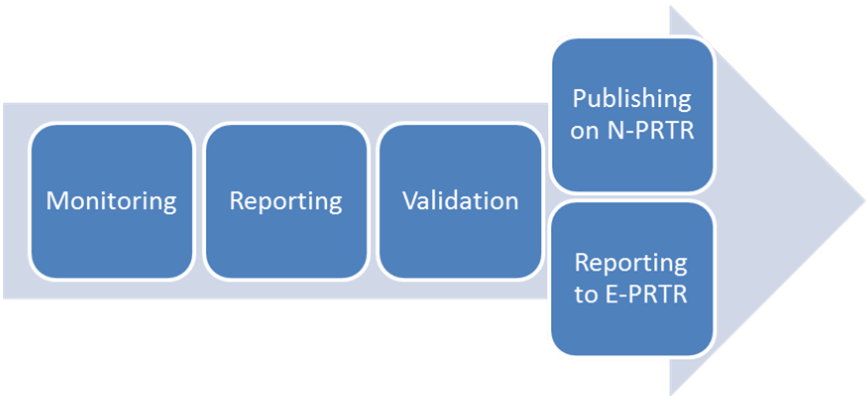


Figure 30. Steps in Norwegian/European emission registration

13.3.1 Monitoring

International and therefore also Norwegian requirements for monitoring of industrial emissions have been described elaborately in chapter 3. Prior to reporting the monitored emissions, the data must be converted to the units requested by the environmental authorities.

13.3.2 Reporting

The installation logs in at the national reporting tool Altinn. This website is an online reporting tool for all kinds of reporting from inhabitants and companies to the authorities in Norway.

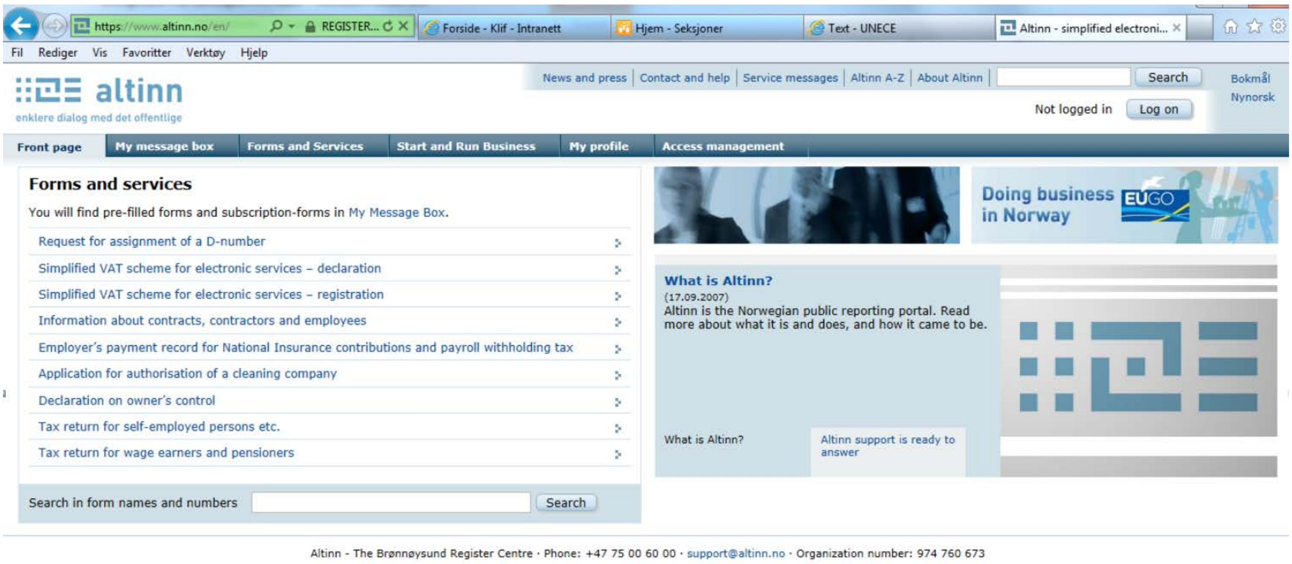


Figure 31. Print screen of the front page of Altinn.no

When logged in, the user chooses the Norwegian Climate and Pollution Agency as the authority to report to, and is directed directly into environmental authorities' database. The database is named "Forurensning" (translated: "Pollution") and is custom made for the Norwegian Climate and Pollution Agency. A structure of the database is given in Appendix C. The reporting consists of 5 main parts:

Part 1: *Initial questions*

This part contains questions about contact data for the employee responsible for reporting and operation status (operating days).

Part 2: *Reporting according to the restrictions given in the permit (concentration)*

This part of the reporting consists of reporting according to the parameters and requirements given in the emission permit issued by the environmental authorities. The part is divided into four subparts:

1. Frame requirements (energy use per produced unit, etc.);
2. Emission to water (according to requirements in the permit, several requirements may be requested for each parameter due to several emission points, averaging requirements, etc.);
3. Emission to air (equivalent to emission to water);
4. Noise restrictions (only applicable if noise measurements are executed).

Emission Limit Values and averaging are prefilled by the environmental authorities for the reporting personnel to easy observe if the reported emissions are according to permit requirements or not. Emissions not regulated with specific limitations in the permit should not be reported in this part, but be reported in Part 4 (for PRTR use).

Part 3: Reporting of illegal pollution and other deviations

This part of the reporting consists of unregulated and illegal pollution and is divided into three subparts:

1. Acute pollution (sudden pollution not regulated by permits);
2. Illegal pollution (pollution exceeding the emission limit values given in the permit);
3. Other deviation (significant production deviations, deviation in waste handling, problems and complaints regarding noise or odor).

Emission measurements executed by third parties that are not accredited are also considered as a deviation, and the reason for use of non-accredited vendors must be reported.

Part 4: Reporting of accumulated emissions and waste amounts (annual amounts)

Reporting of annual amounts is mainly for use in statistics and in PRTR. This part is divided into five subparts:

1. Annual energy use (reported per energy carrier);
2. Annual emission to water (all emission to water of environmental significance);
3. Annual emission to air (equivalent to emission to water);
4. Hazardous waste (all generated hazardous waste according to the European Waste List, whether it is treated, stored or transported away);
5. Ordinary waste (all other generated waste that are not hazardous waste).

For each parameter emitted to water and air it should be informed whether the reported data is measured, calculated or estimated. *Measured* implies continuous measurements or occasional/regular measurements multiplied with water or air flow, *calculated* implies emission based on activity data and emission factors, or mass balance, while *estimated* implies emission based on assumptions without any predefined methodology.

Part 5: Reporting regarding emergency measures

This part is present for the environmental authorities to verify that the facility prioritizes safety and emergency, and is divided into two subparts:

1. Emergency measures (goals, new measures, alerting, etc.);
2. Emergency exercise (date, goal, theme, experiences, outputs, etc.).

The questionnaire must be filled out and submitted electronic annually by the 1st of March. From the 1st of March the environmental authorities will validate all submitted reports.

13.3.3 Validation

Each installation has a dedicated case handler in the environmental authorities (located at the environmental protection agency or the environmental department at the County Governor). The case handler is responsible for validating the reported data in the database.

Prior to validation by the case handler an automatic quality check is run. A flow scheme of the automatic quality control is given in Norwegian in *Annex 8. Flow sheet of the automatic quality control in the database "Forurensning"*. After the automatic quality control, the case handler validates and approves each parameter separately. The validation is a check of the reported numbers looks reasonable. The case handler compares the reported data with reported data from previous years and operation conditions. If there are any deviations which are not explained the case handler contacts the installation for additional information.

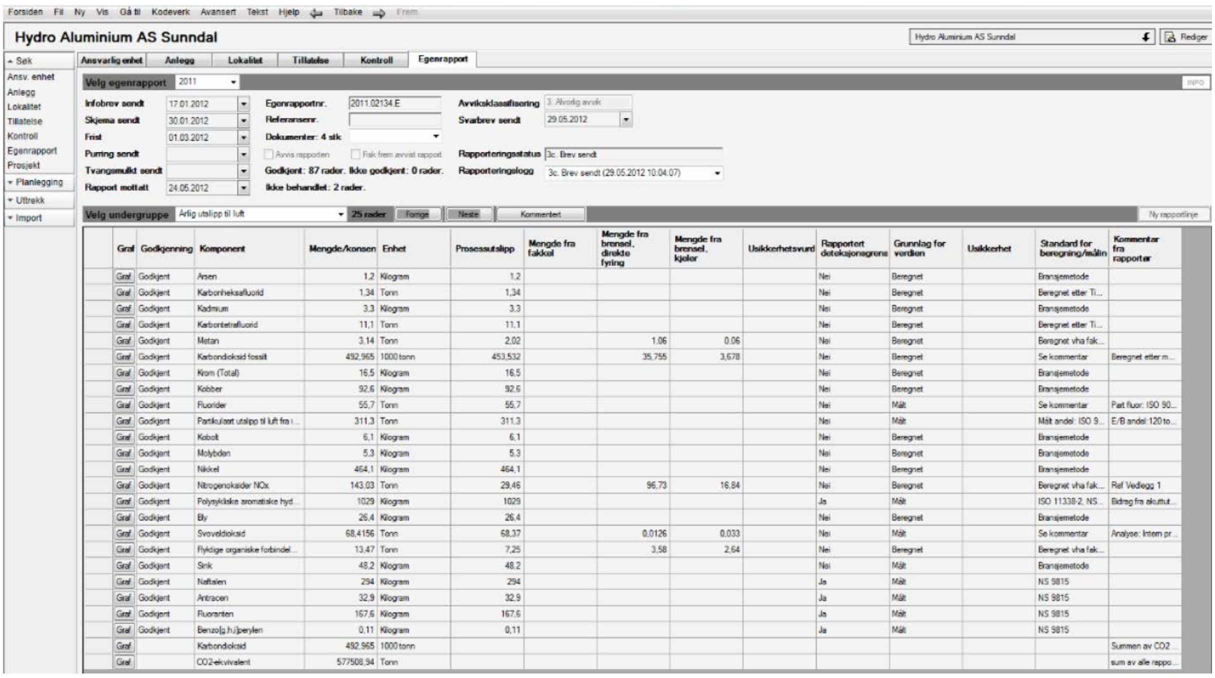


Figure 32. Print screen from "Forurensning".

(The figure shows the page where the case handler for parameters approves reported releases).

The validation does not include a verification of the monitoring and calculation of the reported data. The reported data are normally based on various monitoring equipment, operational conditions and conversions, but this is not verified in the validation process. The environmental authorities conduct inspections/audits of all installations on an irregular basis, where details behind the reported emission data will be checked. The annual validation is therefore only a quick control of the reasonability of the reported emission data, and the system is largely based on trust between the environmental authorities and the installations.

13.3.4 Publishing on N-PRTR

After the case handler has approved all reported emission data from a facility, the data is ready to be published on N-PRTR (www.norskeutslipp.no). The installations report in units defined by the environmental authorities so no further conversions or recalculations are needed.

Countries that ratified the Kiev Protocol on PRTR are not obliged to develop and run individual PRTR websites, as long as the collected data is published on a common website with other countries. Not all European countries have a national PRTR website, but the collected data is forwarded to the European Environmental Agency (EEA) and published on the European PRTR (http://prtr.ec.europa.eu/). Reporting to EEA and publishing on E-PRTR is obliged for all EU and European Economic Area states whether or not national PRTR websites are present.

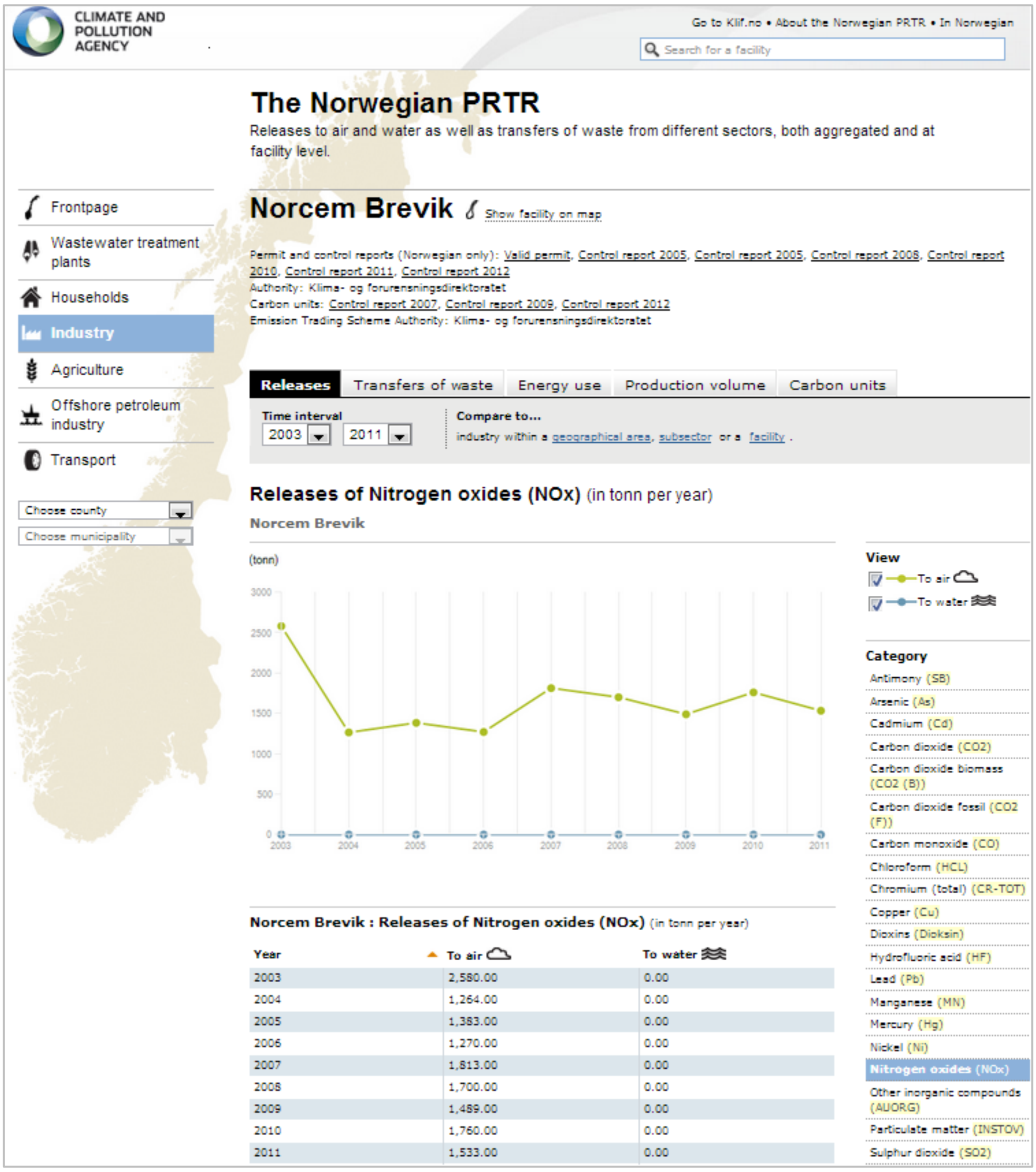


Figure 33. Print screen from N-PRTR. NOx emissions from cement plant Norcem Brevik

13.3.5 Reporting to E-PRTR

The European-PRTR (E-PRTR) implements at EU level the UNECE PRTR Protocol, which was signed by the European Community and 23 Member States in May 2003 in Kiev. On E-PRTR, emission data from countries within the EU and European Economic Area together with Switzerland and Serbia are published. The environmental authorities in each contributing country annually report the collected emission data to the European Commission (EC) through the European Environmental Agency (EEA). The EC/EEA is responsible validating and publishing the data on the E-PRTR.

The reporting to the E-PRTR from the national environmental authorities is done by electronic sending of a data file pre-specified by the EEA directly to their database. The national environmental authorities have to convert the collected emission data to the correct format (units, etc.) to fit the specifications in the data file to the E-PRTR database. The data file must be filled out

correctly to be accepted by the E-PRTR database and incorrect data files will not be able to send. The EEA has made an E-PRTR Guidance document for the reporting procedure (http://prtr.ec.europa.eu/docs/EN_E-PRTR_fin.pdf).

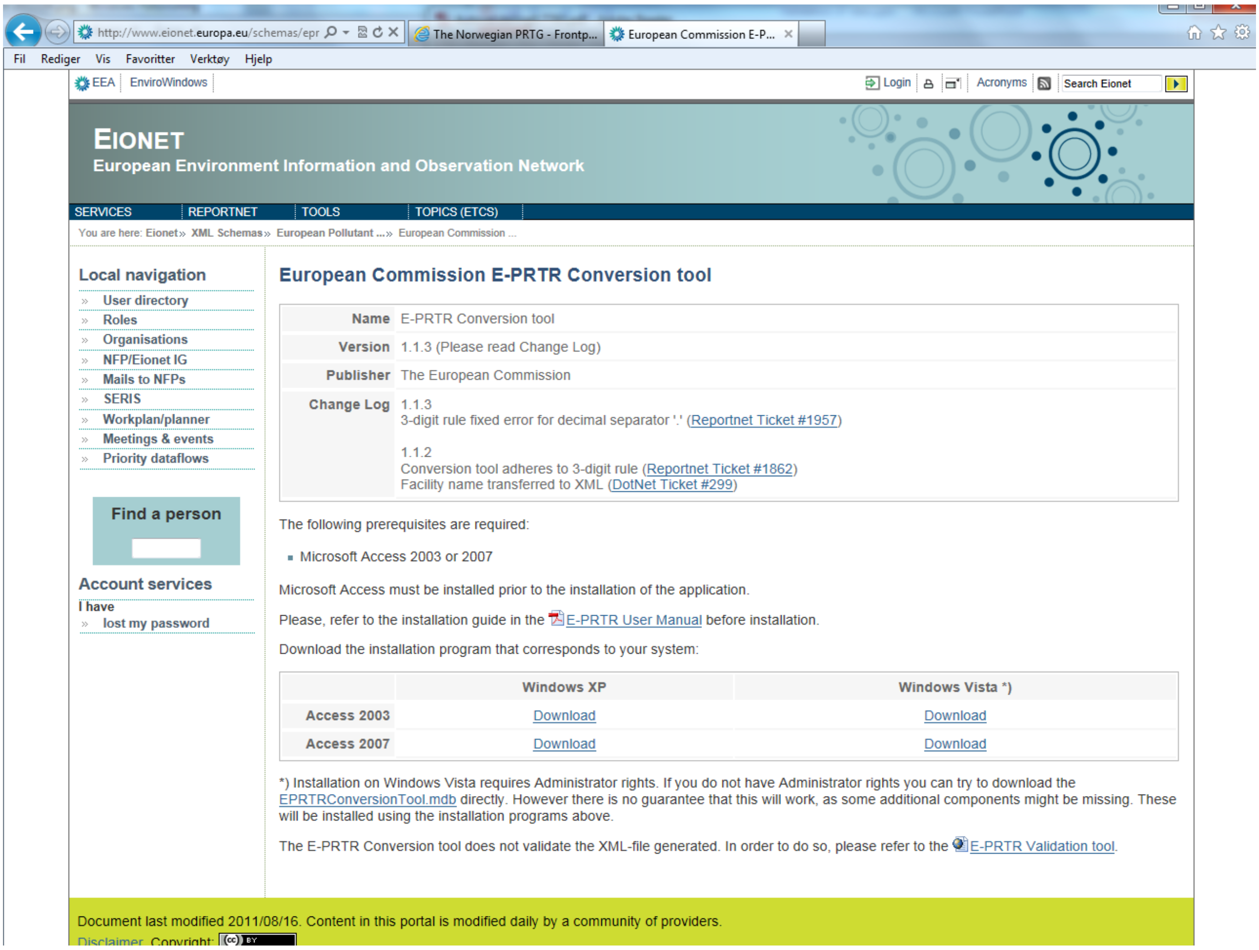


Figure 34. Print screen of the E-PRTR reporting webpage, EIONET

The EEAs electronic “validation tool” controls that all formalities and specifications from each reporting state are correct. This check covers an evaluation of number of facilities and release reports, amounts of releases reported, correct units, etc.

After validation of specifications, the E-PRTR data are compared with data collected under the Convention of Long Range Transboundary Air pollution, United Nation Framework Convention on Climate Change and EU Emission Trading Scheme (for releases to Air), with data reported to Eurostat and EEA (for waste data and transboundary movement of waste), with data reported to EEA and to the Water Information System of Europe WISE (for release to Water). This is done to uncover inconsistence between data reported data under different reporting obligations.

13.3.6 Reporting of CO_2 emissions and publishing on National PRTR and E-PRTR

For CO_2 emissions, verification is undertaken by an accredited third party and subsequently emissions are reported to authorities together with a verification report. The authorities should therefore not verify calculations and monitoring principles since this is already done. However,

authorities may decide to perform on-site inspections to quality assure the verifiers statements. Any deviation found may lead to sanctions, i.e., suspension (most likely temporal). After approving the reports, authorities may ask companies to transfer allowances to authorities account according to the reported emissions.

The GHG emissions are published on national PRTRs and E-PRTR similar to the publishing procedure of the other emissions.

13.4 Recommendations for improvement of the Industrial Emission Registration System

13.4.1 Electronic reporting of emissions

Currently, emission data is reported to the environmental authorities in written form. The case handler in the environmental authorities must then type the data into reports (and into database when a database is up and running). Written reports from the industry is stored in hard copies.

In EU countries, the industry logs into a webpage which direct them directly into the environmental authorities' database. All reporting is done electronic and directly into the database, which do not require any hard copy storing and retyping of data for the case handler.

It is therefore recommended that a database is built on a platform that has the possibility for the industry to log in and report directly into the database.

13.4.2 Frequency of reporting and number of reporting schemes

Currently, there are two systems of environmental reporting:

- Reporting on the implementation of environmental self-monitoring;
- The 2-TP (air) report to public statistics office.

The two reporting templates contain different, but partially overlapping information. There is no free access to reported information. There are strong concerns on the ability of the public statistics office to process, analyze and verify information received with environmental self-monitoring reports.

In Norway, and many other EU countries, there is only one annual reporting obligation (1st of March) for the industry. The electronic report submitted annually is a questionnaire designed by the authorities to cover all needed information for different agencies (environmental protection, statistics, etc.).

It is recommended to reduce number of reporting obligations to only one per year. More frequent reporting is probably not necessary for the authorities and a reduced reporting frequency may reduce the work load for Ministry and industry personnel, but will allow improvements in the report's quality and clarity. One report annual reporting obligation requires the authorities to design the reporting questionnaire to cover needed information from several agencies/ministries. This requires good collaboration across ministries and agencies. Consolidate the two presently co-existing environmental reporting schemes, based on the PRTR protocol as illustrated below.

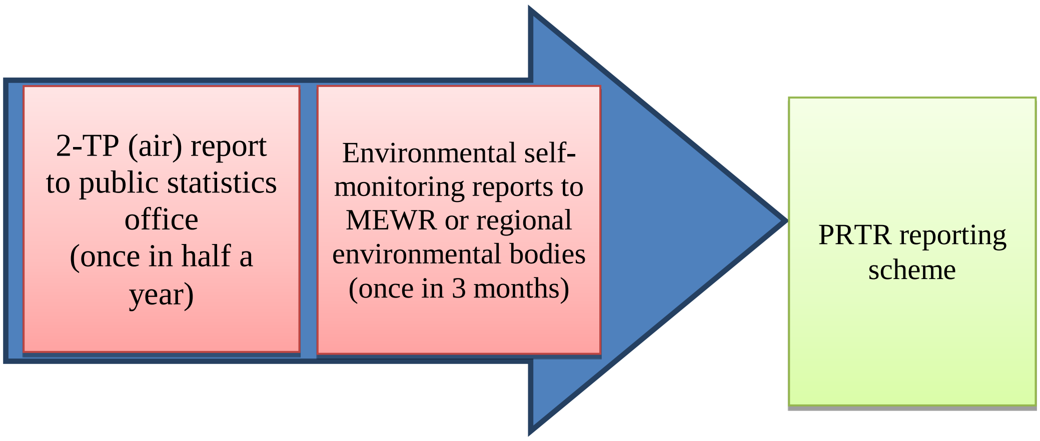


Figure 35. The proposed transition to the PRTR reporting scheme

13.4.3 Information exchange between regionally and centrally located personnel in the environmental authorities

Currently, some industries/installations report to emission data to central environmental authorities in MEWR, while other installations report to environmental authorities in their oblast. The exchange of information and collaboration between the centralized and decentralized personnel is not optimal, and a system for access to the others collected information is needed.

In Norway, the personnel in the centralized environmental protection agency and personnel in the environmental department at the county governors have equal access and equal rights in the database.

It is recommended to increase communication and collaboration between personnel in MEWR and personnel in the oblasts. Ideally through a common database that can be logged into from different locations, but as a first step, a common server where all relevant data is stored will increase the information exchange significantly.

13.4.4 Public access to emission information

The Environmental Code of Kazakhstan puts an obligation to ensure public access to the results of environmental self-monitoring and environmental permit compliance control.

However, in practice, publishing of information on air emissions is not mandatory. The access to the information may be possible upon consent by an industrial facility. Information may be requested in written or electronic form and a fee for providing the information may be charged

In EU countries, all relevant information is published on national PRTR webpage and on E-PRTR. Additional information is provided upon request to the environmental authorities given that the information is not confidential (process or economical related – not emission data).

It is recommended to develop regulations ensuring open publication of environmental self-monitoring reports. Publish data free of charge on the internet. Ideally through a webpage where emission data may be sorted on facility level, but as a start the data can be published annually in a downloadable report.

14 Towards a cleaner industry and improvement of industrial emissions monitoring, reporting and registration system

It is not possible to apply changes to one element of the system and not reviewing other components at the same time. When different permitting/assessment systems are compared, the whole system of ELVs setting-environmental self-monitoring-environmental reporting- public access must be reviewed. The overall system is seen as a cycle that starts with policy planning, together with setting of legislation and regulations, implementation of regulations and self-monitoring of environmental emissions.

Each country takes its own approach to the development and maintenance of industrial emissions control system. Kazakhstan, as a part of its Green Economy Concept has chosen to bring the system closer to international practices in order to reflect a new economic and social reality. This should be facilitated through a step-by-step achievement of feasible objectives. This process has been ongoing since the adoption of the Environmental Code in 2007.

This study found no fundamental contradictions between the system applied in Kazakhstan and in EU countries. Kazakhstan has introduced several new regulations in recent years to strengthen the legal base for both permitting and self-monitoring systems, as well as to introduce elements of technological standardization.

The key challenge is to ensure smooth implementation of the reforms. This entails streamlining, avoiding of duplication, removal of obsolete elements of the system, as well as capacity building. To this end, the study identifies the following main directions for improvement of the regulations:

- Clarification of scope of the permitting and compliance control;
- Optimizing permitting and compliance control requirements;
- Ensuring methodological integrity of permit conditions and monitoring of industrial emissions;
- Enabling public access to self-monitoring and compliance control.

14.1 Clarification on the scope of the permitting and compliance control

The reform scope for environmental regulation and industrial air emissions control is based on the fundamental notions and definitions, including:

- Classification of industrial facilities which are subject for the industrial emissions permitting and compliance control;
- Classification of emission sources, which should be addressed by the permitting and control;
- Classification of pollutants subject for mandatory environmental compliance control.

In order to establish effective environmental policy for industrial emissions control, Kazakhstan needs to streamline and unify present understanding and classifications of the policy field in relation to the above subjects. Environmental regulators have to avoid any duplication and inconsistency between the existing methods for ranking and regulations defining meaning and scope of industrial facilities, emission sources and air pollutants, which are subject to environmental permitting and compliance control.

At this point it is also important to clarify differences in the Kazakh and EU interpretation of ‘emission sources’ and ‘installations’. In the IPPC Directive 'installation’ is defined as a stationary technical unit where one or more activities are carried out, and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution., i.e., the processes, technologies and equipment responsible for generation of emissions of Annex 1 substances. In other words, the EU interpretation of installation could include more than one ‘emission source’. In Kazakhstan, the word ‘installation’ is not used and the closest analogue is ‘emission source’ which is a ‘facility (enterprise, workshop, plant, or vehicle) which is a source of emissions to air of one or more pollutants’. In other words, all physical points of emissions are viewed as ‘emissions sources’. For the purposes of this report we define ‘emissions source’ as being synonymous with ‘installation’. See the Definitions section for further details.

The table below outlines the main content of the proposed reclassification reform:

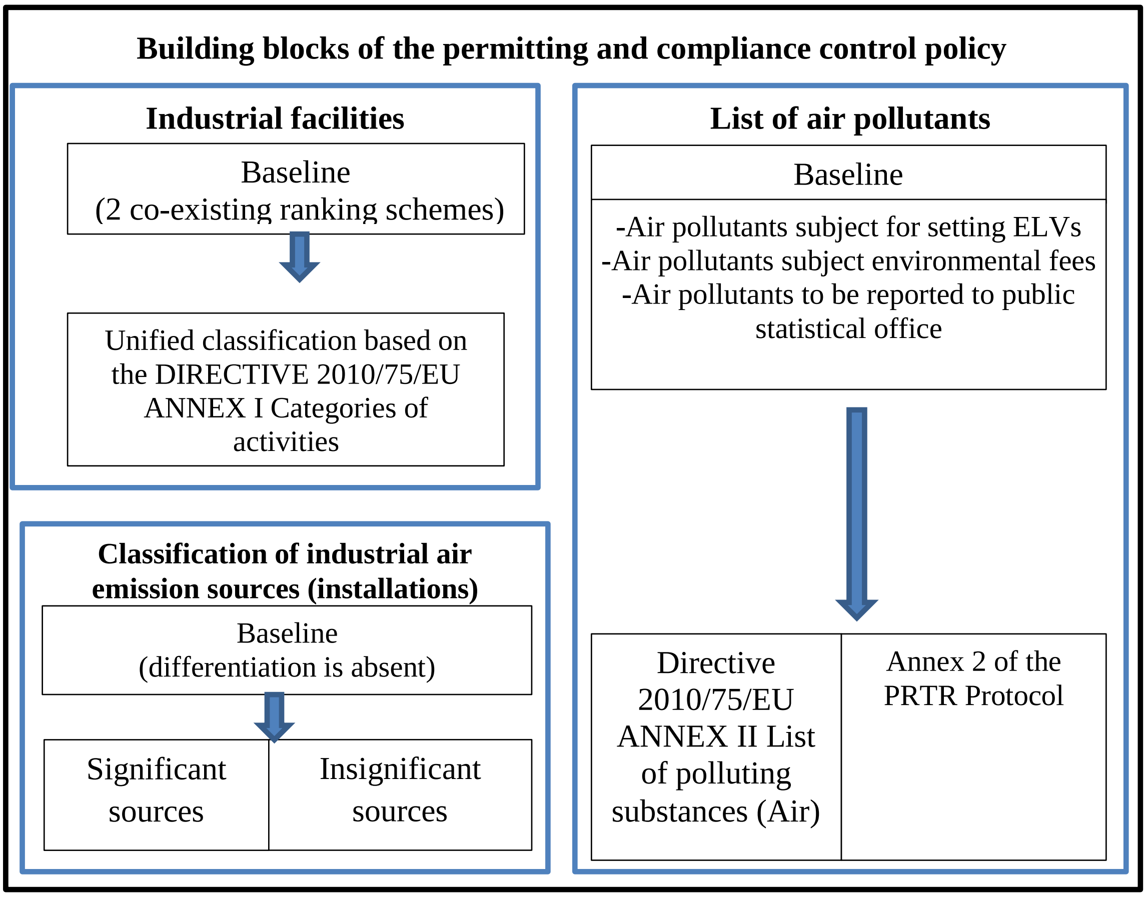


Figure 36. Building blocks and proposed changes to permitting and compliance control policy
(Arrows lead from the current system to the proposed change)

As different requirements for air emissions permitting and compliance control presently apply to industrial facilities, they are ranked accordingly. Kazakhstan has already two co-existing schemes for ranking industrial facilities upon environmental exposure and the main recommendation in context is to unify these schemes. A unified scheme should establish:

- Criteria of industrial facilities with the largest exposure to environment, subject of most stringent control;
- Criteria for industrial facilities, subject for environmental reporting;
- Criteria of industrial facilities with insignificant environmental exposure, subject for simplified air emissions permitting and reporting requirements.

It is proposed to group all industrial facilities into 3 classes.

Class I of environmental exposure - all industrial facilities, which meet the criteria of the ANNEX I Categories of activities of the EU's Directive 2010/75/EU. After a certain transition period, this class of industrial facilities should receive an obligation, after a certain transition period, for the BATs compliance and obtaining integrated permits. Industrial facilities ranked as Class I should receive most stringent permitting, self-monitoring and reporting requirements.

Class II of environmental exposure – all industrial facilities which are not considered as the Class II of environmental exposure, but which are obliged to perform self-monitoring and reporting. It is expedient to relate to this class of environmental exposure all industrial facilities which meet criteria of the Annex I of the PRTR Protocol.

Class III of environmental exposure – are SMEs which cannot be related to the above classes of environmental exposure.

The figure below exemplifies the recommended policy action:

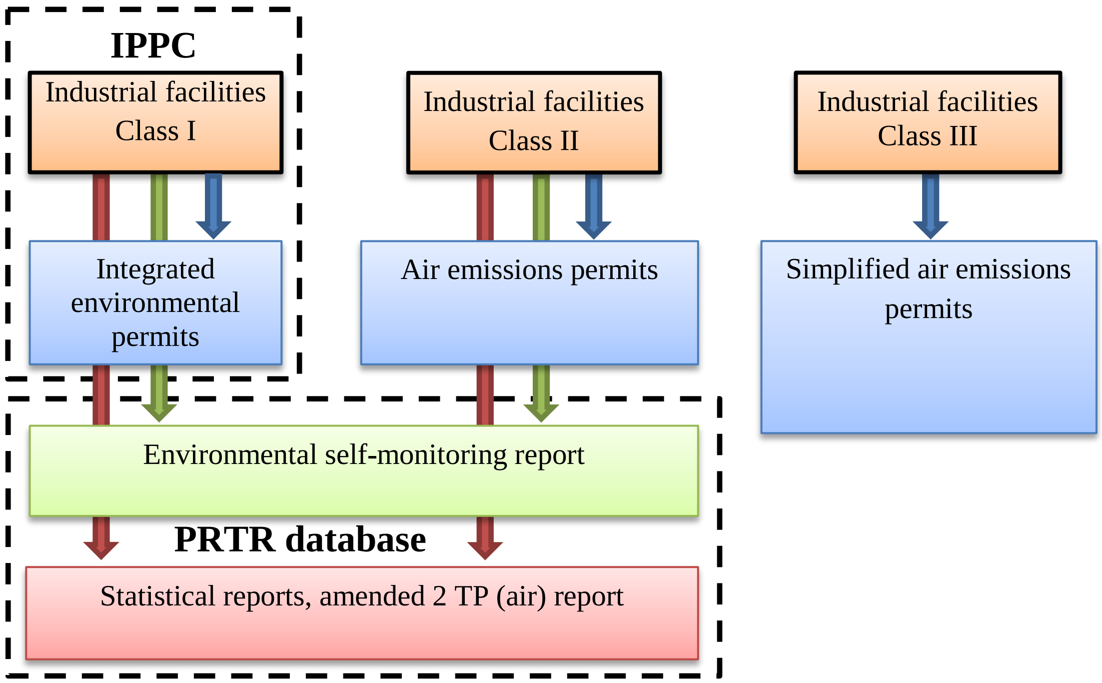


Figure 37. Proposed ranking of industrial facilities and their obligations

Industrial facilities of Class I of environmental exposure should be granted a transition period to the integrated environmental permits and through a consultative process with industries preferably through sector strategy approach and based on pilots. The List of industrial facilities, approved by

Government's Resolution № 95 from 4 February 2008 is close to the Categories of the IPPC activities as defined by the ANNEX I of the Directive 2010/75/EU. Hence, the adoption of IPPC criteria for ranking of industrial facilities can be done promptly. It is therefore advised to adopt the IPPC list in Kazakhstan, as an amendment to the Government's Resolution № 95 from the very beginning.

The next step for clarification of the scope of air emissions permitting and compliance control is to harmonize the formal lists of pollutants and unify the list of pollutants subject to environmental monitoring with the list of pollutants accounted for payment of environmental fees. The unified list should then be harmonized with the ANNEX II List of polluting substances (Air) of the Directive 2010/75/EU.

It is worthwhile to fulfill this task stepwise. At first, the Government may wish to decide that the only list of air pollutants to be considered in the permitting and compliance control is the 'List of pollutants' adopted by the Government's Resolution #557 dated of 30/06/2007. This list is quite similar to the ANNEX II List of polluting substances (Air) of Directive 2010/75/EU. The second step would be to introduce amendments to this list in order to align it with that specified by the Directive.

Furthermore, the present template for environmental reporting to public statistic's office is close to the layout of the PRTR report. Transition of the PRTR reporting scheme will require a minor update of the reporting layout, mainly the 2 TP (air) report.

Differentiation between significant and insignificant sources of emissions (installations) (or major and minor emission sources) is also an important step towards transition to more focused permitting and compliance control. All sources of emissions (installations) that do not fall into a definition of significant should be, as EU practice suggests, excluded from permitting. Kazakhstan may take advantage of using the European methodology to differentiate emission sources (installations) which has proven its effectiveness over time. Differentiation of air emission sources may lessen the workload of both environmental managers at industrial facilities and their environmental regulators. This will help them to keep a stronger focus on significant sources of emissions (installations).

14.2 Optimizing permitting and compliance control requirements

Main areas for optimizing the present permitting and compliance control requirements are:

- Moving the focus of environmental requirements from the 'end-of-pipe' to integrated pollution prevention and control;
- Amend measurement units of air emissions to better relate them to the process conditions;
- Improvement of environmental reporting system.

The figure below exemplifies the proposed policy actions. One strategic direction for further development of the permitting system is moving focus from 'punish-control implementation of end-of-pipe strategies' to integrated pollution prevention and control. The best permitting practice is

integrated environmental permits. Hence, it is hereby advised to oblige for the largest industrial facilities to apply to integrated permits only.

To achieve wider adoption of integrated pollution prevention and control, Kazakhstan should perform a detailed gap analysis and based on this, simplify and further streamline present procedures and requirements for obtaining an integrated permit. This may include amongst others:

- Improvement of the integrated environmental permit terms and provisions;
- Improvement of present procedures for submission of the permit application;
- Development of methodological base for the BATs compliance.

Most of industrial facilities in Kazakhstan lack awareness and are anxious about transition to a new permitting system. To avoid the eventual resistance of the companies towards the transition, environmental regulators should take necessary steps for capacity building, consultation and feedback and implementing integrated permits sector by sector as part of sector strategies and with pilots with early adaptors to early on show some success with the new integrated permit approach. This is a key for success of the integrated permitting system. There is a lot of experience for this type of capacity building and sector strategies and pilots available internationally and this experience can be replicated in Kazakhstan.

For the remaining industrial facilities, the present scheme for environmental permitting should be approximated in order to accommodate modern environmental management strategies, such as pollution prevention. This approximation should include amongst others:

- Setting up ELVs based on the process conditions and BATs;
- Establishing obligations in relation to the BAT’s adoption;
- Setting up ELVs in mg/m^3.

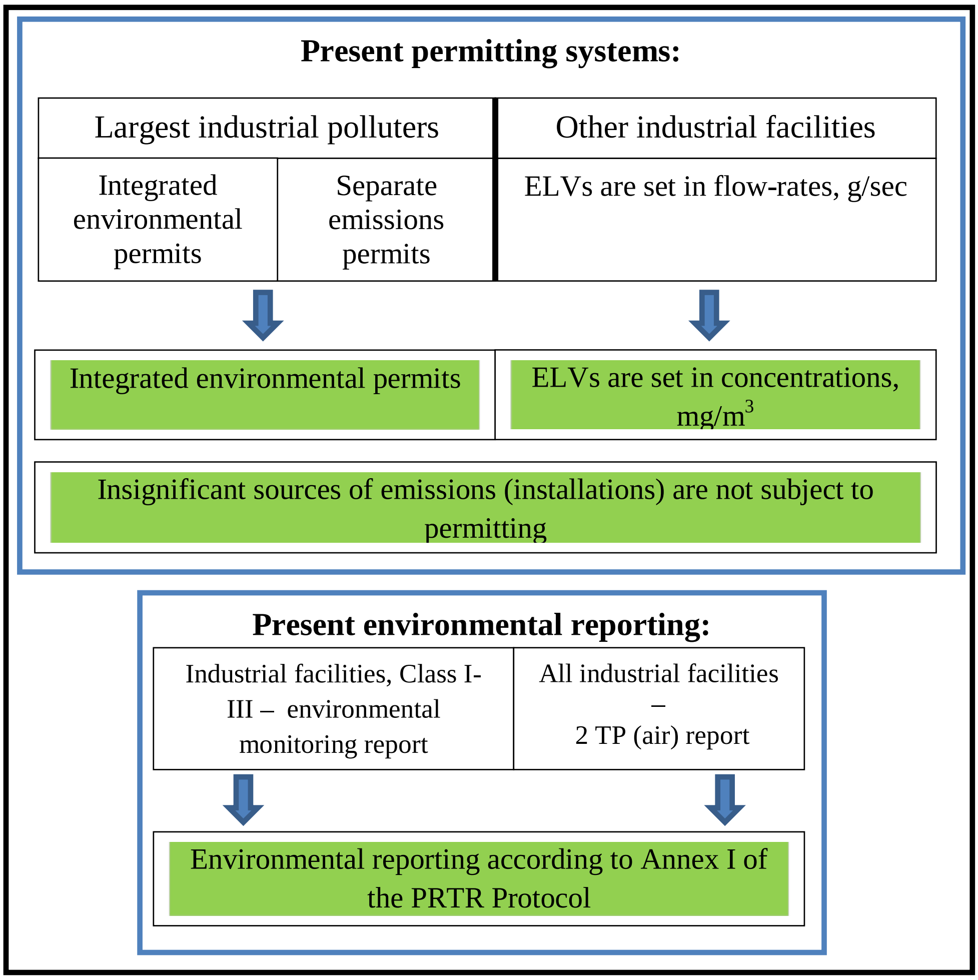


Figure 38. Proposed amendments to the environmental permitting and reporting system (Highlighted areas are the suggested changes to be made)

Concentration of pollutants in air emissions is primarily determined by technology, process conditions and equipment used. By limiting the pollutant concentrations, environmental regulators may unify requirements for the air emissions from emission sources that are located on different distance to living areas, with different background concentrations of pollutants, etc. The concentration of pollutants as environmental indicators well suited to compare and control the environmental performance of similar processes, as well as to apply similar pollution prevention and control techniques.

However, environmental regulators should ensure that transition to the process related approach to setting the ELVs will not compromise compliance to the ambient air quality standards (traditional approach). In case of non-compliance with the quality standards, additional measures are to be taken to reduce industrial air emissions.

The new approach for setting up and control compliance to the ELVs will require new standards for air emissions based on pollutant concentration, mg/m^3. This task can be performed with due respect to the European experience. This will in turn necessitate further development of the template and methodology for the inventory of air emission sources. The figure below illustrates the proposed procedure for the air emissions compliance control.

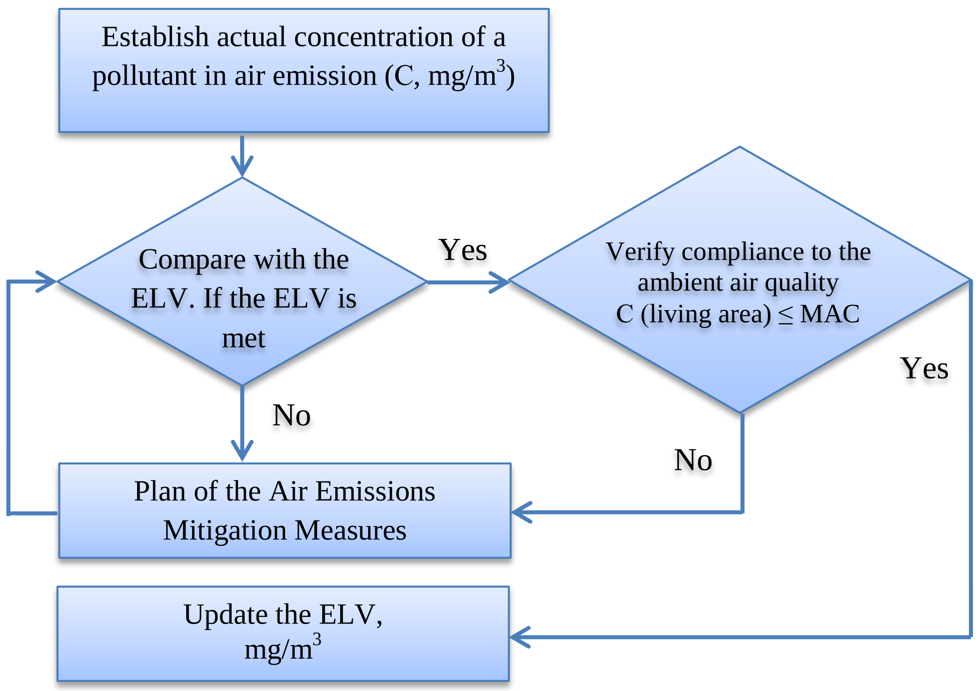


Figure 39. Proposed procedure for the air emissions compliance control

14.3 Ensuring methodological integrity of permit conditions and monitoring of industrial emissions

As mentioned, the present methodological base for setting the permit conditions and monitoring of industrial emission is not optimal and is not integrated in a single document. In this respect, the most urgent policy action is probably to update methodology for self-monitoring and collate it into a single document. This will increase quality of actual measurement and reduce the very need for the cross-check of the measured values with theoretical methods. Development and adoption of new regulations and standards is a prerequisite for the successful completion of the above tasks, such as:

- Development of technological standards for emissions on the basis of BATs;
- Development of national reference materials for BATs implementation;
- Development and adoption of the methodology for determining the “significant environmental impact” and “major pollution sources”;
- Development of guidelines for conducting environmental self-monitoring;
- Update of the present regulations for ELVs setting in order to adopt assessment of pollutant concentrations (mg/m^3).

In addition, it is recommended to harmonize the list of industrial facilities subject to mandatory environmental reporting with a list of activities in Annex I of the Protocol on PRTR. This will ensure prompt transition of the present reporting system to the system based on the international PRTR Protocol. Reducing the number of industrial facilities that are obliged to report to public statistics office (the so-called 2-TP (air) reports will relieve environmental regulators.

14.4 Enabling public access to self-monitoring and compliance control

Adoption of the main principles of the PRTR protocol is the mainstream direction for the enabling public access. Processing of environmental reports by various government bodies, which often lack communication, complicates the process of putting the PRTR in operation. It is therefore expedient to define the main body which will be responsible for collection of environmental reports, their verification and maintenance of the PRTR database, available for all competent authorities, as well as public access to data on industrial air emissions. The public information system could be modelled in a similar fashion to the air quality portal outlined in Section 7 or the PRTR system in Section 13.

The essence of the proposed improvements is presented below:

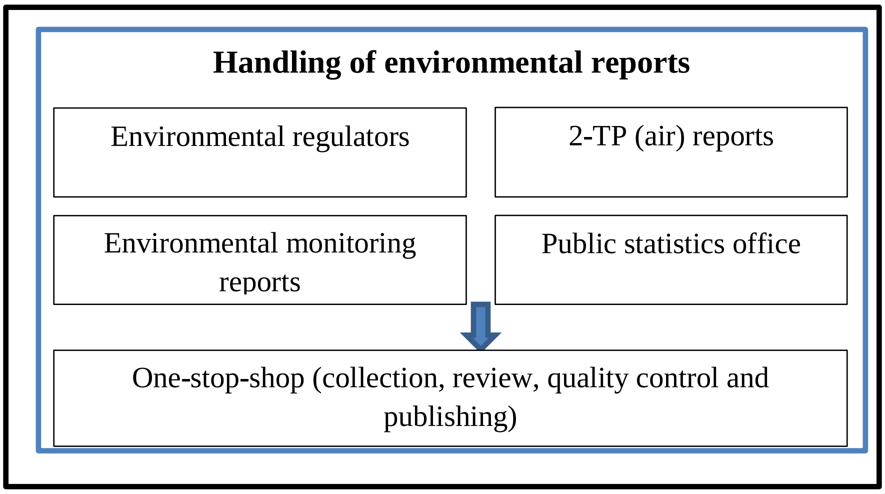


Figure 40. Enabling public access to self-monitoring and compliance control

14.4.1 Public disclosure programs as an informal regulatory option

Public disclosure programs aim to improve environmental compliance through the transparent release of environmental performance data to the public. Once revealed, companies then face this informal pressure to improve their performance so as to minimize their reputational risk. For companies traded on public stock exchanges this media exposure can be significant. Experiments in Indonesia and Colombia have shown some positive results and work best in situations where formal regulations are currently ineffective. See the box below for the experience of PROPER in Indonesia.

Indonesia's Program for Pollution Control, Evaluation, and Rating (PROPER)

PROPER was a national-level public environmental reporting initiative. The objective of this novel regulatory tool was to promote industrial compliance with pollution control regulations, to facilitate and enforce the adoption of practices contributing to "clean technology," and to ensure a better environmental management system. The program was built on the premise that mechanisms of public disclosure and accountability, transparency in operations, and community participation will empower local communities to achieve effective and sustained pollution control practices. The program used color-coded ratings, ranging from gold for excellent performance to black for poor performance, as well as "reputational incentives."

PROPER achieved its objectives by increasing compliance from 35 to 51 percent among pilot program factories, in three river basins, over two years (June 1995–March 1997). PROPER also contributed to voluntary participation by factories in conducting compliance ratings and increased awareness regarding environmental issues. Later econometric analysis found that over the period 1995-1998, there was indeed a positive response to PROPER, especially among firms with poor environmental compliance records. The response was immediate, and firms pursued further emissions reductions in the following months. The total estimated reductions in biochemical oxygen demand (BOD) and chemical oxygen demand (COD) were approximately 32% (Lopez *et al*., 2004).

Additionally, PROPER helped promote an integrated control system of nongovernmental organizations (NGOs), local community groups, the Government of Indonesia's Environmental Impact Management Agency (BAPEDAL), and the media. Finally, PROPER exerted pressure on BAPEDAL to improve its rating methodology and refine its process to ensure that its ratings were trustworthy for initiating action against noncompliance.

Definitions

IPPC Terminology	Kazakh analogue	Compatibility
The EU Directive on integrated pollution prevention and control provides a definition for **Best Available Techniques** (BAT) as: 'best available techniques' should mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for ELVs designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole; 'Techniques' should include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned; 'Available' techniques should mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator; - 'Best' should mean most effective in achieving a high general level of protection of the environment as a whole.	The Environmental Code of the Republic of Kazakhstan, in Article 1 provides a definition of the main terms it uses. Number 12 on this list is a definition of The Best Available Technology – 'used and planned industrial technologies, machinery and equipment, backing up both organizational and managerial measures aimed at reducing the negative impact of economic activities on the environment and ensuring environmental quality compliance'.	The EU Directive considers BAT to be a regulatory approach used to determine what emission level values (ELV) should be applied to a specific company or process within that company. When a company (the licensee) is requesting an operating permit from the environmental regulator, it should demonstrate to the satisfaction of the environmental regulator that the installation/process will be operated in such a way that all the appropriate preventative measures are taken against pollution through the application of BAT. Opposite to the EU Directive, implementation of BATs is a voluntary activity and BATs incompliance does not lead to withdrawal of environmental permits. Kazakh companies that stay within the approved levels of pollution have neither the incentive nor legal requirement to implement BATs. The EU Directive seeks that ELVs are met in a more cost-effective manner than simply through implementing end-of-pipe treatment. Investments identified through the BATs mainly deal with process changes, while end-of-pipe measures are an investment in well-defined equipment, and usually capital costs for measures identified through BAT are lower than end-of-pipe options. If only pollution prevention alone cannot effectively meet the proposed emission level values, some form of 'end-of-pipe' treatment is required and would be considered to be BAT. Opposite to the EU Directive, the Kazakh BATs includes a number of technical and technological solutions, with a predominance of end-of-pipe techniques to reduce emissions to air, water and land. Kazakh BATs propose benchmarks for ELVs for specific processes in rare cases only.
Emission Limit Values (ELVs) refer to the mass, expressed in terms of certain specific parameters, concentration and/or level of an	Kazakh legislation does not provide transcription to the term Emission Limit values.	Kazakhstan's definition of limits for the maximum permissible emissions implies that any emission limit set in permits should not cause the EQS to

IPPC Terminology	Kazakh analogue	Compatibility
emission, which may not be exceeded during one or more periods of time. ELV's concern the discharges from an industrial source. The EU directive presumes that setting ELVs for a specific installation should be based on a combination of the environmental quality standards (EQS), BAT's, in accordance with the relevant technical guidance (BREF) and specific characteristics of any location. The combined approach requires careful case-by-case evaluation, to ensure that the ELVs that are ultimately included in an integrated permit satisfy both the BAT and EQS criteria and comply with local conditions.	The nearest analogue is provided by the Article 27 of Environmental Code: '**Limits for the maximum permissible emissions (LMPE)**, except for greenhouse emissions, waste water discharges and disposal of solid waste, which are defined as permissible quantities of emissions, and calculated for each stationary source of emissions, the entire industrial facility, to ensure that relevant environmental quality standards are met'.	be exceeded. The EU directive goes further by requiring ELVs to be derived also from a consideration of BAT. By applying the integrated approach to setting ELVs, it is intended to achieve environmental performance through pollution prevention, if it can be achieved at a reasonable cost. The emphasis of satisfying the BAT requirements and pollution prevention is not present in the Kazakhstan's definition. ELVs are measured in units of concentration (e.g. g/m^3), while the LMPEs – as flow (m^3/hour).
General Binding Rules (GRBs) for SMEs with significant environmental impact is a tool for IPPC implementation at lower costs at smaller industries. GBRs can be allocated for distinct categories of installations with similar production processes. Installations must have a similar impact on the environment. GBRs contain ELVs based on "state-of- the-art" techniques for that category of installation and requirements for certain operational matters, as well as monitoring, recordkeeping and reporting conditions that are given with the intention to be used directly to set permit conditions and minimum standards.	The GRB as well as any sort of fast/short-track for environmental permitting are not recognized in Kazakhstan.	GBRs are used for reasons of regulatory transparency, administrative efficiency, consistency, and comparability. The reduction of the administrative burden is a reason to use GBRs. These reasons would also be valid in Kazakhstan were it to adopt an instrument such as the GBR.

IPPC Terminology	Kazakh analogue	Compatibility
GBRs also stipulate simplified application forms requiring operators to demonstrate compliance with standard requirements. Most Member States have incorporated in their national legislation the possibility of laying down certain requirements for certain categories of installations in the General Binding Rules (GBR), instead of including them in individual permit conditions (case-by-case based permits).		
According to Article 2(3) of the IPPC Directive: **installation** means a stationary technical unit where one or more activities listed in Annex I are carried out, and any other directly associated activities which have a technical connection with activities carried out on that site and which could have an effect on emissions and pollution. The EU Guidance on Interpretation of "Installation" and "Operator" for the Purposes of the IPPC Directive specifies the meanings as: A technical unit has to be "stationary" to be an installation. A "technical unit" includes all equipment, structures, pipework, machinery, tools, private railway sidings, docks, unloading quays serving the installation, jetties, warehouses or similar structures, floating or otherwise, necessary for the operation of the installation". An activity is said to be directly	The Kazakh legislation does not introduce the term of installation. The closest analogue is the **emission source**, which is a 'facility (enterprise, workshop, plant, or vehicle) which is a source of emissions to air of one or more pollutants'. However, Article 1 of the Environmental Code introduces the term of installation in a narrow context, as "the source of greenhouse gases emissions".	The fundamental difference between the Kazakhstan's system of industrial emissions management and the EU-directive comes out vividly when comparing the EU's term 'installation' with the Kazakhstan's term of 'emission source'. The main objective for establishing the LMPE for Kazakhstan's industries is to meet the air quality standard at the boundary of the residential area. In this context, what comes out from the end-of-pipe is subject to environmental management, while all physical points of emissions are seen as a 'source of emissions'. The integrated approach to pollution prevention and control aims at managing the efficiency of production processes and technologies. That is why the IPPC's term 'installation' refers to the source of emissions, i.e., the processes, technologies and equipment responsible for generation of emissions of Annex 1 substances. Therefore, >1 IPPC installation is possible within the boundary of 1 production site. Also, a permit may

IPPC Terminology	Kazakh analogue	Compatibility
associated with an Annex I activity if it shares some common features, e.g. it is part of the same industrial complex, operates in the same or a related sector, or operates with some collective aspects such as site security or participation in local community relations. Meaning of "site" is basically the geographical location of an installation.		cover one or more installations or parts of installations on the same site operated by the same operator.
Article 2(12) of the EU directive defines **operator as:** "any natural or legal person who operates or controls the installation or, where this is provided for in national legislation, to whom decisive economic power over the technical functioning of the installation has been delegated".	The Environmental Code does not recognize the term ‘**operator’** in relation to environmental permits. However, this term exists in relation to greenhouse gases emissions.	Kazakhstan’s definition of operator present in the Environmental Code is similar to that of the EU’s-directive, but it concerns only greenhouse emissions. This is probably a gap in local legislation.

References

Air Quality Governance in ENPI East Countries. General system gap analysis. EuropeAid/129522/C/SER/Multi. Final report (2012).

AQ directive, 2008. Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. Available at: http://rod.eionet.europa.eu/instruments/633

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

AQUILA N37, 2008. Organisation of intercomparison exercises for gaseous pollution for EU National Air Quality Reference Laboratories of the WHO Euro region. (http://ies.jrc.ec.europa.eu/uploads/fileadmin/H04/Air_Quality/N%2037%20final%20version%20IE%20organisation%20and%20evaluation.pdf)

Baigabulova, Z., 2010. Transport Policy in London: Lessons for Almaty, Working paper No. 1050, February 2010. Transport Studies Unit, School of Geography and the Environment, University of Oxford, 42 pages http://www.tsu.ox.ac.uk/

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

Directive 2004/10/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

DoE, 2010. Guide to the demonstration of equivalence of ambient air monitoring methods. (http://ec.europa.eu/environment/air/quality/legislation/pdf/equivalence.pdf)

Economic Commission for Europe, 2009. Guidelines for reporting emission data under the Convention on Long-range Transboundary Air Pollution. ECE/EB.AIR/97.

Energy Monitoring Report (2011). Karaganda Energy Centre, Kazakhstan.

Energy Monitoring Report (2011). Aktobe Oil, Kazakhstan.

Environmental monitoring. Industrial self and compliance monitoring. EU - Russia Cooperation Programme on Harmonisation of Environmental Standards. Moscow, November 2009.

EN 14212: 2005. Ambient air quality — Standard method for the measurement of the concentration of sulphur dioxide by ultraviolet fluorescence.

EN 14211: 2005. Ambient air quality — Standard method for the measurement of the concentration of nitrogen dioxide and nitrogen monoxide by chemiluminescence.

EN 14626: 2005. Ambient air quality — Standard method for the measurement of the concentration of carbon monoxide by non-dispersive infrared spectroscopy.

EN 14625: 2005. Ambient air quality — Standard method for the measurement of the concentration of ozone by ultraviolet photometry.

EN 12341: 1999. Air Quality — Determination of the PM10 fraction of suspended particulate matter — Reference method and field test procedure to demonstrate reference equivalence of measurement methods.

EN 14907: 2005. Standard gravimetric measurement method for the determination of the PM2.5 mass fraction of suspended particulate matter.

EN 14662: 2005. Ambient air quality — Standard method for measurement of benzene concentrations - Part 3: Automated pumped sampling with in situ gas chromatography.

EN 14902: 2005. Standard method for measurement of Pb/Cd/As/Ni in the PM10 fraction of suspended particulate matter.

EN 15841: 2009. Ambient air quality - Standard method for determination of arsenic, cadmium, lead and nickel in atmospheric deposition.

EN 14884: 2005-12. Air quality – Stationary source emissions – Determination of total mercury: Automated measuring systems.

EN 15549: 2008-03. Air quality – Standard method for he measurement of the concentration of benzo[a]pyrene in ambient airrEN 15980:2009-07: Air quality – Determination of the deposition of benz[a]anthracene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenz[a,h]anthracene and indeno[1,2,3-cd]pyrene.

GUM, 2009. Guide to the expression of uncertainty in measurements (GUM). International Organization for Standardization, ISO, pp 101.

Ministry of Environmental Protection of the Republic of Kazakhstan, 2010. State of Environment of Kazakhstan. Identification of socio-economic factors and conditions that impact on air pollution. Kazakhstan.

INSPIRE directive, 2011. Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) 14.03.2007.

IPR directive, 2011. COMMISSION IMPLEMENTING DECISION of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (notified under document C(2011) 9068)(2011/850/EU). Available at: http://rod.eionet.europa.eu/instruments/650

Ismagulova, G., 2012. Resource Efficiency Gains and Green Growth Perspectives in Kazakhstan.Friedrich Edberg Stiftung.

ISO 17025, 2005. General requirements for the competence of testing and calibration laboratories.

ISO-13964, 1998(E). Air Quality – Determination of Ozone in Ambient air – Ultraviolet Photometric Method.

ISO/DIS 10498, 2004. Ambient air -- Determination of sulphur dioxide - Ultraviolet fluorescence method

ISO 7996, 1985. Ambient air -- Determination of mass concentration of nitrogen oxides Chemiluminescence method.

ISO 4224, 2000. Ambient air -- Determination of carbon monoxide -- Non- dispersive infrared spectrometric method.

ISO 6144, 2003. Gas analysis – Preparation of calibration gas mixtures – Static volumetric method.

ISO 6145-6, 1986. Gas Analysis – Preparation of calibration gas mixtures – Dynamic volumetric methods - Part 6: Sonic orifices.

ISO 6145-7, 2001. Preparation of calibration gas mixtures using volumetric methods: Part 7. Thermal mass-flow controllers.

ISO 6145-7, 2001. Preparation of calibration gas mixtures using dynamic volumetric methods - Part 10: Permeation method.

EN ISO 20988:2007. Air Quality. Guidelines for estimating measurement uncertainty.

KAZHIDROMET, 2010. Information Bulletin on the State of the Environment in the Republic of Kazakhstan for 2010. Ministry of the Environmental Protection of the Republic of Kazakhstan, Department of the Environmental Monitoring (in Russian). 215 pages http://www.Kazhidromet.kz/ru/monitor_beluten_arhiv2010

KAZHIDROMET, 2011. Information Bulletin on the State of the Environment in the Republic of Kazakhstan for 2011. Ministry of the Environmental Protection of the Republic of Kazakhstan, Department of the Environmental Monitoring (in Russian). 215 pages http://www.Kazhidromet.kz/ru/monitor_beluten_arhiv2011

KAZHIDROMET, 2012. Information Bulletin on the State of the Environment in the Republic of Kazakhstan for 2012. Ministry of the Environmental Protection of the Republic of Kazakhstan, Department of the Environmental Monitoring (in Russian). 215 pages. http://www.Kazhidromet.kz/ru/monitor_beluten_arhiv2012

López, J. G., T. Sterner, and S. Afsah, 2004. Public Disclosure of Industrial Pollution: The PROPER Approach for Indonesia? Resources for the Future, Discussion Paper 04–34, Washington, DC.

NAAQS, 2011. National Ambient Air Quality Standards (NAAQS), United States, Environmental Protection Agency (EPA).
Available at: http://www.epa.gov/air/criteria.html and links therein.

OECD, 2000. Reforming Environmental Finance Institutions in Kazakhstan, Conclusions and Recommendations from the Performance Review of the Kazakh State Environmental Protection Fund, OECD EAP Task Force Secretariat. Twelfth Meeting of the EAP Task Force, 18-19 October 2000, Almaty, Kazakhstan. Available at: http://www.oecd.org/countries/kazakhstan/35155230.pdf.

OECD, 2005. Integrated Environmental Permitting Guidelines for EECCA Countries. Paris, France. Available at: http://www.oecd.org/env/outreach/35056678.pdf.

OECD, 2006. Modernising Environmental Self-control by Industrial Operators in Kazakhstan. Policy recommendations. OECD EAP Task Force Secretariat.

OECD, 2006a. Transition to Integrated Environmental Permitting in Georgia: Case Study. Paris, France. Available at: http://www.oecd.org/env/outreach/37123143.pdf.

OECD, 2006b. Transition to Integrated Environmental Permitting in the Kyrgyz Republic: Case Study. Paris, France. Available at: http://www.oecd.org/env/outreach/37123553.pdf.

OECD, 2007. Guiding Principles of Effective Environmental Permitting Systems. Paris, France. Available at: http://www.oecd.org/env/outreach/37311624.pdf.

OECD, 2009. Avenues for Improved Response to Environmental Offenses in Kazakhstan. Paris, France. Available at: http://www.oecd.org/countries/kazakhstan/42072582.pdf.

OECD, 2013. Average annual hours actually worked per worker
Available at: http://stats.oecd.org/Index.aspx?DatasetCode=ANHRS (Data extracted on 13 Aug 2013 from OECD Stat).

Official internet-resource of Almaty City Mayoralty.
Available at: http://ns.almaty.kz/page.php?page_id=1808&lang=2

Shabanova, L., G. Iskanderova, A. Seralieva, 2011. Information – Analytics Centre of the Ministry of Environmental Protection of the Republic of Kazakhstan. Experience of Kazakhstan in the development of the PRTR (Powerpoint presentation).

TRACE ELEMENTS and PAH directives, 2004. Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic hydrocarbons in ambient air. Available at: http://rod.eionet.europa.eu/instruments/606

UNECE, 2007. Guidance on Implementation of the Protocol on Pollutant Release and Transfer Registers. ECE/MP.PP/7 United Nations Economic Commission for Europe.

UNEP 2012. Status of Fuel Quality and Vehicle Emission Standards: East Europe, the Caucasus, Central Asia.
http://www.unep.org/transport/pcfv/PDF/Maps_Matrices/CEE/matrix/CEE_combined_March2012.pdf

World Bank, 2012. Modern Companies, Healthy Environment, Improving industrial competitiveness through potential of cleaner and greener production. Joint Economic Research Programme (JERP). Report 73471. July, 2012, 71 pages.

World Bank, 2007. International Finance Corporation: World Bank Group, Environmental, Health, and Safety (EHS) Guidelines. Available at: http://www1.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/sustainability+framework/environmental%2C+health%2C+and+safety+guidelines/ehsguidelines

World Bank, 2006. Minimizing Environmental Impacts of Industrial Growth: Case study of petrochemical industry in Kazakhstan, World Bank, Washington: DC. Available at: http://documents.worldbank.org/curated/en/2006/02/16375605/kazakhstan-minimizing-environmental-impacts-industrial-growth-case-study-petrochemical-industry-kazakhstan

WHO, 2005. Air Quality Guidelines Global Update 2005, World Health Organization (WHO) Regional Office for Europe, 2006, ISBN 92-890-2192-6. Available at: http://www.euro.who.int/__data/assets/pdf_file/0005/78638/E90038.pdf.

Annex 1. Best international practices on designing air quality monitoring networks[47]

General aspects

The planning and installation of an air quality monitoring network (AQMN) is an important task for environmental protection authorities. Authorities need to plan and set up a well-targeted AQMN, both systematically and in a cost-effective manner. Defining the objectives for measurement will influence network design and optimize resources used for monitoring. It will also ensure that the network is specially designed to optimize information on the key issues at hand.

The main objectives for the development of an air quality measurement and surveillance program might be related to:

- Population exposure and health impact assessment
- Identifying risks to natural ecosystems
- Identifying and attributing pollution to different sources
- Ensuring that industrial emission sources comply with their environmental permits
- Determining compliance with national or international Air Quality standards
- Informing the public about air quality and establishing alert systems
- Providing objective input to air quality management and to transport, land-use and industrial planning
- Developing policies and setting priorities for management action
- Developing and validating management tools such as models and geographical information systems
- Quantifying trends to identify future problems or progress in achieving management or control targets.

It is difficult for any single AQMN to cover all of these objectives and so in practice each network needs to be tailored according to local and national needs, focus and limitations. Often this dilemma is resolved by a country-wide air quality monitoring consisting of a number of sub-networks with different objectives and administrators. This way, for example, networks with national, urban or industry-related objectives can be established with the most appropriate configuration. However, to guarantee the representativeness and comparability of results, it is important that all these sub-networks utilize the same standardized measurement methods and siting criteria, follow the same operating and maintenance routines and quality objectives and use the same quality management principles.

The basic elements of the design of AQMN are quite universal (Figure 41). Input information on activities and emissions in the study area as well as resulting atmospheric pollutants, is necessary. Information on population, land use, topography and meteorology is also needed for the identification of objects for protection and to estimate the dispersion of pollutants. In the optimal case there are some existing monitoring data and dispersion model results on which authorities can base their air quality assessment and further the monitoring network design; otherwise the design must be based on expert evaluation using initial informational inputs. Other boundary conditions to the design of AQMN come from national environmental policy and goals and existing air quality standards (Figure 41). In developed countries (e.g. U.S. and member states of the EU) AQ

[47] This note was prepared by the Finnish Meteorological Institute (FMI: Finland) and the World Bank as part of the Joint Economic Research Program (JERP) between the Government of the Republic of Kazakhstan and the World Bank.

legislation sets very detailed rules for AQ monitoring; where and when monitoring should begin and which compounds and methods should be used (e.g. AQ directive, 2008; TRACE ELEMENTS and PAH directive 2004; NAAQS 2011). In developing countries, this legal framework may be inadequate or missing – and a gaps analysis should be performed to harmonize existing systems with those of best international practice. International organizations have also developed useful AQ guidance focused on their own expert areas; for example the WHO on health-related air pollution issues (e.g. WHO 2005) and the World Bank on best AQ practices for industrial facilities (e.g. World Bank 2007).

In each country the development of the AQMN(s) and the supporting legal framework should be viewed as converging processes which can benefit from the adoption of existing successful approaches.

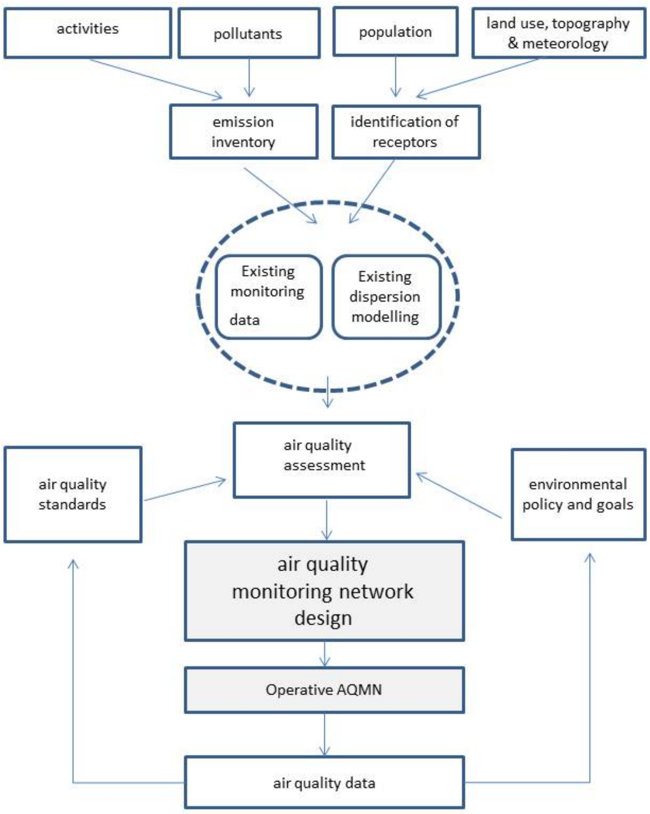


Figure 41. Diagram of the designing of an air quality monitoring network

The basic elements of an operative AQMN

The basic elements of an operative AQMN include measurement sites and components; measurement methods and equipment; quality assurance and quality control; maintenance and repair; communication, data analysis and management; and organization, staff and financial management. The following sections briefly summarize these areas with examples from successful international practices.

Selection of measurement sites and components

The design of the air quality monitoring network basically involves determining the number of stations and their location, environmental parameters to be monitored and monitoring methods, with a view to the objectives, costs and available resources. A typical approach to network design, appropriate over the city-wide or national scale, involves placing monitoring stations or sampling points at carefully selected representative locations, chosen on the basis of required data and known emission/dispersion patterns of the pollutants under study. This approach will produce a cost effective air quality monitoring program. In practice, the operation and maintenance of air quality monitoring stations are expensive, so it is desirable to use as few stations as possible to meet monitoring goals. Moreover, modeling and other objective assessment techniques may need to be utilized to supplement basic information.

Another consideration in the basic approach to the network design is the scale of the air pollution problem:

- Air pollution that is significant at a local scale (c. 1 – 20 km). Typical locally significant emission source categories are, for example, small scale combustion and traffic due to their near surface level emissions. Pollutants related to these sources include nitrogen oxides (NO_2), sulphur dioxide (SO_2), particulate matter smaller than 10 μm (PM_{10}), particulate matter smaller than 2.5 μm ($PM_{2.5}$), carbon monoxide (CO), organic compounds (VOCs and PAHs) and trace elements. Also industries may have locally significant sector-specific emissions like sulphur dioxide (SO_2), particulate matter, hydrogen sulfide (H_2S), organic compounds (VOCs and PAHs) and trace elements. In this case, the network should be concentrated within urban, residential or industrial areas. The sites should be located so that the hot spot and actual range of pollution will be detected.

- There is a significant regional contribution to the problem. A typical example of this category is ozone (O3) - which is formed photo-chemically in the atmosphere from traffic and industrial emissions. This formation may take several hours and may cause the highest concentrations at a distance of several hundred kilometers from the source. Another example of regional pollution is the long range transported fine particles $PM_{2.5}$. These pollutants contribute significantly to large-scale regional pollution phenomena, such as winter or summer smog episodes or dust clouds. For these pollutants the network should also cover the rural background and even remote background areas – to serve as benchmarks for calibration and urban comparisons.

The number, location and instrumentation of monitoring sites will depend upon monitoring objectives, the size and topography of the impacted area, population and the complexity and severity of emissions source(s) (installations). In addition to these detailed site- and component-specific assessments there may be some general rules for the establishment of a monitoring site. Most commonly these rules are linked to specified concentration thresholds. For example, the

European Union (EU) sets certain upper and lower assessment thresholds to assess whether or not a continuous monitoring at a site is mandated. Both the U.S. EPA and EU provide specifications for the minimum number of stations to be established depending upon the size of exposed population or ecosystem. For example, the EU territories of each Member State are classified into zones or agglomerations reflecting population density. In agglomerations with population higher than 250 000, there are more stringent criteria for the number of required monitoring sites and measurement configurations (for more details see Annex 1. Best international practices on designing air quality monitoring networks and Annex 2. EU criteria for the siting of AQ monitoring sites.

These general rules are usually component specific. As an example, the EU requires that a minimum of one rural background station be installed every 100 000 km^2 for measuring $PM_{2.5}$ and PAHs. The U.S. EPA requires a minimum of one NO_2 monitor be placed in any urban area with a population greater than 1 million people to assess community-wide concentrations. Further, at least one NO_2 monitor must be located near major roads in any urban area with a population greater than 500 000 people.

Industrialized areas also require a highly specialized setup of AQ monitoring derived from the environmental impact assessment/environmental permitting procedure. In the absence of any supporting legal framework - AQ monitoring needs should be assessed at a facility-level or through another systematic approach (see e.g. World Bank 2007).

The examples above show that monitoring station siting and the design of its measurement configuration is a complex task and requires taking into consideration many different issues. However, depending on the monitoring objective, it is extremely important to select the siting of monitoring stations appropriately. Siting has a direct bearing on the ability to use monitoring information in assessing compliance in the specific area and to obtain further information on exposure and source apportionment which supports the development of air policy and air pollution management in the area.

Measurement methods, quality control and quality assurance, maintenance and repair

The objectives of the air quality monitoring program help define data quality objectives (DQO), the design of the monitoring network for specific pollutants and monitoring methods. The quality system for measurement should be planned in such a way that it will cover the entire area of activities and it should fit the purpose of achieving data quality objectives. The ultimate purpose of monitoring is not merely to collect data but to provide information required for policy-makers and any other authorities and experts from public institutes, industry and research that may need information (e.g. to be able to make informed decisions on managing and improving the environment).

Monitoring fulfills a central role in this process, providing the necessary sound scientific basis for developing policies and strategies, setting objectives and assessing the state of environment.

To achieve data quality objectives it is required that:

- The measurement methods are standardized methods (reference methods)
- The measurements are traceable to national standards or directly to SI units (International System of Units)

- The uncertainty of measurement results can be expressed following the guidelines by ISO (International Standards Organization)
- The resources (funds, facilities, personnel, technical skills) are adequate to be able to maintain measurement instruments within design parameters

The directive on ambient air quality and cleaner air for Europe (AQ directive, 2008) defines data quality objectives for fixed/continuous measurements and for indicative measurements (campaigns) for all regulated pollutants. The DQO also includes uncertainty, minimum data capture and minimum time coverage.

One important aspect for measurement results are their comparability with other measurements within the same network, but also internationally. The key issue is that standardized measurement methods are used, that the measurement results are traceable to recognized standards (national or international standards or directly to SI units through the primary method of measurement) and that there are inter-laboratory comparisons. The EU organizes, in collaboration with the WHO, joint inter-laboratory comparisons for nationally-responsible laboratories. These comparisons are ongoing events (e.g. AQUILA N37, 2008) on an annual basis and are arranged at the Joint Research Centre (JRC) in Ispra, Italy and at the Umweltbundesamt (UBA) in Langen, Germany.

The best way to provide traceability to measurement results is through a calibration laboratory, preferably a national reference laboratory (NRL). The premises, facilities, resources and personnel of the NRL should be adequate enough to maintain and to provide traceability (i.e. to provide calibration services to all measurement equipment in the network). There are a number of calibration methods that can be used for this purpose (ISO 6144, ISO 6145 part 6, 7, 10). The calibration concentrations provided by the NRL should be linked to SI units through national or international standards with known uncertainty limits calculated according to ISO guidelines or similar (e.g. GUM 2009; EN20988). In Annex 3 a schematic presentation on establishing the traceability chain to air quality measurement results together with the propagation of uncertainty bounds is given. The EU AQ directive requires traceability in a manner defined by ISO 17015 for all measurement results conducted to assess air quality. The task and responsibilities of the NRL are defined in AQ directive in Article 3 and in Annex 1 of Section C. In addition the forum of National Reference Laboratories (AQUILA) under the EC has prepared a document on the role and responsibilities of the NRL to give a wider view of all activities that may be connected to the NRL (AQUILA 2009).

Pollutants that need to be measured, especially in urban areas, are nitrogen oxides (NO and NO_2), sulphur dioxide (SO_2), particulate matter smaller than 10 μm (PM_{10}), particulate matter smaller than 2.5 μm ($PM_{2.5}$), carbon monoxide (CO), organic compounds (VOC, PAH), ozone (O_3) and trace elements. Especially in the case of VOCs - a careful assessment of monitored compounds must be made in terms of the benefits and costs. A similar evaluation should be made for TRACE ELEMENTS and PAH measurements at industrial sites. The ISO has prepared standards on methods applied for each of these compounds (ISO 13964, ISO 10498, ISO 7996, ISO 4224). In addition the European Committee for Standardization (CEN) has prepared standards for each of the pollutants that have limit values (EN 14211, EN14212, EN14625, EN14626, EN 12341, EN 14907, EN14662, part3). The CEN standards include: the measurement method, a scheme for appropriate instruments that apply the method, field operation and ongoing quality control procedures (QA/QC), expression of results and complete guidance on the calculation of uncertainty in field operations. The ongoing QA/QC procedures given in the standards are detailed and sufficient and their frequency is good enough to ensure that analyzers are working correctly. In addition the maintenance of analyzers needs to be conducted according to the manufacturer’s instructions. To

manage these tasks the NRL or similar need to have facilities and be organized as shown in Annex 4. Traceability chain and the propagation of expanded uncertainty.

The member state of EU can also use any other measurement method so long as it can demonstrate the provision of equivalent results to the reference method. The EC has prepared a guide to be followed for testing candidate methods against reference methods (DoE, 2010). In the case of particulate matter - continuous particle analyzers are commonly used for the measurement of particle mass concentrations in ambient air across Europe. A number of equivalence studies by member states have also been conducted in Europe for a large variety of PM-analyzers. Each competent authority or NRL needs to approve test results for instruments used as a substitute. Full equivalence test reports can be downloaded from the database provided by the AirMonTech project (http://db-airmontech.jrc.ec.europa.eu/pollutantSearch.aspx?pol_id=50).

The accreditation of the quality system (QA/QC) is one important way to prove competence of the NRL. It is also required by the AQ directive that NRLs be accredited according to ISO 17025 for reference methods. There are not any requirements that measurements at the monitoring site be accredited. However, there is a requirement that the QA/QC procedures be established for data collection and reporting. In the case of emission measurements from stationary sources - accreditation should be required as proof of expertise and capability for the task since sampling and sample treatment is a very crucial process.

For the chemical analyses of trace elements and organic compounds, a chemical laboratory should be established along with an accreditation process. The laboratory should be capable of preparing and cleaning sampling equipment (i.e. filters and precipitation samplers), preparing samples for chemical analysis and conducting chemical analyses according to standard operating procedures. The laboratory should be equipped with instruments suitable for sample preparation and chemical analysis for the components required by regulation (or directives in the case of the EU). First, an investment plan needs to be established and necessary equipment purchased. A comprehensive plan for establishing a quality management system for the chemical laboratory in order to fulfill accreditation requirements also needs to be prepared. After the laboratory is established, all instrument performance should be tested and standard operation procedures be created for all operations in the laboratory. The laboratory personnel should also be trained in the operation and to follow the QA/QC program of the laboratory.

Communication, data analysis, management and assessment

Once a measurement site is operative, a data center has to be established. This center is typically responsible for data validation, processing, communication and archiving. Depending on the organizational structure of a country’s network, there may be one data center for each network or there may be specialized data centers with different responsibilities. However, it is necessary to have one final national database for national assessment purposes. For example, the U.S. EPA collects all monitoring data from the States’ networks and annually evaluates nationwide AQ trends and (non)-attainment areas. The European Union collects data from Member states for union-wide assessments. Equally important are the local assessments conducted by local environmental authorities that focus on locally-significant objectives (or pollutants). An important part of the annual assessments is also the environmental reports of enterprises themselves.

Today a great majority of AQ monitoring is conducted with real-time-resolution, automatic analyzers applying direct first-order, on-line quality controls. This means that measured concentrations can be readily communicated to the public as well as other users via the Internet.

Open sharing of real-time information to the public is one of the major goals of air pollution monitoring today (and also forms the basis of environmental compliance with the Aarhus Convention).[48] This information should be processed into a useable and understandable format (e.g. by using an Air Quality Index concept). Examples include: the U.S.: http://airnow.gov; Europe: http://www.eea.europa.eu/themes/air/air-quality/map/real-time-map ; Finland: www.ilmanlaatu.fi and FYR Macedonia: http://airquality.MEWRp.gov.mk/airquality/.

To enable these various data transfers effectively, timely and reliably - the data management systems of AQMNs must be kept up-to-date. The EU is now in the transition process towards a new, advanced integrated GIS-based system for reporting and sharing ambient air quality data and information, called e-Reporting (IPR directive 2011; INSPIRE directive 2011). This new system will modernize data reporting, improve data quality, facilitate information sharing and reduce the administrative burden of reporting.

Organization, staff and finance management

Efficient air quality management requires defining organizational responsibilities for monitoring and related activities. At the national level, the responsible authority for producing reliable information on air quality is often defined by legislation, for example by the state institution responsible for the background monitoring network while municipalities or regions have the responsibility of air quality measurements in cities and towns in their administrative territories. In addition, polluting industries may be required to perform periodic measurements through the environmental permitting process. The responsibilities for different parts of air quality management include the allocation of sufficient experienced personnel for tasks which are defined within the organization performing the measurements.

Staff requirements largely depend on the size of the monitoring network. The operation of a comprehensive national air quality network requires a number of experienced staff with specific responsibilities related to the different parts of air quality management (e.g. maintenance and calibration, data management and reporting, chemical analyses, etc.). For the most part, tasks related to air quality monitoring require personnel with higher education with additional training related to the specific task. The complexity of monitoring and related tasks requires continuous development and training of staff - for example by taking part in international conferences, workshops, inter-comparison exercises, study tours, etc.

The establishment and operation of an efficient air quality network requires significant funding and therefore it is important to consider not only the initial investment but also the annual costs of network operation. The initial cost of a monitoring station varies significantly depending of the pollutants to be monitored. A monitoring station which measures wide range of pollutants (NO/NO_2, O_3, SO_2, CO, PM_{10}, $PM_{2.5}$, BTX) can be estimated to cost approximately 150 000 to 200 000 euros. The annual operational costs can be estimated to be approximately 15-20 % of investment costs. The operational costs strongly depend on for example on size and complexity of network, the pollutants to be measured and techniques to be used, organization and salary level in the country.

Careful planning and network optimization is crucial in avoiding unnecessary costs of an oversized monitoring network. Initial investments for monitoring equipment and setting up stations, laboratory calibration and the development of a chemical laboratory for analysis can be high, but

[48] The UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (also known as the Aarhus Convention).

the more common mistake during planning is to underestimate operating costs – including spare parts and consumables, calibration gases, spare instruments, personnel and maintenance costs, utility costs, data communication and electricity costs. Therefore ensuring the financial sustainability of the network is one of the most important aspects to designing an air quality monitoring network. Operating costs are normally covered by the organization responsible for monitoring, depending on the legal regulations of the country. Often the state has the responsibility of maintaining the national air quality monitoring network and related costs, which may cover part or all of the air quality measurements done in the country. In addition, other stakeholders may be required, or voluntarily, perform measurements mainly in municipalities, or by polluting industries or research organizations where the costs of overall monitoring are divided. In some countries costs of the national air quality monitoring network operated by the state is shared by several stakeholders.

Annex 2. EU criteria for the siting of AQ monitoring sites
(AQ directive, 2008)

Assessment of ambient air quality and location of sampling points for the measurement of sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (PM_{10} and $PM_{2,5}$), lead, benzene and carbon monoxide in ambient air

A. **General**

Ambient air quality shall be assessed in all zones and agglomerations in accordance with the following criteria:

1. Ambient air quality shall be assessed at all locations except those listed in paragraph 2, in accordance with the criteria established by Sections B and C for the location of sampling points for fixed measurement. The principles established by Sections B and C shall also apply in so far as they are relevant in identifying the specific locations in which concentration of the relevant pollutants are established where ambient air quality is assessed by indicative measurement or modelling.

2. Compliance with the limit values directed at the protection of human health shall not be assessed at the following locations:

(a) any locations situated within areas where members of the public do not have access and there is no fixed habitation;

(b) in accordance with Article 2(1), on factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply;

(c) on the carriageway of roads; and on the central reservations of roads except where there is normally pedestrian access to the central reservation.

B. **Macroscale siting of sampling points**

1. Protection of human health

(a) Sampling points directed at the protection of human health shall be sited in such a way as to provide data on the following:

— the areas within zones and agglomerations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value(s),

— levels in other areas within the zones and agglomerations which are representative of the exposure of the general population,

(b) Sampling points shall in general be sited in such a way as to avoid measuring very small micro-environments in their immediate vicinity, which means that a sampling point must be sited in such a way that the air sampled is representative of air quality for a street segment no less than 100 m length at traffic-orientated sites and at least 250 m × 250 m at industrial sites, where feasible;

(c) Urban background locations shall be located so that their pollution level is influenced by the integrated contribution from all sources upwind of the station. The pollution level should not be dominated by a single source unless such a situation is typical for a larger urban area. Those sampling points shall, as a general rule, be representative for several square kilometres;

(d) Where the objective is to assess rural background levels, the sampling point shall not be influenced by agglomerations or industrial sites in its vicinity, i.e. sites closer than five kilometres;

(e) Where contributions from industrial sources are to be assessed, at least one sampling point shall be installed downwind of the source in the nearest residential area. Where the background concentration is not known, an additional sampling point shall be situated within the main wind direction;

(f) Sampling points shall, where possible, also be representative of similar locations not in their immediate vicinity;

(g) Account shall be taken of the need to locate sampling points on islands where that is necessary for the protection of human health.

2. Protection of vegetation and natural ecosystems

Sampling points targeted at the protection of vegetation and natural ecosystems shall be sited more than 20 km away from agglomerations or more than 5 km away from other built-up areas, industrial installations or motorways or major roads with traffic counts of more than 50 000 vehicles per day, which means that a sampling point must be sited in such a way that the air sampled is representative of air quality in a surrounding area of at least 1 000 km^2. A Member State may provide for a sampling point to be sited at a lesser distance or to be representative of air quality in a less extended area, taking account of geographical conditions or of the opportunities to protect particularly vulnerable areas.

Account shall be taken of the need to assess air quality on islands.

C. **Microscale siting of sampling points**

In so far as is practicable, the following shall apply:

— the flow around the inlet sampling probe shall be unrestricted (free in an arc of at least 270°) 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 shall be between 1,5 m (the breathing zone) and 4 m above the ground. Higher positions (up to 8 m) may be necessary in some circumstances. Higher siting may also be appropriate if the station is representative of a large area,

— the inlet probe shall not be positioned in the immediate vicinity of sources in order to avoid the direct intake of emissions unmixed with ambient air,

— the sampler's exhaust outlet shall be positioned so that recirculation of exhaust air to the sampler inlet is avoided,

— for all pollutants, traffic-orientated sampling probes shall be at least 25 m from the edge of major junctions and no more than 10 m from the kerbside.,

The following 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.,

D. **Documentation and review of site selection**

The site-selection procedures shall be fully documented at the classification stage by such means as compass-point photographs of the surrounding area and a detailed map. Sites shall be reviewed at regular intervals with repeated documentation to ensure that selection criteria remain valid over time.

Annex 3. EU guidance for determining minimum number of AQ monitoring sites (AQ directive, 2008).

Criteria for determining minimum numbers of sampling points for fixed measurement of concentrations of sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (PM_{10}, $PM_{2,5}$), lead, benzene and carbon monoxide in ambient air

A. Minimum number of sampling points for fixed measurement to assess compliance with limit values for the protection of human health and alert thresholds in zones and agglomerations where fixed measurement is the sole source of information

1. *Diffuse sources*

Population of agglomeration or zone (thousands)	If maximum concentrations exceed the upper assessment threshold (1)		If maximum concentrations are between the upper and lower assessment thresholds	
	Pollutants except PM	PM (2) (sum of PM_{10} and $PM_{2,5}$)	Pollutants except PM	PM (2) (sum of PM_{10} and $PM_{2,5}$)
0-249	1	2	1	1
250-499	2	3	1	2
500-749	2	3	1	2
750-999	3	4	1	2
1 000-1 499	4	6	2	3
1 500-1 999	5	7	2	3
2 000-2 749	6	8	3	4
2 750-3 749	7	10	3	4
3 750-4 749	8	11	3	6
4 750-5 999	9	13	4	6
≥ 6 000	10	15	4	7

(1) For nitrogen dioxide, particulate matter, benzene and carbon monoxide: to include at least one urban background monitoring station and one traffic-orientated station provided this does not increase the number of sampling points. For these pollutants, the total number of urban-background stations and the total number of traffic oriented stations in a Member State required under Section A(1) shall not differ by more than a factor of 2. Sampling points with exceedances of the limit value for PM_{10} within the last three years shall be maintained, unless a relocation is necessary owing to special circumstances, in particular spatial development.

(2) Where $PM_{2,5}$ and PM_{10} are measured in accordance with Article 8 at the same monitoring station, these 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, and the number of $PM_{2,5}$ sampling points in the urban background of agglomerations and urban areas shall meet the requirements under Section B of Annex V.

2. *Point sources*

For the assessment of pollution in the vicinity of point sources, the number of sampling points for fixed measurement shall be calculated taking into account emission densities, the likely distribution patterns of ambient-air pollution and the potential exposure of the population.

B. Minimum number of sampling points for fixed measurement to assess compliance with the $PM_{2,5}$ exposure reduction target for the protection of human health

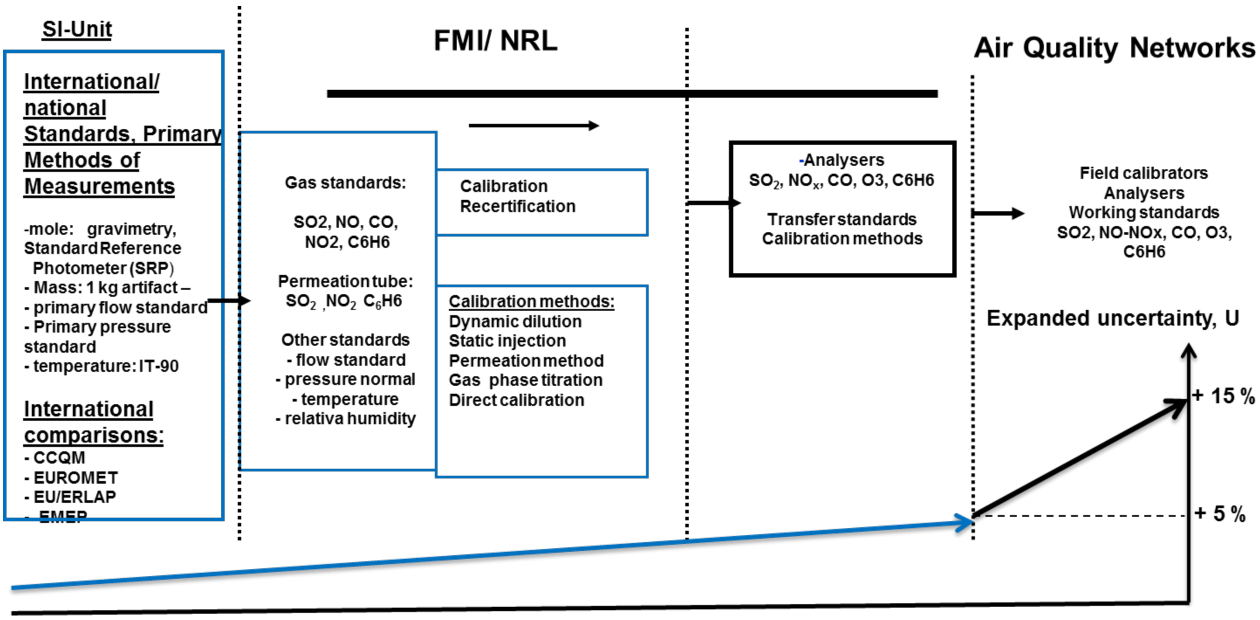
One sampling point per million inhabitants summed over agglomerations and additional urban areas in excess of 100 000 inhabitants shall be operated for this purpose. Those sampling points may coincide with sampling points under Section A.

C. Minimum number of sampling points for fixed measurements to assess compliance with critical levels for the protection of vegetation in zones other than agglomerations

If maximum concentrations exceed the upper assessment threshold	If maximum concentrations are between upper and lower assessment threshold
1 station every 20 000 km^2	1 station every 40 000 km^2

In island zones the number of sampling points for fixed measurement should be calculated taking into account the likely distribution patterns of ambient-air pollution and the potential exposure of vegetation.

Annex 4. Traceability chain and the propagation of expanded uncertainty
from SI units through the NRL to the air quality network for gaseous components: SO_2, CO, NO, NO_2, O_3, C_6H_6



Annex 5. Inventory of Relevant Regulations

List of Regulations that govern the division of production facilities according to environmental impacts:

- Экологический кодекс: ст. 40 Классификация объектов оценки воздействия на окружающую среду по значимости и полноте оценки; ст. 71 Категории объектов, требующих получения разрешений на эмиссии в окружающую среду.
- Санитарные правила «Санитарно-эпидемиологические требования к зданиям и сооружениям производственного назначения», утверждены постановлением Правительства Республики Казахстан от 17 января 2012 года № 93.
- Постановление Правительства Республики Казахстан от 31 марта 2009 года № 449 «Об утверждении критериев распределения объектов I категории, подлежащих государственной экологической экспертизе, и для выдачи разрешений на эмиссии в окружающую среду между уполномоченным органом в области охраны окружающей среды и его территориальными подразделениями»
- Постановление Правительства Республики Казахстан от 4 февраля 2008 года № 95 «Об утверждении Правил выдачи комплексных экологических разрешений и перечня типов промышленных объектов, для которых возможно получение комплексных экологических разрешений вместо разрешений на эмиссии в окружающую среду»
- Приказ Министра охраны окружающей среды Республики Казахстан от 23 июля 2009 года № 143-О «О распределении объектов I категории, подлежащих государственной экологической экспертизе, и для выдачи разрешений на эмиссии в окружающую среду между уполномоченным органом в области охраны окружающей среды и его территориальными подразделениями»

List of Regulations that govern environmental permitting process:

- Экологический кодекс.
- Постановление Правительства Республики Казахстан от 4 февраля 2008 года № 95 «Об утверждении Правил выдачи комплексных экологических разрешений и перечня типов промышленных объектов, для которых возможно получение комплексных экологических разрешений вместо разрешений на эмиссии в окружающую среду»
- Постановление Правительства Республики Казахстан от 31 марта 2009 года № 449 «Об утверждении критериев распределения объектов I категории, подлежащих государственной экологической экспертизе, и для выдачи разрешений на эмиссии в окружающую среду между уполномоченным органом в области охраны окружающей среды и его территориальными подразделениями»
- Приказ Министра охраны окружающей среды Республики Казахстан от 23 июля 2009 года № 143-О «О распределении объектов I категории, подлежащих государственной экологической экспертизе, и для выдачи разрешений на эмиссии в окружающую среду между уполномоченным органом в области охраны окружающей среды и его территориальными подразделениями»

List of Regulations for Integrated Permits:

- Экологический кодекс (ст. 70, 79).
- Правила выдачи комплексных экологических разрешений были утверждены Постановлением Правительства РК № 95 от 4 февраля 2008 года

- Постановление Правительства Республики Казахстан от 8 августа 2012 года № 1033 «Об утверждении стандартов государственных услуг в области охраны окружающей среды, оказываемых Министерством охраны окружающей среды Республики Казахстан и местными исполнительными органами»
- Приказ Министра охраны окружающей среды Республики Казахстан от 7 мая 2007 года № 135-п «Об утверждении Правил проведения общественных слушаний»

List of Regulations Governing Setting Emission Limit Values:

- Экологический кодекс: ст. 25 Нормативы эмиссий; ст. 26 Технические удельные нормативы эмиссий; ст. 27 **Нормативы предельно допустимых выбросов и сбросов загрязняющих веществ, нормативы размещения отходов производства и потребления;** ст. 28 Порядок определения нормативов эмиссий.
- Методика определения нормативов эмиссий в окружающую среду, Приложение к приказу Министра охраны окружающей среды Республики Казахстан от «16» апреля 2012 г. № 110-Ө.
- РНД 211.2.02.02-97 «Рекомендации по оформлению и содержанию проектов нормативов предельно допустимых выбросов в атмосферу (ПДВ) для предприятия».
- Постановление Правительства Республики Казахстан № 168 от 25 января 2012 года **«Об утверждении Санитарных правил «Санитарно-эпидемиологические требования к атмосферному воздуху в городских и сельских населенных пунктах, почвам и их безопасности, содержанию территорий городских и сельских населенных пунктов, условиям работы с источниками физических факторов, оказывающих воздействие на человека»**
- "Требования к эмиссиям в окружающую среду при сжигании различных видов топлива в котлах тепловых электрических станций" (Постановление Правительства Республики Казахстан от 14 декабря 2007 г, № 1232);
- "Требования к эмиссиям в окружающую среду при производстве ферросплавов" (Постановление Правительства Республики Казахстан от 26 января 2009 г, № 46);
- "Требования к эмиссиям в окружающую среду при производстве глинозема методом Байер-спекание" (Постановление Правительства Республики Казахстан от 6 августа 2009 года № 1207)
- Постановление Правительства Республики Казахстан от 30 июня 2007 года N 557 «Об утверждении перечня загрязняющих веществ и видов отходов, для которых устанавливаются нормативы эмиссий»
- Постановление Правительства Республики Казахстан № 168 от 25 января 2012 года **«Об утверждении Санитарных правил «Санитарно-эпидемиологические требования к атмосферному воздуху в городских и сельских населенных пунктах, почвам и их безопасности, содержанию территорий городских и сельских населенных пунктов, условиям работы с источниками физических факторов, оказывающих воздействие на человека»**

List of Regulations for Environmental Monitoring:

- Экологический кодекс (глава 14).
- Приказ Министра охраны окружающей среды Республики Казахстан от 14 февраля 2013 года № 16-Ө. Зарегистрирован в Министерстве юстиции Республики Казахстан 14 марта 2013 года

№ 8376 «Об утверждении Требований к отчетности по результатам производственного экологического контроля»

- РНД 211.2.02.02-97 «Рекомендации по оформлению и содержанию проектов нормативов предельно допустимых выбросов в атмосферу (ПДВ) для предприятия»
- РНД 211.3.01.06-97 Руководство по контролю источников загрязнения атмосферы
- СТ РК 1517-2006 Охрана природы. Атмосфера. Метод определения и расчета количества выброса загрязняющих веществ

List of Regulations for Air Pollution Reporting:

- Экологический кодекс
- Закон Республики Казахстан «О государственной статистике» ст. 12

Annex 6. Workshop for pollution prevention, BATs and public access to pollution release information. Astana, 22-24 of May, 2013

Norsk Energi has conducted a workshop for pollution prevention, best environmental techniques and public access pollution release and transfer information for environmental managers from 6 key polluting industries of Kazakhstan, as well as for representatives of environmental regulators. The workshop was hosted by the Ministry of Environment and Water Resources of Kazakhstan (MEWR) and the World Bank.

The main purpose of the workshop was to inform and train Kazakh counterparts on modern approaches for air emissions self-monitoring, pollution prevention and control, as well as in Best Available Techniques (BATs). Representatives of the largest industrial companies in Kazakhstan, including Arselor Mittal Temirtau steelworks, KazakhMys, leading mining and non-ferrous metals group, Energy Centre - large energy company from Karaganda took part in the workshop. These industries could be considered as industry champions for pollution prevention and control and their interest and experience can have significant dissemination and demonstration effects to the rest of the industry.

Pictures from the workshop for industries

Presentations on the following topics were made by Norsk Energi's experts:

- The concept of cleaner production;
- Examples of programs of cleaner production;
- Planning and implementation of cleaner production measures;
- The concept of cleaner production and environmental management system;
- Best available technologies;
- The results of a "quick scan" of industrial facilities in Kazakhstan upon BAT-compliance;
- Government support and regulation of companies to implement "cleaner production" and BAT.

One of the central topics of the workshops was therefore a discussion on how to push and pull in Kazakhstan modern preventative approaches and enable modern integrated permitting procedure, based on integrated pollution prevention and control principle. The participants expressed their

interest and concerns associated with introduction of new, modern systems and approaches. However, most of industry representatives agreed upon that the conventional system is not very effective, as it promotes costly ‘end-of-pipe solutions’ and it does not encourage continual environmental improvements. As one of the participants stated, ‘The conventional system entails too much environmental reporting, thus there is no time for environmental management. Those responsible for the environment in industrial facilities are often engaged just in "paper" work.

An important part of the workshop was a video conference on practical implementation for PRTR in Norway. In Norway, both permits and monitoring reports for each industrial facility are available on the webpage (www.norskeutslipp.no), making it possible to compare actual emissions with the limits given in the permit. The webpage also contains the inspection reports by Norwegian Climate and Pollution Agency. On the webpage it is possible to find both aggregated emissions and emissions at facility level.

This video conference has connected the PRTR developers from the MEWR in Astana with Lars Petter Bingh, PRTR quality responsible at the Norwegian Climate and Pollution Agency in Oslo. During the 2.5 hours, Lars Petter presented and answered several questions on the structure, functions and layout of the Norwegian PRTR system. It is expected that Norsk Energi with the assistance by Norwegian Climate and Pollution Agency the will develop recommendations for collecting and publishing data on the release of pollutants, based on the Norwegian model. These recommendations will help Kazakhstan to meet the requirements of the Kiev protocol.

Video-conference between PRTR developers at MEWR in Astana with the Norwegian Climate and Pollution Agency in Oslo

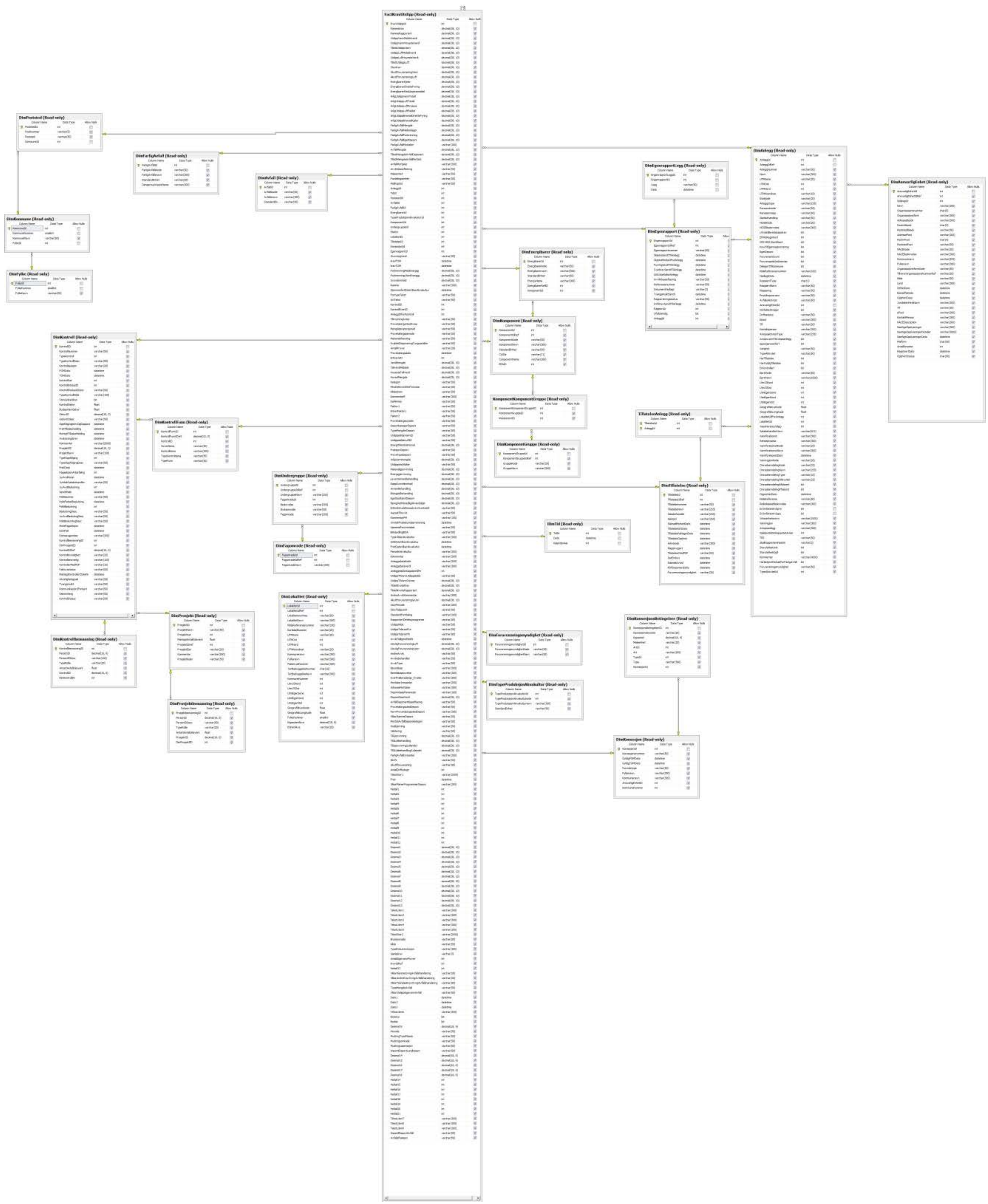
The workshop has been arranged under the framework of the Joint Economic Research Program (JERP), - a cost-sharing arrangement between the World Bank and the Government of Kazakhstan. The Government of Kazakhstan has in 2013 requested to develop policy recommendations on Industrial Green Growth Policy and perform a regulatory assessment to support an Industrial Emissions Registration System that needs to be put in place for Kazakhstan to join the Kiev Protocol of Aarhus convention. Norsk Energi has a central role in the study by preparing a gaps-

analysis between legislation in Kazakhstan, EU Directives and Norway on industrial air pollution, regarding emission limit values, and other environmental indicators, measurement programs, methodologies for calculating environmental fees and examples of subsidy programs for environmental investments by industries.

The workshop was conducted by Sergei Faschevsky from International department and Esben Otterlei Tonning from Environmental department of Norsk Energi, as well as by Dmitriy Laznenko, from Sumy University (Ukraine).

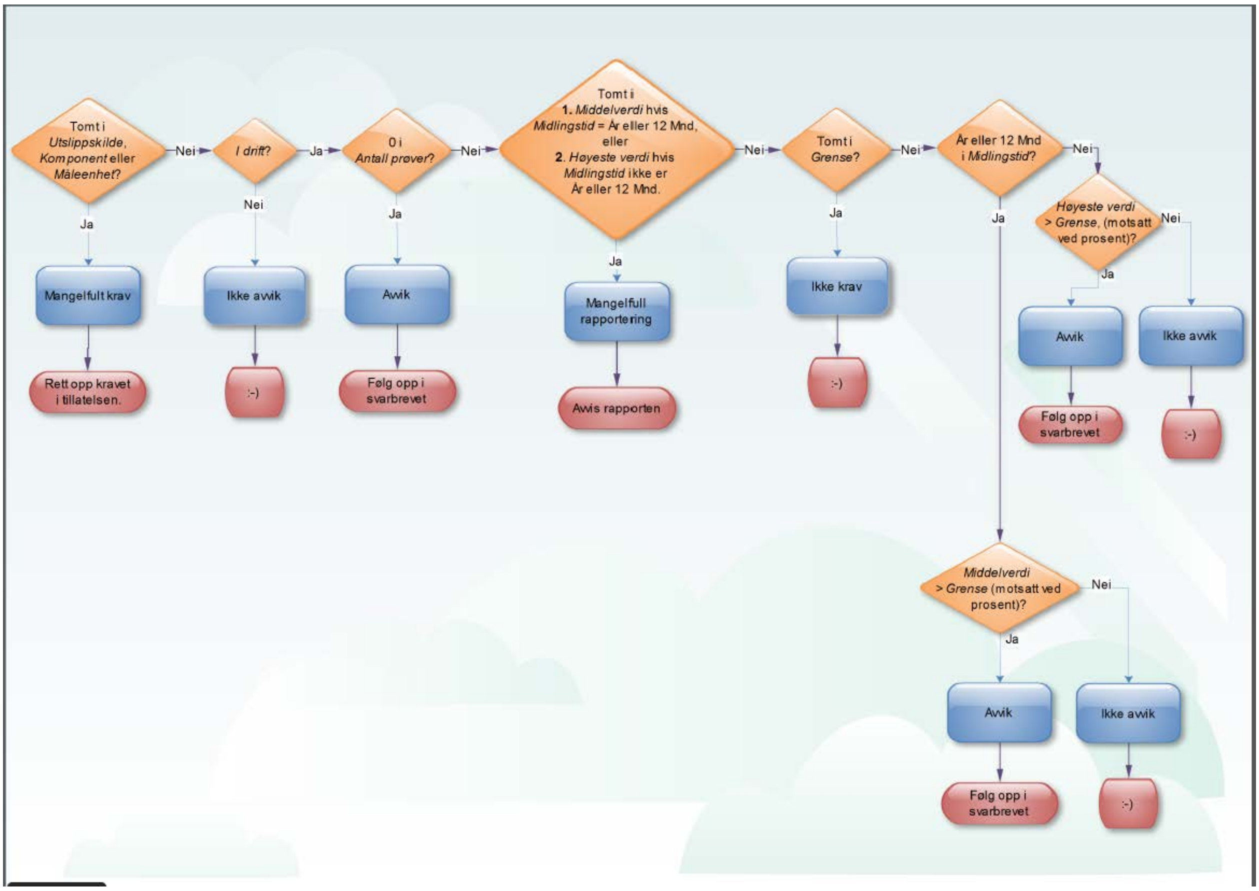
Kazakhstan is the largest country in Central Asia, which experience rapid growth in the recent decade due to increased production and export of natural resources, first of all oil & gas, coal and metals. There is significant evidence that exposure to pollution impacts in Kazakhstan is causing serious health and environmental impacts, particularly in urban areas. Greenhouse gas emissions per GDP rank among the highest in the world. The challenges faced by Kazakh policymakers are rooted in current environmental legislation and regulatory practices which have little focus on the prevention or reduction of environmental pollution.

Annex 7. Structure of the Norwegian Climate and Pollution Agency's database "Forurensning"



Print screen by the Norwegian Climate and Pollution Agency

Annex 8. Flow sheet of the automatic quality control in the database “Forurensning”



Annex 9. Steps for Developing an Industrial Sector Strategy

1. **Commitment to developing a sector strategy and selection of sectors**

The development of an industrial sector strategy involves substantial effort and cost. Some confirmation of internal commitment is therefore required that the government is willing to make these efforts and bear the costs, otherwise the initiative will turn into a disappointment and negatively influence standing with the industrial sectors. Preferably, the strategy to 'reach out' to industrial sectors and develop sector-based policies should be included in the national environmental plan or its equivalent.

It is important to start with a small number of sectors that are homogenous and include a number of companies that can be expected to pro-actively cooperate ('the early adopters') and have indicated their interest to do so.

2. **Initiation to consultation and coordination**

Every successful strategy is based on detailed and open discussions among policymakers; and the permitting, inspection and enforcement authorities to identify their respective wishes, needs and problems. The consultation process can start with a few meetings but should then develop into a structure in which the parties meet on a regular basis and have agreed to work towards developing and implementing a sector strategy. Participants should include the Ministry of Environment and Water Resources, the Ministry of Economy and/or industry, regulators (local / regional authorities or environmental protection agencies) and the industrial sector. The latter is preferably represented by industrial associations in the sector of concern. In industrial sectors characterized with few enterprises, such as the fertilizer industry or the basic metals industry, the enterprises can all be individually represented.

The main question to be answered in the consultation process is what barriers prevent enterprises from introducing environmental control measures and what enterprises and regulators can do to remove these. It is important to try and distinguish between genuine desire to improve environmental performance and good but soft intensions in this direction. Each party should develop points-of-view on what policy instruments are most preferable to remove barriers, and clearly express them, whether modest or ambitious. An important factor in this, and good indicator to test ambitions, is clarity on the willingness of parties to invest in the outcome of the process. Is the government willing to invest e.g. in research, cleaner production centers or financial support for the 'early-adaptors' within the industry that try-out new pollution abatement processes? Are industries willing to invest in research, information centers and environmental control measures for their production processes to implement the sector strategy?

If at the start of this process, objectives and options are not very clear; it may be a good idea to launch the dialogue with a workshop to collect ideas. If sector based policies are new to all parties, an experienced moderator to prepare and chair the meetings can help. The process of creating the platform for coordination between stakeholders and identify common objectives for sector focused environmental policy instruments can take from a few months for simple targets, such as sector guidelines, to more than a year for other instruments.

3. Data collection and analysis

Good insight into the features of the sector and its environmental performance is crucial to have meaningful discussions on feasible emission reductions and most suitable policy instruments to accomplish these. The data collection program is tailored to the ambitions of the sector strategy. If the objective is the development of environmental sector guidelines, the research can be relatively modest and limited to numbers and categories of enterprises; type of environmental emissions and possible control measures with their costs. The abundance of international data that exist on environmental performance, e.g. BREFs, can provide an important reference for successful policies and applicable environmental control measures. If the objective is more ambitious, e.g. a long-term program to improve environmental performance of a sector, then more information is required including insight into the financial performance of the sector and the capacity to bear the costs of investments or the ability to reflect these in product sales prices.

Research and data collection are important to adequately select the most suitable environmental control measures and policy instruments but may also be needed to support the discussion on the likely financial consequences of the policy options proposed by the participants. In most cases consultants are hired to perform data collection and analysis tasks. This process can take from a few months to more than a year, and cost between € 50, 000 to over € 1 million.

4. Introduction of sector policy instruments

As a result of the consultations and sector investigations the stakeholders in the process can negotiate the program, instruments, introduction steps and implementation arrangements to launch the agreed sector strategy and instruments. This can be a comprehensive task; for example for a for a long-term voluntary agreement it would include the signing of documents and determination of detailed monitoring arrangements, or the establishment of a financial subsidy for environmental or energy efficiency measures in certain industrial sectors; but can also be much simpler, such as when the objective is to introduce sector environmental guidelines or an environmental information center. Depending on the complexity of the instruments and arrangement, this step can take from a few months to more than one year.

Annex 10. Air Quality Monitoring Station Specifications (example from Kosovo)

Service Nº	Description of Service	Final Completion Date(s) of Services
1	Preparation of sites for installation of Three (3) Air Quality Monitoring Stations. The sites must have at least the following: - Suitable concrete base - Freestanding light perimeter fence (with lockable fence door) - Electricity supply - Ethernet connection - Lightning protection i.e. grounded lightning rod Three sites have already been identified A site visit is highly recommended and will be offered prior to bid submission LPTAP will assist the winning bidder for access to sites and discussions with landowners (Obiliq Municipality and KEK) in regard to electricity and Ethernet connections.	One week prior to delivery of and installation of equipment
2	Delivery, installation and testing of the equipment of the items 1-10 of the Table 1 “List of Goods and Delivery Schedule” within one week after the delivery.	10 days from the goods acceptance at the final destination
3	The vendor is required to provide on-site training for at least 10 people employed by the Ministry of Environment and Spatial Planning in Kosovo. Training must be conducted in English and also in Albanian along with all reading materials. The training must cover the following items at a minimum: • Four days of instruction • Equipment operation • Analyzing data • Preparing reports and disseminating the information in accordance with the air monitoring plan • Trouble shooting activities • Use of calibration gases or permeation tube systems • Calibration and maintenance frequencies and procedures • Data verification audits Training certificates are to be provided to all participants engaged in the vendor training.	Within 3 weeks of equipment delivery and installation

Item Nº	Name of Goods or Related Service	Technical Specifications and Standards
1	Environmentally Controlled Monitoring Shelter	• Environmental closure that maintains internal temperatures within 20º to 30 C • Shelter is made of double-wall coated aluminum plate providing isolation against temperature and electrical radiation • Two standard cylinder locks for main door and maintenance access door, which could also be part of a key system • Internal air conditioner and temperature management system providing optimized energy consumption and ability to maintain internal temperature requirements, including accommodating heat load resulting from operation of analyzers and associated equipment • Rugged, unobtrusive and burglar proof design to allow applications in public areas • Analyzing modules on drawers for easy expansion of the system as well as good serviceability • Tie-down attachments for securing shelter to pad or ground, for security, stability and in accordance with local code and expected wind loads • Cables and tubing protected against mechanical damage • Internal zero air supply for periodical zero check or calibration • Shelter should be sized to accommodate up to 7 analyzers • A 2.5 meter high wire fence with locked doorway should be installed around the perimeter of the station as a security measure.
2	Sulfur Dioxide Analyzer	**Measurement method:** UV fluorescence measurement method according to EN14212 standard **Certification:** Certified by an accredited institution for suitability according to the EN14212 standard **Noise reduction and UV lamp lifetime prolongation:** Lamp supply intensity stabilization; pulsed lamp supply **Lower detectable limit:** 0.5 ppb **Measurement range:** • Preset ranges: 0.5; 1; 2;5; and 10 ppm • Extended ranges: 20 ppm **Operating temperature:** 20°C - 30°C **Zero drift:** < 1 ppb per 24 hours **Span drift:** < 0.5% per week **Linearity:** ±1% full scale **Power requirements:** 220/240VAC 250W **Outputs/inputs:** • RS232/RS485 with bi-directional protocol for data acquisition and remote diagnostics with Modbus standard

Item N°	Name of Goods or Related Service	Technical Specifications and Standards
		protocol • Serial ports may be daisy chained • Ethernet with TCP-IP for data acquisition and remote diagnostics with Modbus standard protocol **User interface:** • LCD multiline display • Menu driven software operated with soft keys • Possibility to customize the screens and soft keys **Remote diagnostic:** • Remote connectivity via Ethernet/TCP-IP (Internet) and RS232/RS485 • Ability to dial a modem on RS232 • All internal parameters available on Ethernet and RS232/485 ports • Microsoft Windows based software for emulating the front panel on a remote PC **System for zero/span check:** • Valves for external Zero/Precision/Span gas from central calibration unit • Controlled by the data logger, from the front panel or remotely **Installation:** In the 19 inches or 48.26 cm standard rack on telescopic slides allowing to pull the instrument totally out of rack and without interrupting the measurement **Connection to data logger:** Digitally (Ethernet or RS232) **Calibration check:** With internal permeation source
3	Nitrogen Oxides Analyzer	**Measurement method:** • Photoluminescence according to the EN14211 standard • Single channel and single photomultiplier **Certification:** Certified by an accredited institution for suitability according to the EN14211 standard **Lower detectable limit:** 0.50 ppb **Measuring range:** Possibility to set any range from 0 – 0.05 ppm to 0 – 20 ppm Preset ranges 0.05; 0.1;0.2;0.5; 1; 2;5; 10; 20; ppm **Operating temperature:** 20°C - 3 0°C **Zero drift:** < 0.50 ppb per 24 hours **Span drift:** < 1% full scale per 24 hours **Linearity:** ±1% full scale **Pump:** Built in **Power requirements:** 220/240VAC 300W **Outputs/inputs:** • RS232/RS485 with bi-directional protocol for data acquisition and remote diagnostics with Modbus standard protocol • Serial ports may be daisy chained

Item N°	Name of Goods or Related Service	Technical Specifications and Standards
		Connection to data logger: Ethernet with TCP-IP for data acquisition and remote diagnostics with Modbus standard protocol **User interface:** • LCD multiline display • Menu driven software operated with soft keys • Possibility to customize the screens and soft keys **Remote diagnostic:** • Remote connectivity via Ethernet/TCP-IP (Internet) and RS232/RS485 • Ability to dial a modem on RS232 • All internal parameters available on Ethernet and RS232/485 ports • Microsoft Windows based software for emulating the front panel on a remote PC **System for zero/span:** • Valves for external zero/precision/span gas from central calibration unit • Controlled by the data logger, from the front panel or remotely **Installation:** In the 19 inch or 48.26 cm standard rack on telescopic slides allowing to pull the instrument totally out of rack and without interrupting the measurement **Connection to data logger:** Digitally (Ethernet or RS232) **Calibration check:** With internal permeation source
4	PM-2.5 and 10 Analyzers	**Measurement method:** • Hybrid measurement with an optical measurement for quick response and filter-based measurement via beta gauge (C14 source) • Continuous monitoring - no stepwise-sampling • No correction factor for concentration values **Certification:** Certified by an accredited institution for equivalency according to the EN12341 and EN14907 standards **Measured fraction:** either PM_{10} or $PM_{2.5}$ **Sampling system:** Intelligent reduction of humidity, temperature determined to outdoor humidity, conforming to the certified configuration (must be part of the instrument) **Measuring cycle:** ≤ 1 minute **Minimum detectable limit:** • < 0.2 µg/m³ (2-sigma; 24-hour time resolution) • < 0.5 µg/m³ (2-sigma; 1-hour time resolution) • Range: up to 10.000 µg/m³ **Operating temperature:** -30°C +60°C **Power:** 220/230VAC **User interface:**

Item Nº	Name of Goods or Related Service	Technical Specifications and Standards
		• 2 x RS232 with bi-directional protocol for data acquisition and remote diagnostics with standard protocol • Analog output of concentration (0…10V or 4…20mA) • LCD multiline display • Menu driven software operated with keys **Remote diagnostic:** • Remote connectivity via RS232 • All internal parameters available on RS232 port • Microsoft Windows based software for controlling the instrument remotely • Calibration check in field must be possible **Installation:** Mounted in a 19 inch or 48.26 cm standard rack, pump may be separated **Calibration check:** With foils of known absorption values and associated response
5	Ozone analyzer (O_3)	**Measuring method:** • UV-photometry according to the EN14625 standard • Dual-chamber design for simultaneous measurement of zero and sample value **Certification:** Certified by an accredited institution for suitability according to the EN14625 standard **Lower detectable limit:** 0.5 ppb **Measuring range:** Any range from 0 - 0.05 ppm to 0 – 20 ppm or preset ranges 0.05; 0.1; 0.2; 0.5;1; 2;5; 10; 20 ppm **Operating temperature:** 20°C - 30°C **Zero drift:** <1 ppb per 24 hours **Span drift:** ±1% of reading or 100 ppb per month **Linearity:** ±1% of reading > 20 ppb **Power requirements:** 220/240VAC 250 W **Outputs/inputs:** • RS232/RS485 with bi-directional protocol for data acquisition and remote diagnostics with Modbus standard protocol • Serial ports may be daisy chained • Ethernet with TCP-IP for data acquisition and remote diagnostics with Modbus standard protocol **User interface:** • LCD multiline display • Menu driven software operated with soft keys • Possibility to customize the screens and soft keys **Remote diagnostic:** • Remote connectivity via Ethernet/TCP-IP (Internet) and RS232/RS485 • Ability to dial a modem on RS232 • All internal parameters available on Ethernet and RS232/485 ports

Item N°	Name of Goods or Related Service	Technical Specifications and Standards
		• Microsoft Windows based software for emulating the front panel on a remote PC **System for zero/span check:** • Valves for external Zero/Span gas from central calibration unit • Controlled by the data logger, from the front panel or remotely **Installation:** In the 19 inches or 48.26 centimeters (cm) standard rack on telescopic slides allowing to pull the instrument totally out of rack and without interrupting the measurement **Connection to data logger:** Digitally (Ethernet or RS232) **Calibration check:** With internal ozone generator
6	Carbon Monoxide Analyzer	**Measurement method:** Non-dispersive Infrared absorption with gas filters correlation wheel according to the EN14626 Standard **Certification:** • Certified by an accredited institution for suitability according to the standard EN14626 • The certificate must be included in the offer **Lower detectable limit:** 0.04ppm **Measuring range:** • Possibility to set any range from 0-1ppm to 0-200ppm, • Preset ranges 1; 2; 5; 10; 20; 50; 100; 200 ppm **Operating temperature:** 20°C-30°C **Zero drift:** <0,1ppm / 24 hours **Span drift:** < 1% full scale / 24 hours **Linearity:** • ±1% full scale **Power requirements:** 220/240VAC 275W **Outputs/inputs:** • RS232/RS485 with bi-directional protocol for data acquisition and remote diagnostics with Modbus standard protocol • Serial ports may be daisy chained • Ethernet with TCP-IP for data acquisition and remote diagnostics with Modbus standard protocol **User interface:** • LCD multiline display • Menu driven software operated with soft keys • Possibility to customize the screens and soft keys **Remote diagnostic:** • Remote connectivity via Ethernet/TCP-IP (Internet) and RS232/RS485 • Ability to dial a modem on RS232 • All internal parameters available on Ethernet and RS232/485 ports

Item N°	Name of Goods or Related Service	Technical Specifications and Standards
		• Microsoft Windows based software for emulating the front panel on a remote PC **System for zero/span check:** • Valves for external Zero/Span gas from central calibration unit • Controlled by the data logger, from the front panel or remotely **Installation:** In the 19 inch or 48.26 centimeters (cm)standard rack on telescopic slides allowing to pull the instrument totally out of rack and without interrupting the measurement **Connection to data logger:** Digitally (RS232) **Calibration check:** With external gas cylinder (cylinder and pressure regulator are part of delivery**)**
7	Dynamic Calibration System	**Calibration Gas System for performance of calibration of SO_2 and NO/NO_2 analyzers:** • Compatible with automated (data logger and remotely controlled) and manual zero, precision and span checks, for SO_2 and NO/NO_2 analyzers specified • Based on ISO-traceable permeation tubes as gas sources • Direct interface with data logger system and remotely controllable by modem and data logger system • All necessary fittings, fixtures and tubing
8	Data logger - ANSI-SQL relational database	**Data acquisition:** • Data acquisition over Ethernet (LAN) and TCP/IP • Ethernet with TCP/IP supporting Modbus protocol • Serial ports (RS232 and similar) • Standard protocols (Modbus and AK or MS Windows communication protocol) • Data acquisition over analogue signals, and status inputs • should be used for meteorological instruments station status (internal temperature, door opened, flow in the sampling system) **Data scaling:** Linear scaling of data for conversion to the user (engineering) units **Data validation:** The validity of the data is to be determined basing on instrument status and station status (temperature, sample flow, door open) **Data sampling:** • Configurable sampling interval • Sampling interval from 1 second to 1 hour **Data averaging:** • Configurable averaging • Arithmetic average (e.g. concentration), vector average (e.g. wind direction), total (e.g. precipitation) • Three averages calculated in parallel • Typical setting

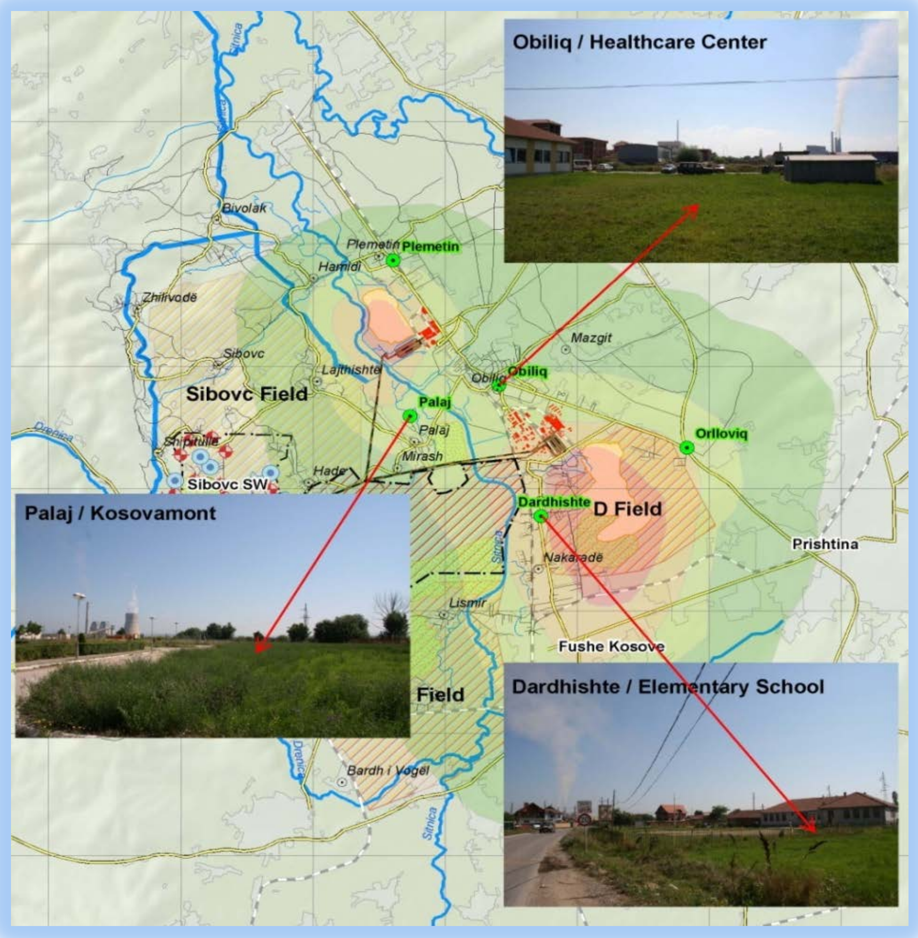
Item N°	Name of Goods or Related Service	Technical Specifications and Standards
		o 1 minute average o 5 minutes average o 30 minutes average • Determining and storing the validity criteria for average (percent of good data in an average) **Zero / span check registration:** • Results of zero / span check for instruments to be stored separately • Expected ("should be") user configurable and stored with the results • Criteria for selection of valid zero/span data configurable • Time for stabilization • Duration of zero / precision / span purge time **Zero / span check control by data logger:** Following parameters configurable (for each instrument): • Duration of zero • Duration of span • Time for stabilization • Minimum duration of zero and span • Purge time after zero and span • Interval between automatic zero/precision/span cycle • Delay between zero and span **Alarms:** User configurable alarms basing on status, data value, results of zero/span check **Data storage:** All measured data and calculated averages to be stored **Data presentation:** • Data presentation with HTML pages available on LAN port for standard html-browsers (e.g. Internet Explorer, Firefox, Mozilla) • Tabular and graphical presentation • Presentation of: o Momentary values (automatic update) o Averages for selected time span o Access protected with password o Predefined graphics and tables depending on user logged in **Service support:** • Registration of all service parameters of the instruments (configurable) • Configurable e-mailing of tabular or graphical results to selected users **Configuration:** • Configuration via html – browser • Access protected with password • Each data logger delivered completely configured and

Item N°	Name of Goods or Related Service	Technical Specifications and Standards
		tested, but available for later adaptation or expansion by the user **Remote access:** Full access to the data logger functions locally and remotely via LAN interface and Internet **Data transmission:** • Data transmission with HTTP/HTTPS protocol • Possibility to test the transmission with html browser **Data polling:** • The data are polled by central station • The polling station determines the parameters, averages or type of data and period for which the data should be transmitted • Possibility to download data manually from a html browser as a file
9	Temperature and Relative Humidity Sensor	**Main features:** • Thermohygrometric sensitive element easily replaceable, even by unskilled person • Natural ventilation with anti-radiant shield • Relative humidity or dew point measurement • Highly-reflective anti-radiant shield • Analog standard output (0/4÷20 mA0/1÷5 VDC) • Power supply 12 VDC • Standard protocols (Modbus and AK) **Range: -**30°C to 70°C **Accuracy:** • Temperature: min. ±0.1°C (0°C) • Humidity: min. 1.5% (5÷95%, 23°C) **Resolution:** • Temperature: min. ±0.06°C • Humidity: min. 0.5%
10	Wind Speed and Direction Sensor System	**Wind sensor requirements:** Measurement of wind speed and wind direction with ultrasonic sensor **Wind speed:** • Range: Min. 0 – 50 m/s • Accuracy**:** Min. +/- 2% • Resolution: Min. 0.01 m/s **Wind direction:** • Range**:** 0 to 359° – no dead band • Accuracy**:** Min. +/- 3° • Resolution: Min. 1° **10 meter tower:** • Tower for mounting of all meteorological sensors • Preferably attached to the shelter, for better structural

Item Nº	Name of Goods or Related Service	Technical Specifications and Standards
		integrity • Preferably electrically raised and lowered for ease of service of sensors • Properly reinforced and or guyed n compliance with local code and expected wind load

Annex 11. Example Air Quality Monitoring Report (from Kosovo)

MINISTRY OF ENVIRONMENT AND SPATIAL



PLANNING

KOSOVO ENVIRONMENTAL PROTECTION AGENCY

KOSOVO HYDRO-METEOROLOGY INSTITUTE

REPORT

MONITORING AIR QUALITY IN KEK AREA

(January - June, 2013)

Prishtina, 2013

Contents

Foreword

Dear reader,

The aim of this Report "Monitoring of the air status in KEK area", is to inform the public regarding the air quality in this area.

Kosovo Environmental Protection Agency through this report first of all fulfils its' legal obligations deriving from the Law on Environment Protection and the Law on Protection of the Air from Pollution, and other environment related obligations to timely and correctly inform the wide public and all other interested parties in regard to the air condition in KEK area.

Through this report KEPA also intends to increase the transparency towards the inhabitants of the area, and to contribute to further steps towards implementation of the project for the Power Plant 'Kosova e re'.

Transparency and realistic information regarding the air in the municipality of Obiliq should assist the central and the local institutions, and also various investors for successful implementation of new energy related projects and projects for environment improvement in this area, involving the wide public in the most efficient manner and not only through information, but also through active decision making process.

KEPA extends its' gratitude and expresses the understanding for all stakeholders, relevant institutions and various groups of interest which may be users of the data deriving from this report, but at the same time it requires accurate and exact interpretation of the data contained in the report. We will be immensely grateful and ready to provide clarification and supplementary data for any unclear information you encounter in the data presented in this report.

Dr.Sc. Ilir Morina, Chief Executive of KEPA

Introduction

This report contains data related to the air quality collected by the automatic continuous (uninterrupted) monitoring system of air quality in the area of KEK. Air quality monitoring system in KEK area consists of three monitoring systems installed in the following locations: in Obiliq Family Medicine Centre, in Dardhishtë, Primary School in Palaj, 'Kosova Mont' building. The report refers to the monitoring period from 01 January to 31 June of 2013.

This report presents the air polluters' concentration for the monitoring period through the charts and tables.

Review of the collected data has been outlined referring the threshold values, and threshold benchmark values of information and alarm benchmark, for human health and ecosystem protection, as defined by Directive 2008/50 and Administrative Instruction on limit values of the air quality; No. 02/2011**.**

1. Monitoring of air quality in KEK area

Pursuant to the Law on Environment Protection, No. 03/L-025, Law on Air Protection from Pollution, No. 03/L-160 and Law on Hydro-Meteorological Activity No. 02/L-79, MESP respectively KEPA/KHMI is responsible for monitoring the air quality in the entire territory of Kosovo, including the urban, industrial and rural areas.

Kosovo Energy Corporate undertakes its' activity in the area of Obiliq municipality being the most important enterprise for the economy of Kosovo, but at the same time it also causes environment pollution.

Two lignite mines known as Bardh and Mirash operate within KEK, along with two Power Plants known as: Kosova A and Kosova B, with the general effective capacity of 645- 870 MW, from 1478 MW of the installed capacity, using a total quantity of approximately 7 million tons of lignite a year.

Environmental problems for this area are also the ash dumps which accumulate more than 40 million tons of ash, thus covering around 150 ha of arable land. Open craters created while excavating in open pit mines for coal exploitation and the self ignition of coal cause air pollution in the surrounding area.

Taking into account such facts, it has been considered that an immediate need exists to undertake the continuous monitoring of air quality in KEK area in order to have a realistic overview on the status of air quality in this area.

By the end of 2012, with the support from the World Bank, MED financed purchase of three stations for monitoring of air quality in KEK area (see Tab. 1 and fig.1). By the end of December 2012 an agreement was reached between MED and MESP for these stations to be transferred under ownership of MESP and under management of KEPA/KHMI.

1.1. Locations of monitoring of air quality in KEK area

Stations for monitoring of air quality in KEK area (see tab. 1 and fig.1), which are managed by KEPA respectively by KHMI have been installed in three locations. One in Obiliq - Family Medicine Centre, one in Dardhishtë village, Primary school, and one in Palaj in 'Kosova Mont' building.

Stations are equipped with analysers for monitoring air pollution from: Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Carbon monoxide (CO), Ozone (O_3), particulate matter suspended on the air PM_{10} and $PM_{2.5}$ and meteorological parameters e.g.: direction and speed of the wind, temperature, air pressure and humidity.

The above mentioned stations are incorporated in the network of air quality monitoring in Kosovo and they are representative for monitoring the area with industrial background.

Tab.1. Stations for monitoring air quality in KEK area (industrial area)

Local code of the station	**Name of the station**	**Managed by**	**Type of the stations**	**Measured parameters**
KS0110	Obiliq - Family Medicine Centre	KEPA/ KHMI	Industrial background	SO_2 , NO_2, CO,O_3, PM_{10}/$PM_{2.5}$
KS0111	Dardhishte - Primary school	KEPA/ KHMI	Industrial background	SO_2 , NO_2, CO,O_3, PM_{10}/$PM_{2.5}$
KS0112	Palaj - Kosova Mont	KEPA/ KHMI	Industrial background	SO_2 , NO_2, CO,O_3, PM_{10}/$PM_{2.5}$

1.2. Frequency of measurement

Frequency of measuring is regulated by Administrative Instruction **No. 15/2010** on "Criteria for Definition of Monitoring Points for Air Quality, Number and Frequency of Measurements, Classification of Monitored Polluters, Methodology of Work, Method and Time of Data Reporting**.**

1.3 Allowed limits for air quality

Norms of air quality in Kosovo are regulated by the Administrative Instruction for the Limit Values - Norms of Air Quality, No. 02/2011 and Directive 2008/50/EC on Environment air quality and clean air for Europe.

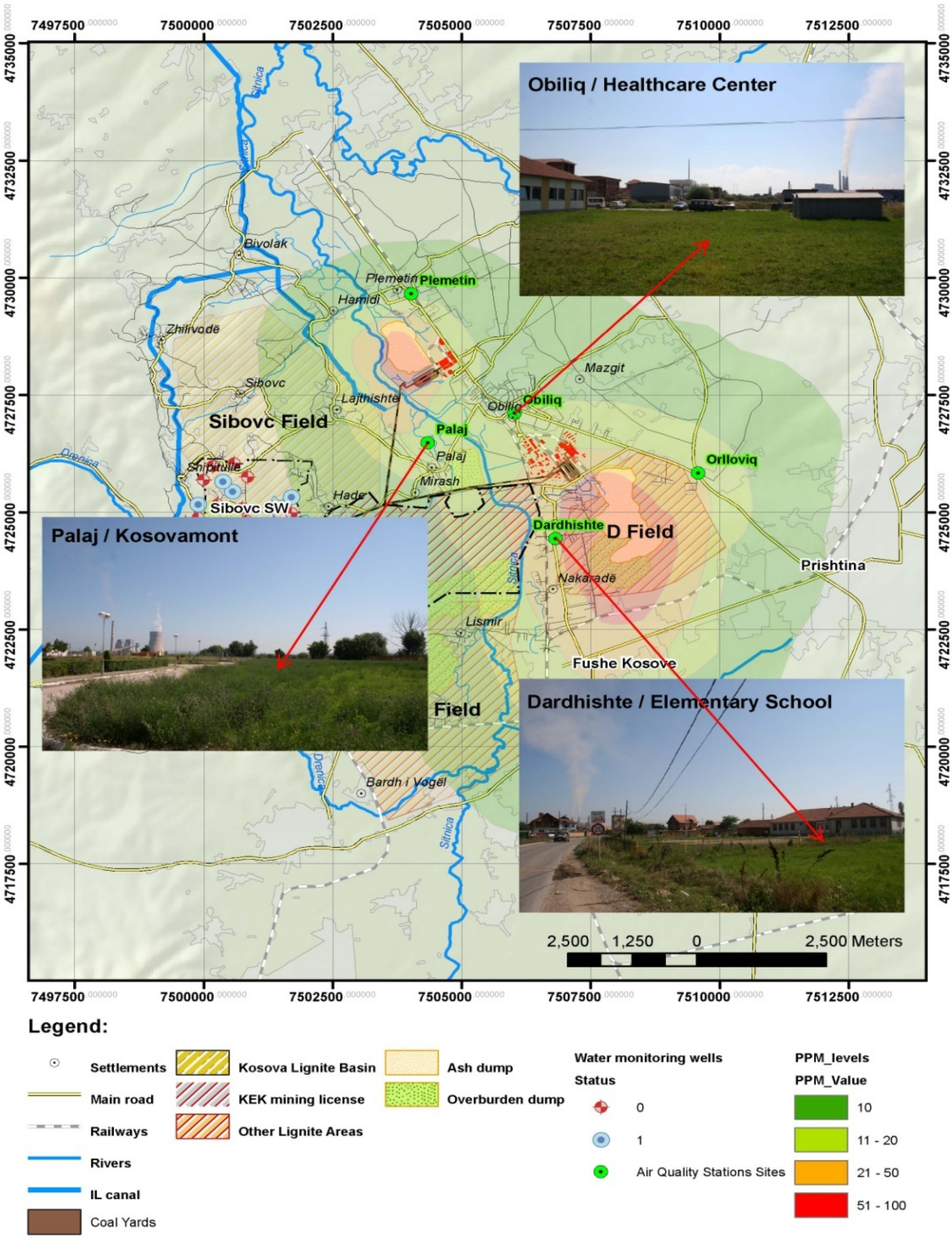


Fig.1. Locations of monitoring stations in KEK area

2. Assessment of air quality in KEK area

In order to assess the air quality in KEK area, available data analysis has been conducted from air quality monitoring in KEK area and by taking as a comparison point the EU standards from the Directive 2008/50/EC, on air quality and Administrative Instruction for the limit values - air quality norms; **No**. **02/2011.**

Directive 2008/50/EC for Ambient air quality and cleaner air for Europe, directs the activities, assessment and management of air quality, setting the aimed values and limit values for air quality, having as objective the protection of human health and the environment.

2.1 Results from air quality monitoring

Air quality monitoring in KEK area has been conducted through continuous monitoring in three fixed monitoring stations. The air has been monitored for pollution by: sulphur dioxide (SO_2), nitrogen dioxide (NO_2), Ozone (O_3), carbon monoxide (CO) and suspended PM_{10} and $PM_{2.5}$ particulate matter. In each of these stations meteorological parameters have been measured as well, including: wind speed, wind direction, temperature, air pressure and relative humidity.

The results from air quality monitoring for the period 01 January - 31 may 2012 have been presented on Table 2.

2.2. The analysis of the results from air quality monitoring in KEK area

The results collected from air quality monitoring have been analysed, thus comparing with the EU standards as a reference point which derive from Directive 2008/50/EC, on air quality and the Administrative Instruction for the limit values - norms of air quality; **No**. **02/2011,** in order to reach a conclusion over the status of air quality in KEK area**.**

Tab. 2. Monthly average values from air quality monitoring in the area of KEK

Environment air quality indicators						
Sulphur Dioxide - SO_2	**I**	**II**	**III**	**IV**	**V**	**VI**
KEK - Obiliq (Family Medicine Centre) SO_2 ($\mu g/m^3$)	15,88	12,72	7,28	2,75	1,47	3,11
KEK - Dardhishte (Primary School) SO_2 ($\mu g/m^3$)	9,00	7,08	5,08	5,82	4,80	6,35
KEK - Palaj (Kosova Mont) SO_2 ($\mu g/m^3$)	4,43	4,83	3,17	2,35	1,62	3,19
Nitrogen Dioxide - NO_2	**I**	**II**	**III**	**IV**	**V**	**VI**
KEK - Obiliq (Family Medicine Centre) NO_2 ($\mu g/m^3$)	17,16	11,05	9,54	10,81	7,31	11.22
KEK - Dardhishte (Primary School) NO_2 ($\mu g/m^3$)	13,80	9,01	8,42	10,42	7,56	10,41
KEK - Palaj (Kosova Mont) NO_2 ($\mu g/m^3$)	8,62	4,96	4,24	3,73	2,86	4,26
Ozone - O_3	**I**	**II**	**III**	**IV**	**V**	**VI**

KEK - Obiliq (Family Medicine Centre) O_3 (µg/m^3)	38,93	14,31	52,27	63,00	66,53	63,08
KEK - Dardhishte (Primary School) O_3 (µg/m^3)	46,33	50,05	67,28	71,80	71,28	64,87
KEK - Palaj (Kosova Mont) O_3 (µg/m^3)	45,25	49,68	66,50	68,17	64,89	57,75
Carbon Monoxide - CO	**I**	**II**	**III**	**IV**	**V**	**VI**
KEK - Obiliq (Family Medicine Centre) CO (mg/m^3)	0,85	0,83	0,70	0,63	0,38	0,26
KEK - Dardhishte (Primary School) CO (mg/m^3)	0,87	0,61	0,60	0,60	0,40	2,96
KEK - Palaj (Kosova Mont) CO (mg/m^3)	0,60	0,66	0,66	0,61	0,51	0,27
PM_{10} - particulate matter of aerodynamic diameter < 10µm	**I**	**II**	**III**	**IV**	**V**	**VI**
KEK - Obiliq (Family Medicine Centre) PM_{10} (µg/m^3)	79,41	55,67	49,74	48,80	36,83	28,53
KEK - Dardhishte (Primary School) PM10 (µg/m^3)	59,23	45,35	39,40	49,63	40,21	36,51
KEK - Palaj (Kosova Mont) PM10 (µg/m^3)	57,61	37,54	35,43	48,75	39,04	29,51
$PM_{2.5}$ - particulate matter of aerodynamic diameter < 2,5µm	**I**	**II**	**III**	**IV**	**V**	**VI**
KEK - Obiliq (Family Medicine Centre) $PM_{2.5}$ (µg/m^3)	69,39	46,75	38,30	27,03	15,20	13,25
KEK - Dardhishte (Primary School) $PM_{2.5}$ (µg/m^3)	40,43	26,82	23,11	20,33	14,56	13,27
KEK - Palaj (Kosova Mont) $PM_{2.5}$ (µg/m^3)	47,42	36,54	28,04	21,78	14,81	12,56

2.2.1. SO_2 - Sulphur Dioxide

In Fig. 2 presented below the monthly average values have been given regarding the concentration of SO_2 from monitoring in the stations: Obiliq - Family Medicine Centre, Dardhishtë - Primary school, Palaj - Kosova Mont, for the period January - June 2013.

From the chart we may see the concentration of SO_2 from three monitoring stations is within the standards set by the Directive 2008/50/EC for the air quality.

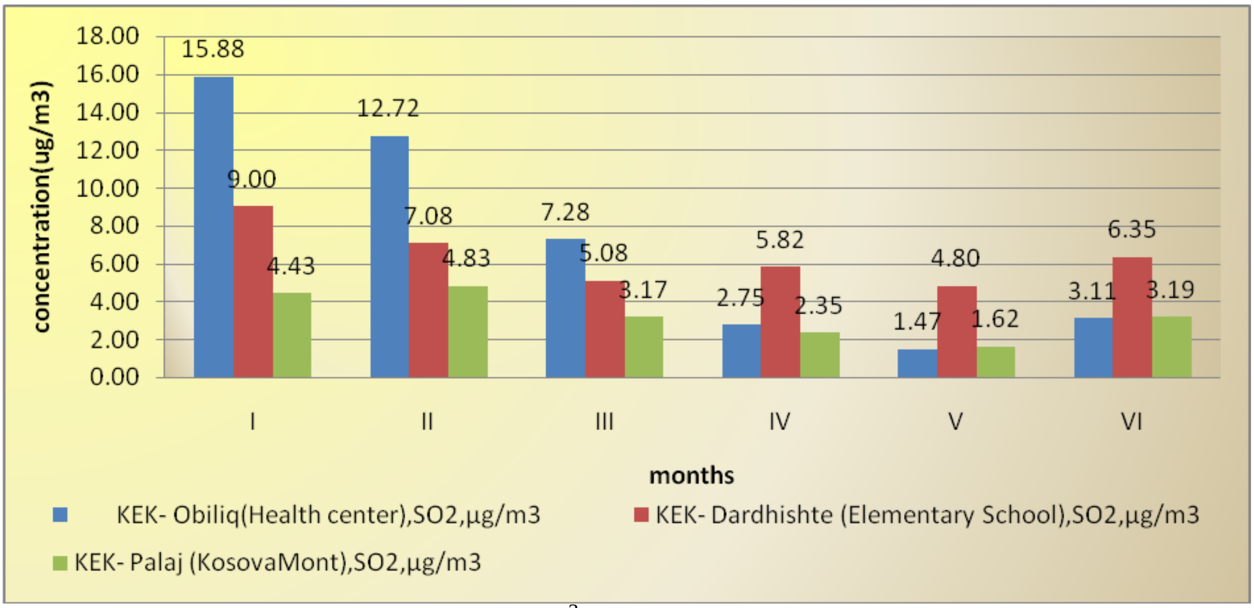


Fig.2. Monthly average values of SO_2 (ug/m^3) for the period 01 January – 31 June 2013

In the chart of monthly average values, we may notice that there are no cases of exceeding the daily limit values (125ug/m^3) with SO_2 in any of the monitoring stations as the maximum monthly average value is 15,88 µg/m^3. Concentration of SO_2 in all monitoring stations is decreasing compared to the winter months.

This is noticed from the fact that in the month of January the maximum monthly average value of SO_2 concentration was registered in 15,88ug/m^3, whereas in May the minimum monthly average value was registered for SO_2 being 1,47ug/m^3.

From all the monitoring stations, the one hour maximum value has been reached being 57,21ug/m^3 in the monitoring station in Dardhishtë, and thus we notice that it does not exceed the one hour limit value (350ug/m^3) deriving from the Directive 2008/50/EC and A.I. No. 20/2011. Whereas the maximum daily average value reaches 29,63ug/m^3, in the monitoring station in Obiliq, thus noticing that also the daily value (125ug/m^3) does not exceed the daily limit value in any of the three monitoring stations.

2.2.2. NO_2 - Nitrogen Dioxide

Fig. 3 presents the chart containing the data on monthly average values of NO_2 concentration from monitoring in the stations: Obiliq - Family Medicine Centre, Dardhishtë - Primary School and Palaj - KosovaMont for the monitoring period January - June 2013.

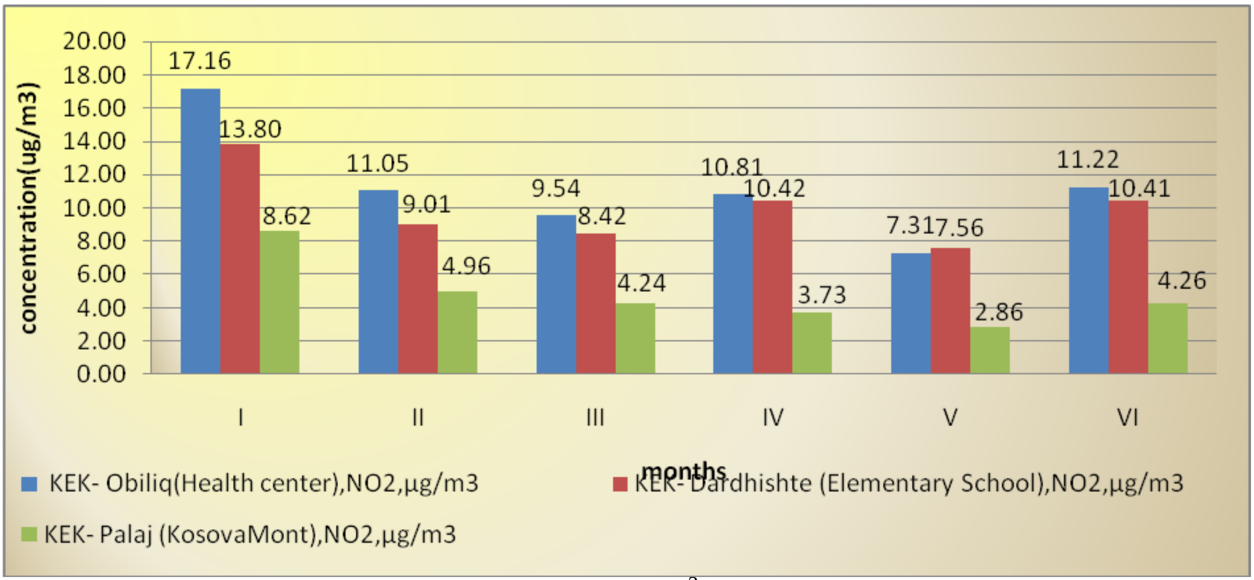


Fig.3. Monthly average values of NO_2 (ug/m^3) for the period January – June 2013

From the analysis of monthly average values for the three stations it has been noticed that during the winter months the concentration values of NO_2 in the air is higher compared to spring season months (fig.3), however these values are low, e.g. they are within standards provided by Directive 2008/50 for the air quality.

Maximum one hour value recorded by all monitoring stations has reached to 68,72 (ug/m^3) in the monitoring station of Obiliq, where it is noticed that it does not exceed the limit value 1h (200ug/m^3).

From the analysis of the data in the 5 first months of 2013, we may assume that annual limit values should not be exceeded (40ug/m^3), for human health protection, considering that during this period the maximum average monthly value reaches 17,16 (ug/m^3) what means that it is a very low value compared to the standard annual limit value.

2.2.3. CO - Carbon Monoxide

In the chart below (see fig. 4.) data is presented regarding the concentration of CO gathered from the monitoring stations in KEK area for the monitoring period January - June 2013.

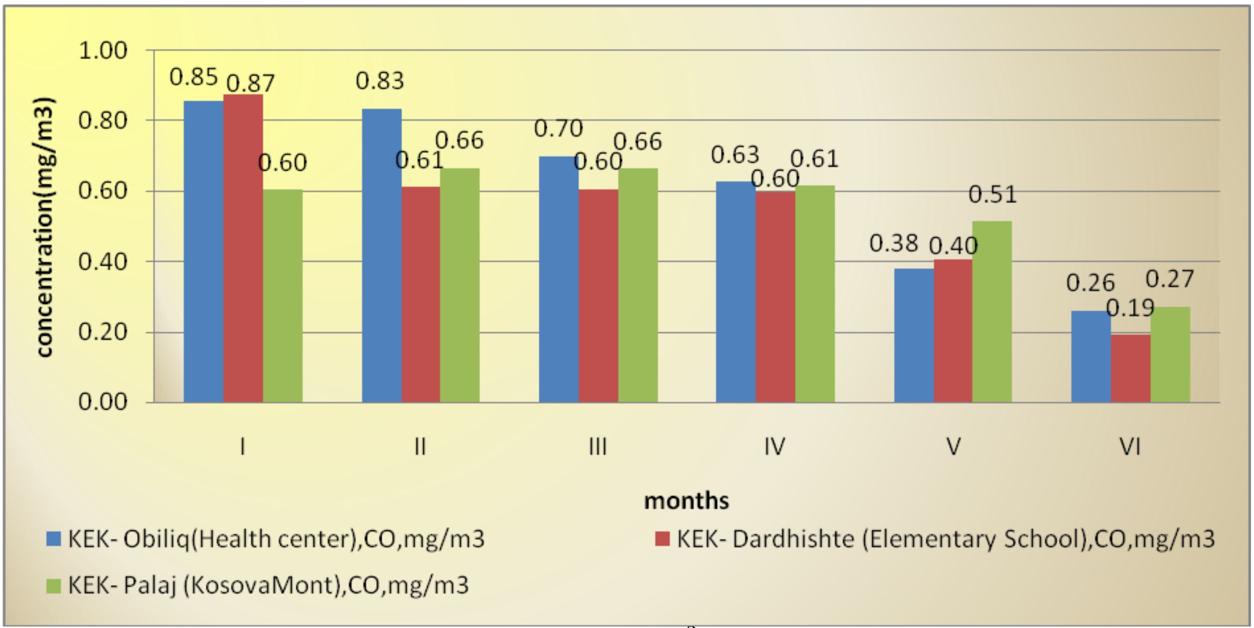


Fig.4. Monthly average values of CO (ug/m^3) for the period January - June 2013

From the data collected in three monitoring stations in KEK area, it has been noticed that during the monitoring period January - June 2013 there is no case of exceeding the maximum daily average limit value 8h (10mg/m^3).

Fig. 4. presents the chart of monthly average values of CO concentration in three monitoring stations, it has been noticed that the maximum monthly average values was reached in January in the monitoring station in Dardhishte and it reaches up to 0,87 (ug/m^3) whereas during June in the monitoring station in Obiliq, the minimum value reaches up to 0,19 (ug/m^3), and hence we can assert that the CO concentration is lower during the months of spring season.

2.2.4. O_3 - Ozone

The below table indicates the exceeding values of the benchmark of information and benchmark of alarming and exceeding of daily average in three monitoring stations in KEK area during the monitoring period January – June.

Tab3. Number of exceeding limit values cases for the information benchmark, alarming benchmark and maximum daily average value 8h

Ozone O3 - Number of exceeding cases			
	Targeted values, for human health protection, daily maximum average - 8 hours	Average information benchmark - one hour	Alarm benchmark, one hour average
	>120 µg/m^3	>180 µg/m^3	>240 µg/m^3
Obiliq - Family Medicine Centre	1	2	1
Dardhishte - Primary School	2	5	2
Palaj - Kosova Mont	1	6	-

From the table above we may notice that during the monitoring period January - June 2013 13 cases were registered when information benchmark has been exceeded (180ug/m^3) for ozone (O_3), 2 cases in the monitoring station in Obiliq, 5 cases in the monitoring station in Dardhishtë and 6 cases in the monitoring station in Palaj.

Exceeding cases for O_3 concentration were recorded during months of April, May and June, where the maximum average value of 1h was recorded in May in the monitoring station in Dardhishtë and it reaches the value of 261,68µg/m^3.

Whereas exceeding of limit value for alarming benchmark (>240ug/m^3) for O_3 were recorded in 3 cases: 1 case in the monitoring station in Obiliq and 2 cases in the monitoring station in Dardhishtë.

There have also been recorded cases of exceeding the maximum targeted daily average value for 8 h (120ug/m^3).

From the analysis of the results, it has been noticed that during the months of spring season, the ozone concentration has been raised, and we can also see that on the chart presented on fig. 5.

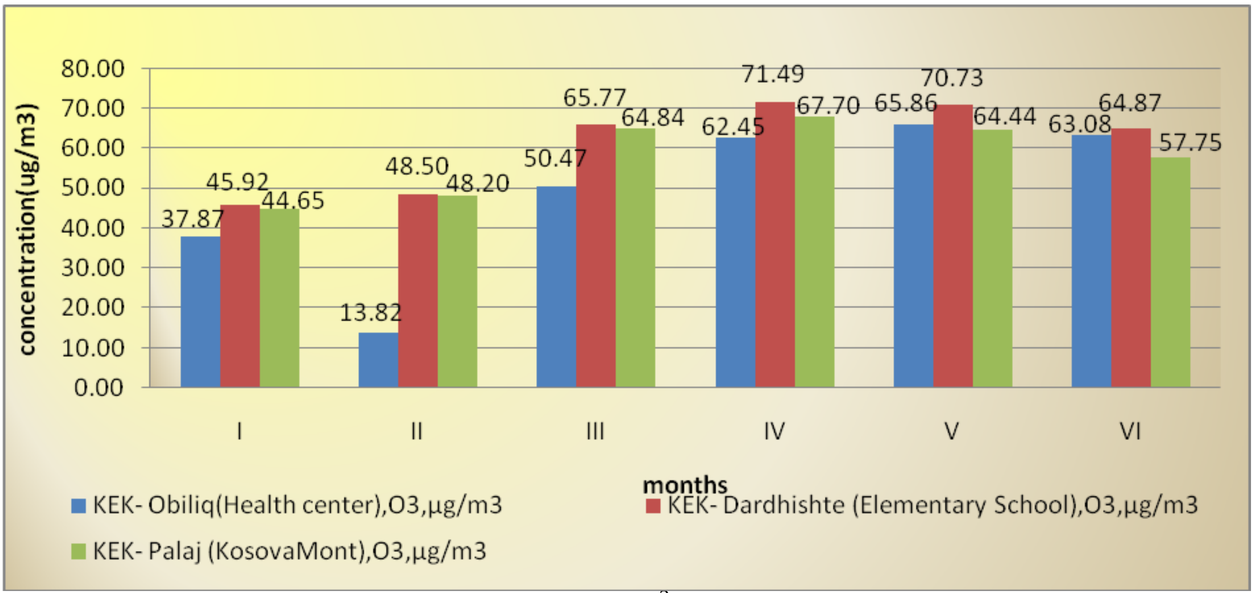


Fig.5. Monthly average values O_3 (ug/m^3) for the period January - June, 2013

2.2.5. PM_{10} - Particulate matter of aerodynamic diameter < 10µm

In the table below the number of days has been presented when the daily limit values have been exceeded ($50ug/m^3$) for the PM_{10}, during the monitoring period January – June 2013.

Tab. 4. Number of days when the daily limit values have been exceeded for PM_{10}

PM_{10}- number of days - the daily limit values have been exceeded, 01 January - 31 May							
Daily limit value	**50µg/m3**						
Number of allowed days of exceeding within one year	**35 days/year**						
	I	II	III	IV	V	VI	Total
Obiliq - Family Medicine Centre	18	12	13	11	7	1	62
Dardhishte - Primary School	17	8	8	11	10	8	62
Palaj - Kosova Mont	15	5	5	12	12	4	53

From the table we may see the number of allowed days has been exceeded for the daily exceeding within one year (35 days/year), according to the directive 2008/50/CE and according to AI No. 02/2011.

In the monitoring station in Obiliq, during this five month period the highest number of days was reached when the daily values were exceeded ($50ug/m^3$), where the number of exceeding days reaches the number of 62 days, in the monitoring station in Dardhishtë 62 days and in Palaj 53 days of exceeding values.

In the monitoring station in Obiliq the maximum daily value of PM_{10} was recorded during the month of January and it reaches 164,0 (ug/m^3), what means that it is 3,28 times higher than the allowed daily value ($50ug/m^3$).

In the monitoring station in Dardhishtë the maximum daily value of PM_{10} reaches 137,0 (ug/m^3) during the month of January, what means that it is 2,74 times higher than the allowed daily value and in the monitoring station in Palaj the maximum daily value of PM_{10} reaches 131,3 (ug/m^3) during the month of January, what means that it is 2,62 times higher than the allowed daily value.

From the data analysis we may conclude that the highest concentration of PM_{10} in the air is reached during the winter season, as we may see from the diagram of monthly average values (see fig.6.).

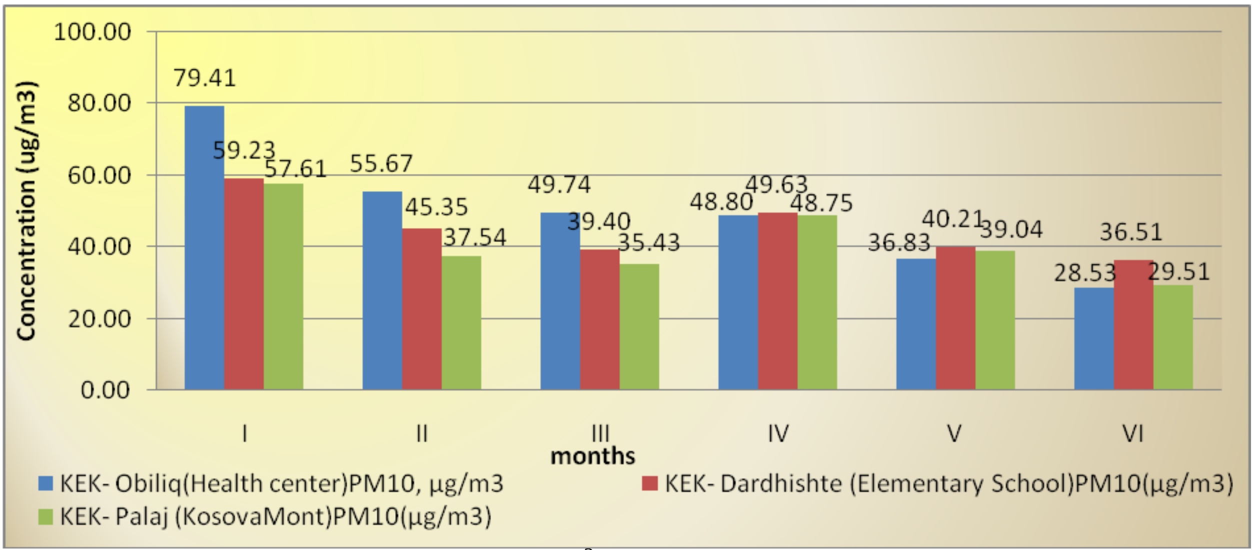


Fig.6. Monthly average values of PM_{10} (ug/m^3) for the period January - June 2013

2.2.6. $PM_{2.5}$ - Particulate matter of aerodynamic diameter <2.5µm

In Fig. 7 monthly average values have been presented for $PM_{2.5}$ (ug/m^3) from air quality monitoring in three stations installed in KEK area, during the period January – June 2013.

From fig. 7 we may see the maximum values which were mainly reached during the winter season. The maximum monthly value was presented in the monitoring station installed in Obiliq- Family Medicine Centre, where the value reaches 69,39 (ug/m^3) during the month of January.

Whereas in the month of May the minimum values of $PM_{2.5}$ concentration were recorded in all monitoring stations. The minimum value was recorded in the monitoring station in Palaj - KosovaMont and the value is 12,56 ug/m^3.

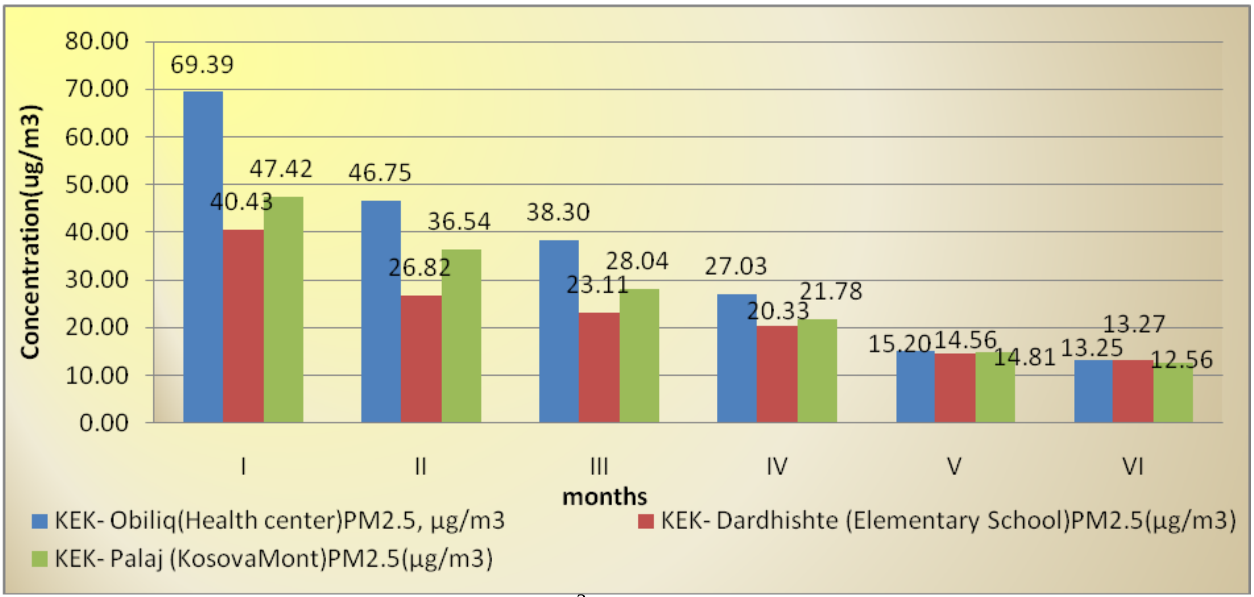


Fig.7. Monthly average value of $PM_{2.5}$ (ug/m^3) for the period January - June 2013

3. Meteorological condition at site - air quality monitoring

In the air quality monitoring stations the meteorological parameters have been integrated as well. To supplement the data collected from the network of air quality monitoring, summarising data have been presented of the meteorological parameters as well which impact on the mechanism of accumulation, transport, diffusion, distribution and transformation of polluters in the atmosphere. The monitored meteorological parameters in these stations include:

- Air temperature
- Atmospheric pressure
- Air humidity
- Direction and speed of the wind

Description of the meteorological condition is a summarising description of the impact of meteorology on potential occurrences, especially in forming the Ozone and maximum accumulation of PM_{10}.

Direction and speed of the wind are amongst the most important meteorological parameters which influence the distribution of air pollution.

Dominating wind directions in three monitoring stations have been presented in the below figure.

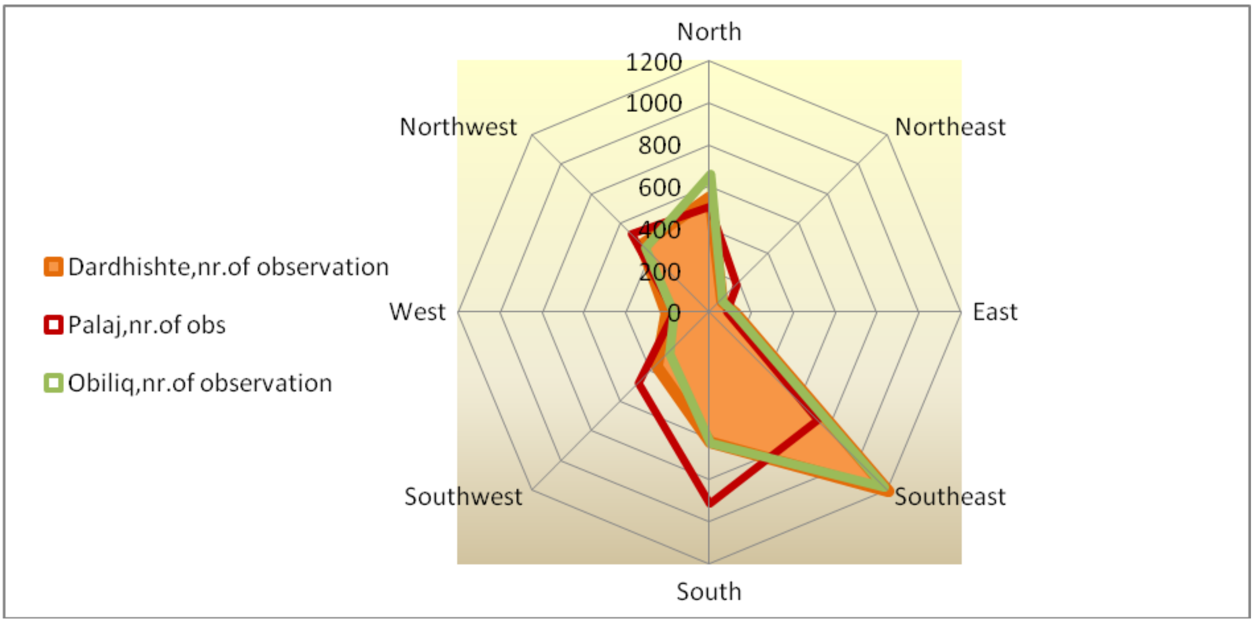


Fig.8. Dominating wind directions in monitoring stations for the period January - June 2013

4. Conclusions and recommendations

4.1. Conclusions

From assessment and processing of collected data it is noticed that the highest exceeding values in the three monitoring stations have been with the polluter PM_{10} and $PM_{2.5}$, from where we can conclude that the main air polluting problems in KEK area are as follows:

- Low quality of air as a result of contamination with particulate matter PM_{10} and $PM_{2.5.}$
- The raise of concentration of PM_{10} and $PM_{2.5}$ in the winter season, as a result of emission of gases from KEK, because of combustion for heating the houses and the meteorological conditions.

4.2. Recommendations

To better reflect the air quality in KEK area, and intending to improve the air quality in this area it is recommended as follows:

- Expanding the network of monitoring and to supplement the measuring instruments;
- To add the number of monitoring parameters according to the requirements provided by the laws and instructions regulating air quality issues;
- MESP and polluting operators is recommended to undertake measures to reduce the pollution with PM_{10} and $PM_{2.5}$.

Report “Monitoring air quality in KEK area”
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