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AIR QUALITY MANAGEMENT IN RIGA

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Increasing urbanization and industrialization generally lead to higher emissions of air pollutants in many countries. Fixed emissions from fixed sources such as refineries, power and industrial plants, commercial and residential building, chemical and fuel storage facilities, and gasoline stations are the main sources of air pollution. Motor vehicles contribute mobile emissions. Air pollution has adverse impact on people including morbidity and mortality, chantes of value in commercial property as a result of air pollution and/or noise. Air pollution causes loss of value of agricultural crops sometimes caused by seepage of toxic chemicals, loss of quality of materials: corrosion and destruction of materials. It means higher costs of maintenance and costs of making particular measures of protection of historically valuable objects and sites. Air quality management is very important in many countries.

The aim of the article is to show the importance of air quality management and the main components of the general action plan to manage, to control and evaluate air pollution.

The objective of this research is to evaluate air pollution costs in Riga and to develop means, required to facilitate the assessment of the air pollution costs.

Research methods. Generally accepted qualitative and quantitative economic research methods have been applied in this study. In general, these are methods of analysis and synthesis for studying problems and processes in order to establish the necessary stepso f actions.

Research results are evaluation of respiratory diseases (RHA) coefficients appropriate in hospitals of Riga, air pollution costs, development of means to facilitate assessment of air pollution costs, selection of the main organizational, technical and economic measurements.

Air quality assessment is based on established air quality objectives and economic objectives. Air quality management (AQM) refers to all the activities a regulatory authority undertakes to make sure that the air we breathe is safe, both outdoors and indoors. The AQM process is the system of understanding the sources that contribute to pollution in the air, health and environmental effects of the pollutants, and then taking steps to reduce or control the sources for reaching or maintaining the target pollution levels in the air. These levels may vary from country to country, but the overall system for planning, assessing, characterizing, mitigating, and implementing control strategies is similar.

Successful air quality management requires the establishment of an integrated system for continual air quality management. Such a system involves:

- An inventory of air pollution activities and emissions;
- Monitoring of air pollution and dispersion parameters;
- Calculation of air pollution concentrations by dispersion models;
- Inventory of population, materials, and urban development;
- Calculation of the effect of abatement/ control measures; and
- Establishment/ improvement of air pollution regulations.

In order to ensure that an AQMS is having the desired impact, it is also necessary to carry out surveillance and monitoring. This requires the establishment of an Air Quality Information System (AQIS) that can keep the authorities and the general public well informed about the quality of air, assess the results of abatement measures, and provide continuous feedback to the abatement strategy process [3].

These components are inputs into a cost-benefit and cost-effectiveness analysis. Valuation of air pollution in monetary terms is the essential component of AQM and development projects. A sustainable economic development calls for air quality management. Air pollution costs are negative external costs. In the process of producing or consuming some commodities, harmful or beneficial side effects arise that are born by companies and people not directly involved in the production or consumption of the commodities. These side effects are called externalities because they are felt by an economic unit (company and individuals) not directly involved with the economic units that generate these side effects. Externalities are called negative external costs when they are harmful. Air pollution is a negative externality because it has an adverse impact on people's health and environment.

For creating good AQM system it is important to identify the main components of air pollution and amount of emissions. Air quality measurements are taken by means of the automatic DOAS (Differential Optical Absorption Spectroscopy) stations that ensure continues registration of polluting substances in Riga. We can see the average concentrations of the main emissions in the last year in Riga in the 1. table.

1 table

The average concentrations of the main emissions in 2006

N.	Street	SO_2	NO_2	NO	O_3	CO	PM_{10}	C_6H_6	$C_6H_5CH_3$	HCO
1.	Tvaika 44	5.1	26.4	-	53.7	-	-	6.4	10.8	6.4
2.	Brīvības	5.3	60.7	-	40.9	-	54.4	8.1	10.7	-
3.	Valdemāra	-	44.8	106	16.9	900	51.0	0.7	2.4	-
4.	Maskavas	6.4	30.6	-	41.9	-	-	-	-	-
5.	Raiņa	5.1	23.8	-	26.1	-	-	-	-	-
6.	Viestura 24	8.2	20.7	-	53.2	-	-	8.3	27.4	-

Source: Riga city council, Environmental department air protection division (2006)

Sulphur dioxide, carbon monoxide and nitrogen dioxide are emitted into the atmosphere mainly from heating systems and motorized vehicles.

PM_{10} has limit value 50 µg/m^3. It can't overflow this value more than 35 times in a year. Particulates (PM_{10}) have adverse impact on human health. It causes different circulatory system diseases. According to statistical data, a large number of inhabitants suffer from various diseases of circulatory system. We can see the number of the circulatory system diseases in Riga in the 2.table.

2 table

The circulatory system diseases in 2006

	Time in hospital (days)					
	0–14 year	among 1000 inhabitants	15–17 year	among 1000 inhabitants	18 year and older	among 1000 inhabitants
Circulatory system diseases	40143	450.48	6050	220.92	81527	133.97
Acute respiratory infections	21474	240.98	2147	78.40	8511	13.99
Pneumonia	6598	74.04	780	28.48	22677	37.26
Bronchitis	195	2.19	22	0.80	12828	21.08
Asthma, asthmatic bronchitis	7388	82.91	574	20.96	13579	22.31
Other chronic pulmonary diseases	–	–	–	–	4379	7.20
Other respiratory diseases	48	0.54	19	0.69	7273	11.95

Sourses: Veselības statistikas departaments (2006)

It is necessary to know the magnitude of air pollution and its impact on people, the economy and the ecosystem. The firsts step is to observe physical changes in the environment then to estimate in monetary terms the value of environmental damages. There are useful physical and behavioral methods. Physical linkage methods have the relationship between environmental degradation (deteriorated environmental quality) and physical damage without taking into account the subjective preferences of affected people.

Based on Canadian and US studies, there is a statistically significant relationship among the cases of hospital admissions due to respiratory hospital diseases (RHA). The following functions are suggested per 100 000 population:

Upper change in RHA per 100 000 = 1,56·change in PM_{10}

Central change in RHA per 100 000 = 1,20·change in PM_{10}

Lower change in RHA per 100 000 = 0,657·change in PM_{10} [4]

3 table

Morbidity effects of 1,11 µg/m^3 change in 1,11 PM_{10} in Latvia

Upper change in RHA	Central change in RHA	Lower change in RHA
1.73	1.33	0.73

PM_{10} was high in 2003. It was 55,3 μg/m^3 in Brivibas street and 53,5 μg/m^3 in Valdemara street. In a year average PM_{10} was 55,51 μg/m^3. PM_{10} reduced in 2006. PM_{10} was 54,4 μg/m^3 in Brivibas street and 51,0 μg/m^3 in Valdemara street in 2006. Average PM_{10} was 54,4 μg/m^3 in a year. Change in PM_{10} is 1,11 μg/m^3.

Using coefficients (3.table) it is possible to estimate health associated with decreasing particulate levels. Using the lower estimate of dose-response relationship, the benefits from reducing particulates would be 292 fewer cases of respiratory hospital admissions per year (RHA coefficient · change in PM_{10} · population exposed). We assumed that population exposed was 400 who lived and worked in the center of Riga.

Air quality management system needs tools to judge the relative desirability of various environmental measures. Cost-benefit analysis (CBA) is one of them. The first step of the process is to determine the objective by which to evaluate various decisions. Next is to set the main alternatives to be analyzed. Then specify the cost and benefit elements of each decision and evaluate the cost and benefit elements in monetary terms if possible. The final step is comparing of cost and benefits of various alternative of decision.

Valuation of air pollution reducing in monetary terms is possible using some physical linkage method like cost of illness and behavioral linkage methods such as contingent valuation.

Cost of illness method is used to estimate health and safety effects of environmental degradation. These effects are divided into morbidity and mortality. The estimation of human health costs because of environmental degradation consist of three basic steps:

1) Determine the relationship between changes of environmental pollution and human health. This step involves establishing dose-response function;
2) Predict the changes in human health associated with specific changes in environmental pollution;
3) Derive monetary measures of changes in health status.

There are identified several steps in tracing the link between pollution and health, and they are:

- determine the type and volume of emission;
- estimate pollution concentration at relevant points in the atmosphere;
- establish the relationship between specific concentration of pollutant and human health (dose-response studies).

Obtained information can be used for economic valuation (the cost of the lost working day or the number of days withrestricted activity is normally estimated from average wages, and medical costs per hospital admission can also be obtained.

Dose response coefficients are obtained either through statistical analysis or from biomedical literature. A monetary cost function is the physical damage function multiplied by a unit economic value of physical damage.

The morbidity effects of people are estimated by the cost of illness method. The cost of illness method measures the cost of environmental damage in such terms:

- direct outlays for the treatment of illness like hospital care, cost of service for physicians and other medical personnel, cost of drugs;
- indirect losses in output due to illness –lost earnings;

The value of personal pain, suffering and inconveniences associated with illness are omitted.

Economic costs for changes in morbidity are very specific. Hospital admission costs are high in some states comparing to other states.

RHA in monetary terms=average stay · average cost of stay + days · lost day wage rate [5].

RHA in monetary terms =10 days · 9Ls + 10 days · 19,4Ls = 90 +194= 284 Ls.

Contingent valuation (CV) method can be used to determine what people are willing to pay or willing to accept for specified amenities or ecological values.

This approach is useful for the following types of problems:

- air and water quality;
- recreation including fishing, hunting, parks, wildlife;
- conservation of natural assets like forests, wilderness;
- option and existence values of biodiversity;
- risk of health as a result of air pollution;
- transport improvements;

CV differs from conventional market research methods as it is concerned with a hypothetical event. CV surveys ask respondents different questions about the social, economic and demographic background of the respondents and their families. Questionnaire should include a typical question: “Would you be willing to pay x Ls to improve air quality?” Respondents are asked to state his or her willingness to pay for no market goods in hypothetical market.

The values that people express in CV interviews depend upon such factors as the way of CV interviews, the design of the questionnaire, the amount of questions etc.

The authors combined cost of illness and

contingent valuation methods. We made interview by telephone and personally visited respondents at home. These approaches have their own strength and weaknesses.

The merits of this method:

- Interviewer gives basic information and can more deeply explain certain questions;
- Collected data are more real, because respondent feels safe at his/her home;
- All questionnaires are useful, because a surveyor controls the process of surveying.

The shortcomings of this method:

- The most time-consuming process in comparison with the survey by using a telephone and the survey at school;
- Respondents can be dissatisfied because the interviewer disturbs their work. Therefore respondents can give wrong answers;
- Respondents rather often want to speak not only on the given theme, but they also want to speak on other themes;
- Respondents don't want to open the door to unknown persons. That's why it is better to make such a survey with the help of the house janitor;

Where telephones are in widespread use, telephone interviews offer the advantage of cheapness, economy of time, and the ease of obtaining information. Combination of these two types of interviews was useful. Also the design of questionnaire is of vital importance. It should normally begin with a detailed description illustrated if possible with diagrams or photographs. This ensures that a respondent is well informed about it. Sometimes the interviewer should elicit how the respondent would evaluate the environmental change (willingness to pay).

The authors made a survey in the center of Riga where there is a very high transport intensity. Respondents were from the center of Riga who live and work in this region. The survey consists of 15 questions. The survey includes a typical question too - would you be willing to pay x Ls to improve air quality? Most of respondents were ready to pay 5 Ls to improve air quality. It is an easier way how to determine air pollution costs. Precise calculation is difficult because respiratory diseases are caused not only by air pollution. They influenced by other factors too such as smoking, allergies, inherent illness like asthma, negative are environment in the working place like particulates in construction of roads, houses some production etc. It is possible to indicate the following factors:

People at risk (respiratory diseases) = f (A, S, L, I, W etc.)

A – high air pollution;

S – smoking;

L – allergies;

I – inherent illness;

W – high particulate level in working place.

CV needs a very careful interpretation. It is very data-intensive, and the proper conduct of surveys is costly and time consuming.

The shortcoming CV methods is that it relies on peoples' view, rather than evidence of their market behavior. CV relies on the respondents' understanding the issue of environmental changes. This assumes a certain level of education about environmental awareness. Various biases can lead to false values in willingness to pay. Sometimes respondents may have difficulty ranking their true preferences in hypothetical situations, especially when they are unfamiliar with the problem.

This approach can be useful in evaluation components of development projects which cannot be measured using other methods. Although they may not always yield precise estimates, they do provide an information which can be very valuable. Therefore the major challenges in using CV are to design appropriate surveys and ensure their application in specific situations.

Conclusions. Air quality management includes different economical, technical and organizational measures for mobile and stationary emission reducing

Technical measures. Some of the measures appropriate for emission abatement are technical. One of them is application of (three-way or oxidative) catalytic converters. It abates about 90% emissions of CO, NO_X and VOC. Cars with a fuel control system and catalytic converters are expensive. The next technical measure for emission abatement is application of carbon filters. It is important for reduction of VOC evaporation in tanks and fuel systems. Carbon filters abate about 80% of evaporation emissions.

The other steps are connected with improving fuel quality or using alternative energy. Strict inspections and maintenance of all vehicles also can improve air quality.

Organizational measures. Good traffic management is also very important in emission reduction. Transport specialists have investigated that there is bigger pollution in congested traffic. This is a very important problem in the center of Riga. Successful traffic management reduces congestions and thus diminishing idling of vehicles, accelerating and decelerating and fuel consumption (CO emissions from idling engines are very high in congested traffic). Organizational measures include traffic signals improvements, one-way road system, coordination of different transport modes, development of public

transport system (passengers movements by trams, trolleybus, railway transport) etc.

Economical instruments. The principle "polluters-pay" is used for pollution reduction due to traffic too. In Latvia this principle is used in the town of Jūrmala, where pollution charges are used in practice. Every road user must pay an entrance fee of 1 Ls for entering the town. These revenues go to a special Town budget with the main objective to solve the environmental problems in Jūrmala. Here it is important to mention that, this payment has an important place in the scheme of how to channel high traffic passing Jūrmala, thereby improving the air quality in Jūrmala.

Efficient economical instrument is road pricing. It can bring good results: some drivers are ready to change the time of their journey, some drivers are ready to change their mode of travel – switching to walking, cycling or using public transport. Restricting the amount of motorized vehicles is possible by elevation of fuel prices. Parking pricing also influences vehicle fleet in the city.

The objectives of environmental policy cannot be determined in isolation from other objectives of other branches – agriculture, production, transport, human welfare etc. Air quality management must take it into account the decision making process. Air quality management should be based on full cost-benefit analysis including economic incentives and incorporating both transport and environment objectives.

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Air Quality Management in Riga

Summary

Air quality assessment is based on the established air quality objectives and economic objectives. Air quality management (AQM) reflects the main components of a general action plan to determine, to evaluate air pollution and then how to manage and to control it. There is high air pollution in the center of Riga. Mainly it is coused by motorized vehicles. The mount of particulates (PM 10) overflowst the allowed limit. This emission has adverse impact on human health. Air pollution costs have been calculated using dose-response relationship. A function has been developed to facilitate precise air pollution costs calculation. The main economical, technical and organizational measures have been depicted for mobile and fixed emission reducing.

Key word: air quality management, mobile and fixed emissions, particulates (PM 10), respiratory diseases, monetary valuation.