Emergency Air Protection: Implementing Smog Alarm Systems in Central and Eastern Europe

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Final Report

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Preface

Emission rates are much higher in Central and Eastern Europe (CEE) than in Western Europe, making occurrences of air pollution episodes - smog - much more likely in CEE countries. Thus, the immediate health risk due to smog is higher by far in the CEE region than in Western countries. A tool is needed to combat this situation. Until recently, only Western countries with more favorable situations had smog alarm systems to provide emergency environmental protection (emergency air protection) in the case of air pollution episodes. These systems should also be installed in those places where there is a more drastic need for them.

Smog alarm systems must be established if emergency air protection is to be provided in order decrease public health risks. The Regional Environmental Center for Central and Eastern Europe (REC) in Budapest was the main sponsor for the two-year IIASA project on Emergency Air Protection.

To achieve well designed smog alarm systems throughout the CEE region, the project was built up in three major steps:

1) To get experience and information from existing systems in the West,
2) To bring this information actively to three selected CEE cities, and
3) To facilitate the implementation process.

The IIASA contribution to this task was 1) to provide the scientific background by analyzing institutional and technical issues of smog alarm systems in Western countries (Breiling, Alcamo 1992), and 2) to assist three selected cities, Bratislava, Budapest and Cracow, currently involved in the setting up of smog alarm systems, to find the best possible design for them, and finally 3) to encourage other cities with smog areas within the CEE region to establish their own Smog Alarm System (SAS) based on the experiences of Western countries, which was evaluated using the examples of three case study cities. To achieve the last purpose a process was started by a conference on Emergency Air Protection in Central and Eastern Europe in Budapest in June, 1993.

Acknowledgment

Many thanks to all the participants of the Budapest Conference on "Emergency Air Protection in Central and Eastern Europe", held in June 1993 and those who attended the preparatory meeting in Sopron.

Special thanks go to the Hungarian Academy of Sciences, the Clean Air Action Group, the Polish Youth Forest Action Group, and the Slovak Union of Nature and Landscape protectors for organizing the meeting together with IIASA. Without their efforts this project could not have had the broad support also provided by several Hungarian institutions not individually mentioned here. Thanks also go to the Mayor of Budapest for his kind invitation.

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Chapter 1

Introduction

Main Factors Determining Smog Episodes

- There are three different factors that lead to an episode (See Figure 1.1). They have to be seen in context in order to elaborate on efficient smog alarm plans.

1) The emissions of industry, domestic heating and traffic (sources of smog episodes).
2) The meteorologic condition (reasons for smog episodes).
3) The local topography (aggravation of smog episodes).

Emissions
The amount of emissions determines the severity of smog episodes. High stack emissions have a different influence on smog than low stack ones. In general, industrial emissions are more easy to control than domestic heating and traffic, because there are only a few main contributors.

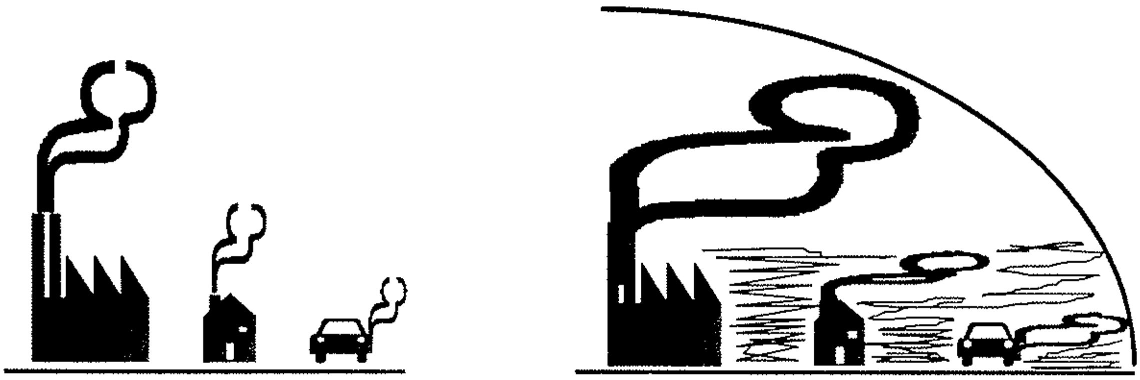
Meteorology
Smog only occurs during certain periods of the year and comes into existence at very cold or hot temperatures and at no or little wind speed. Due to an inversion layer the polluted air masses cannot ascend and stay at the bottom in the area where they were generated.

Winter smog is caused by the primary pollutants SO_2, SPM, NO_X and CO. Typically, danger of winter smog exists during 10 to 20 days during one winter. The metereologic situation in Europe has been favorable during the last four years. Because winters have been mild, temperature inversions developed less often and winter smog appeared less frequently and less severe. Despite the favorable air quality, due to the mentioned facts and improvements in low stack emissions, a recovery of industry based on high sulfur content energy fuel and cold winters would unfortunately provide evidence that the winter smog issues are not yet solved.

Summer smog is caused by the secondary pollutant O_3 (several chemical reactions are necessary to transform primary pollutants into ozone). Four years ago the summer smog problem was not yet as obvious as it is now. It is likely that the CEE regions will become the center of summer smog episodes if car densities increase further in CEE cities and standards are not considerably improved. Then, values could become higher than in the densely populated areas of Western Europe, where summer smog is nowadays one of the main local concerns. An early summer smog regulation within the CEE region is a unique chance to counter the extent of a forecasted future environmental problem.

Topography
The pollution situation can be aggravated if the topography is unfavorable. This is usually the case in hilly mountainous areas and in basins. The volume for diffusing polluted air masses is very small and, therefore, concentration can become very high with relatively few emissions. Emission sources should be eliminated first in these locations.

Fig. 1.1. Schematic presentation of factors creating a smog situation



a) Situation with no smog
This is the typical situation leading to long range export of pollutants. This type of pollution becomes a transboundary problem and effects neighboring countries more than smog episodes.

b) Situation with smog
Pollutants are tracked locally by metereologic conditions (inversion layers) and can not escape. Mountainous areas or basins worsen the situation. Most episodes do not effect neighboring countries.

Objectives of Emergency Air Protection

Protection of public health.
Smog alarm systems are established to protect the public from major health damages. Risk groups are particularly vulnerable: that is people already suffering from respiratory diseases, infants and school children. The idea is to:

i) warn the public by appropriate information and to
ii) undertake short-term measures to shorten the extent of the episodes.

Therefore, public information and short-term measures are the two key elements of a smog alarm system.
Smog is extreme air pollution where concentrations of SO_2, SPM, NO_X CO (winter smog) and O_3 (summer smog) are many times (up to 30 times) higher than the yearly average and several times (up to 10 times) higher than recommended World Health Organization (WHO) air quality standards (See Table 1.2).

Table 1.2. WHO general air quality standards in micrograms per cubic meter.

	SO_2	SPM	NO_2	CO	O_3
Annual mean	40-60	60-90			
98%ile	100-150	150-230			
24 hours			150		
8 hours				10,000	120
1 hour			400	30,000	150-200
30 min				60,000	
15 min				100,000	

Smog episodes will result in "smog alarms" only if they exceed the given criteria, which are not only based on considerations concerning public health and that differ from country to country. In many systems surveyed, smog criteria are established in such a way that up to a certain level no protection is granted and interventions against episodes can only take place during acute emergencies. In this situation, permanent air pollution reduction measures are required against smog. However, in most cases a smog alarm system indicates the smog problem and does express the will of society to counter, at least, the extent of the smog problem.

Cutting down peak concentrations

Local peaks

In general, smog areas cover around 1000 km^2 or tens of kilometers in diameter. In most cases the local pollution cannot escape due to temperature inversion (unfavorable metereologic conditions) and due to unfavorable topographic conditions, for example in hilly, mountainous areas or in basins. Winter smog, caused by the primary pollutants SO_2, SPM or NO_X effects directly the place where it is emitted. Summer smog is caused by the secondary pollutant ozone, which is generated by the coexistence of primary pollutants NO_X and CxHy (volatile organic compounds). Therefore, summer smog does not extend over the same areas as winter smog and are usually larger in size.

Time peaks

We do not have the same likelihood of the generation of smog concentrations all the time. As indicated by the names, winter and summer, smog can exist only in certain periods of the year. Winter smog is likely in midwinter at particularly cold temperatures from December to March. Summer smog is correlated to high temperatures and occurs in Europe between May and August. Counting all possible dangerous days together, they add up to perhaps two weeks. Higher wind speeds favor the mixing of air layers and temper the smog situation.

Enforcement of short-term measures during smog alarms.

If all alarm criteria are met, there should also be reduction and control measures. Otherwise, the system cannot provide incentives for industry, citizens and drivers. In this respect, efficiency is low. Normally, the pre-alarm does not foresee binding measures. Level 1 and level 2 alarms force action in emission reduction measures. At the moment, many western countries discuss how to put summer smog regulation into action. Proposed traffic measures, e.g., in Switzerland and Zürich in particular, would have had consequences, in particular for the individual traffic, and would have to be ordered before an emergency exists. Therefore, we face a dilemma, because short-term measures are seen only as a consequence of emergencies and not as restraints to avoid these situations.

Developing models as forecasting tools
If measures should be acted on in time, reliable forecasting tools have to exist. This task can be taken over by computer models. Various models exist that could be used individually or in combination. Two examples are: the models of Cracow to forecast winter episodes and the Los Angeles summer smog model. Since models cannot be simply taken over, they have to be adjusted to typical local conditions.

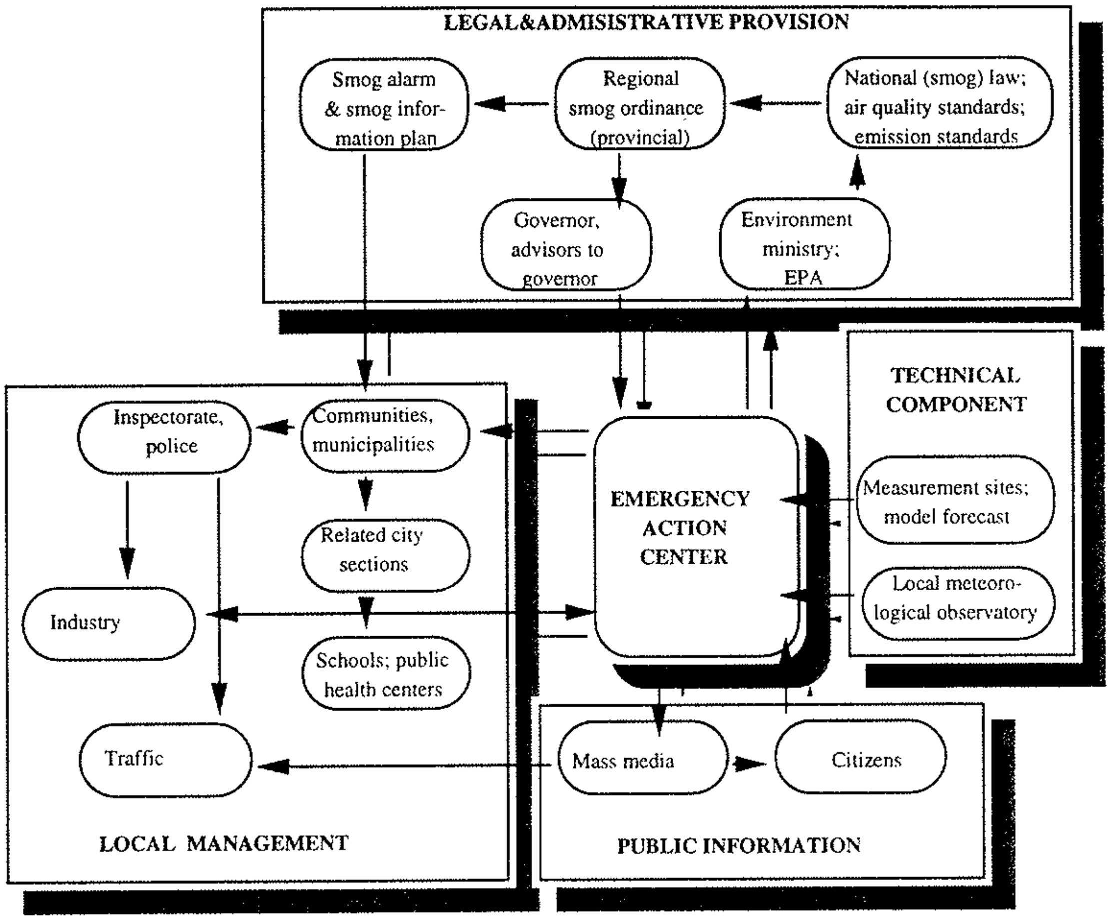
Smog Alarm Systems as first the step to general air quality
There are three emissions sources for smog episodes from industry, domestic heating and traffic. The main obstacles to achieving permanent pollution reduction are the high costs of pollution control, the competition in pollution control, and the competition for available funds between pollution control and economic development. A recovery of industry with the current industrial infrastructure, where most of the plants are relatively old, will lead to the same pollution levels experienced in the last years of the socialist period. A reconstruction of the industry, similar to that in the former Eastern Germany is desirable for CEE countries. A higher living standard might enable the population to afford state-of-the-art automobiles and to switch from coal to gas heated firing.

Serving as an educational tool
A main purpose of smog alarm systems is to bring adequate awareness of the immediate (although perhaps temporary) seriousness of air pollution to the population. There is information about the level of pollution that attempts to enable risk groups primarily, to perform individual actions. Measures during an alarm demonstrate to the public that they contribute to air pollution and that they become restricted from performing their usual activities.

Institutional setup of smog alarm systems

Smog alarm systems are interdisciplinary. Different institutions are involved from various scientific and administrative fields. Five individual subsystems are selected in the following figure to describe the linkages within a smog alarm system and identify the components of smog alarm subsystems.

Figure 1.3. Typical smog alarm communications.



The legal component of an SAS consists of different administrative bodies within one country.

Emergency Action Center

The Emergency Action Center is the core element of a smog alarm system. All information is centralized here. Smog counter measures and smog information to the public are coordinated from here.

Legal subsystem of SAS

Smog alarm laws and laws describing emission standards are developed on a national base. The responsibility for announcing smog alarms usually lies with provincial or county government officials. Individual smog alarm plans are elaborated for communities or municipalities or smog alarm districts. The governor or one of his assisting officers proclaims a smog alarm on the basis of predefined criteria.

Technical subsystem of SAS

Monitoring network

Five constituents: SO2, SPM, NOx, CO and O3 are smog relevant. The monitoring network is the largest capital cost of the system. Costs are in the range of US$ 100,000 to 350,000 (depending on the number of constituents measured, the sophistication of the equipment and some additional variables). The annual maintenance costs are between US$ 10,000 and US$ 100,000.

Meteorological observations

Smog alarm is usually given only after consultations with those who perform the meteorological forecast, since a smog episode can only be generate because of unfavorable meteorologic conditions.

Local management subsystem of SAS

Certain institutions are informed in advance about smog alarm measures or who must be contacted in the case of smog alarm. The responsible city sections inform health and school authorities as well as control agencies about an episode. Risk groups are informed by their authorities and controllers and the police proof the execution of emission reduction measures in industry and traffic. The Emergency Action Centers of the advanced SAS in Japan have the possibility of direct control of the main polluters because permanent emission exhaust measurement stations have been established.

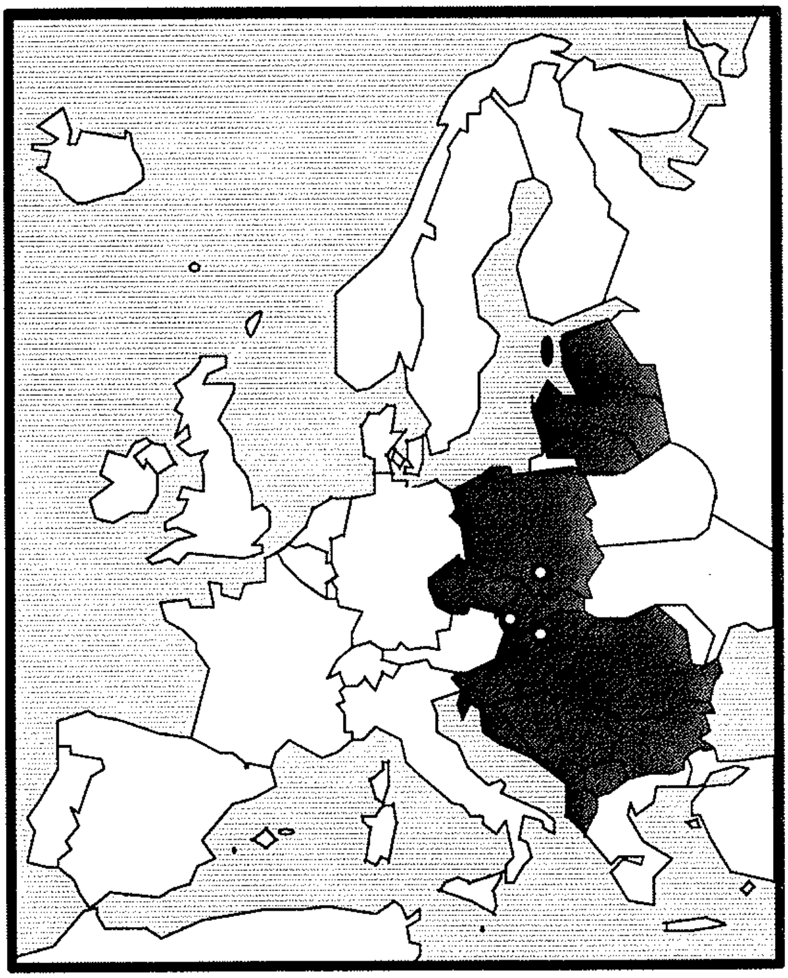
Public information subsystem of SAS

The Emergency Action Center is obliged to inform the mass media about the proclamation of an alarm. Usually, some key values of the day are sent to the media or to interested institutions. The mass media, radio and TV announce the proclamation of an alarm in their programs. Through these announcements the public is informed. In addition, many systems have established a telephone hot line, so that the public can obtain the most recent information.

The Central and Eastern European Region

Four years have passed since the opening of the former socialist Central and Eastern European (CEE) countries. In the CEE at present there is a period of transition and economic depression. The standard of living for the majority of the citizens is worse than it was before the opening. The majority suffers due to a lack of social security. Therefore, it is not surprising that day-to-day problems diminished the intensity of environmental awareness.

Map 1.4.: The Central and Eastern European Region



Some of the known environmental problems - in particular ambient air quality problems - decreased during the last four years. Unfortunately, economic recession was the main driving force responsible for reducing the amount of industrial emissions (SO_2, SPM, NO_X). While the use of total primary energy consumption decreased 38% in Bulgaria, 21% in former Czechoslovakia, 14% in Hungary, 21% in Poland and 31% in Romania, the industrial output decreased even more, between 31% in Poland and 55% in Romania (Cofala, 1993). Another reason for improved air quality (SO_2, SPM) was the introduction of centralized gas heating facilities. In Cracow, where low stack emissions from domestic heating were particularly high and almost all heating was coal-based, some 50% of the apartments are now gas-heated. In Bratislava 90% of private apartments are gas-heated.

The three sources mentioned, industrial emissions, domestic heating and emissions from traffic (mobile sources) are the main contributors to smog episodes. During the last four years, there was a change in the relative contribution of the emission sources. The improvements in industrial and domestic sectors are offset partly by the increase in traffic and traffic emissions, mainly nitrogen oxides (NO_X), carbon monoxide (CO) and hydrocarbons (CxHy). During the last few years the number of cars doubled and tripled in the major centers of CEE countries. The demand was satisfied by worn-out western cars, which to a large percentage no longer corresponded to stringent Western emission standards. Motortruck traffic has multiplied since the opening of CEE countries. Rail traffic decreased heavily. Lacking appropriate infrastructures, lorries have to pass city centers in many cases and thereby contribute additionally to traffic jams and reduced urban air quality (NO_X, CO, O_3).

The interdisciplinary character of smog alarm systems makes it difficult to establish these systems in CEE countries. Various interests contribute to their design. However, a joint harmonized effort carried out by all CEE countries simultaneously can accelerate the process of the establishment of smog alarm systems within the CEE region. Individual countries would not be in isolation (as Western countries have been) while developing the systems, and could support each other. A successful experience in CEE could also stimulate other regions of the world, for example, the neighboring countries of former Soviet Union, or countries undergoing heavy industrial development like Brazil, China, India and others could start to cooperate on the issue of emergency air protection and to counter smog episodes.

Chapter 2

Major Findings from Western Countries

This chapter summarizes the conclusions presented in the report prepared at the end of Phase I of the study (Breiling, Alcamo , 1992).

Monitoring Network

The networks in the cities reviewed measure the following pollutants: SO_2, SPM, NO_X, CO and O_3. The monitoring network is the largest capital cost of the system. Costs of stations range from about US$ 100,000 to US$ 350,000 (depending on the number of constituents measured, the sophistication of the equipment, and other variables). The annual maintenance costs per station vary widely between US$ 10,000 and US$ 100,000, depending on how the maintenance is carried out – whether it is by the staff of a local government agency, a private firm, or other.

Table 2.1. Description of smog areas and number of measurement sites

	Smog areas according to size				Number of measurement sites[a]					
Smog area	Population (× 1000)	Population density (people/km²)	Smog areas (km²)	Urban area (>1000 people /km²)	Multi[c]	SO_2	SPM	NO_x	CO	O_3[b]
Cities										
Graz	249	1,960	127	yes		4	4	6	2	2 (17)[c]
Kawasaki[d]	1.188	8,250	144	yes		9	9	18	12	9
Linz	250	1,667	150	yes		10	10	10	10	3 (11)[c]
Milan	1,561	8,577	182	yes		10	4	9	8	2
Nagoya	2,080	6.380	326	yes		23	23	27	14	20
Vienna	1,590	3.831	415	yes		14	11	13	14	4 (20)[c]
Kitakyushu[e]	1,065	2,285	466	yes	14					
Kobe	1,777	3.279	542	yes		13[d]	13	18	6	12
Grenland	100	125	800	no		5	2	4		3
Berlin	3,350	3,794	883	yes		38	27	27	10	9
Hof (district)	120	133	903	no		2	2	2	2	2
Zürich (canton)	1,110	642	1,729	no		12	6	12	5	6
Smog alarm districts										
Osaka (region)[e]	7.750	4.160	1.863	yes	121					
Rhine Ruhr (district)	7,000	1.892	3,700	yes		54	54	54	54	33
Sachsen (state)[e]	5,100	288	17,713	no	33					
Leipzig (district)[f]	1,400	283	4,966	no		14	2	1		
Dresden (district)[f]	1,810	268	6,738	no		32	3			
Sachsen-Anhalt (state)	3,100	153	20,292	no		27	9	9	9	5
Halle (district)[g]	1,700	194	8,771	no		35	4		1	6
Los Angeles (region)	13,000	433	30,000	no		11	7	23	21	33
Netherlands (entire country)	14,400	353	40.844	no		85	23	45	26	38

[a]These refer to automatic measurement sites, except for Leipzig, Dresden, and Halle.
[b]In some cases other oxidants are also measured.
[c]Number of entire county that is relevant as summer smog area.
[d]NO_2, CO with emission exhaust stations.
[e]The number of total multicomponent measurement sites, number for constituents might be less.
[f]Since October 1990 part of Sachsen. These districts of Sachsen are presented separately because data were available for them.
[g]Since October 1990 part of Sachsen-Anhalt. This district of Sachsen-Anhalt is presented separately because data were available for it.

Although different cities have drastically different numbers of stations, they have roughly the same coverage per unit population. On average, there are 0.8 stations per 100,000 inhabitants for SO_2, which makes more data available on this pollutant.

Criteria for Calling Alarms

The responsibility for announcing smog alarms normally lies with provincial or county government officials. Legal authority is usually derived from a national smog alarm law (Austria, Germany, Japan, the Netherlands, the USA) or provincial legislation (Italy, Switzerland). With this authority, a local government adopts a smog ordinance which specifies an Emergency Action Plan. Contained in the ordinance or plan are the criteria and procedure for calling an alarm, a specification of the lines of communication in the event of an episode, and the countermeasures that must be taken.

The cities surveyed use different criteria and in different combinations to decide whether or not to call an alarm.

Threshold Values

Table 2.2. Smog alarm threshold values in microgram per cubic meter

	Pre-alarm					Level 1 alarm					Level 2 alarm				
Smog area	SO_2	SPM	NO_2	CO	O_3	SO_2	SPM	NO_2	CO	O_3	SO_2	SPM	NO_2	CO	O_3
Graz	400	600[a]	350	20,000	200	600	800[a]	600	30,000	300	800	1,000[a]	800	40,000	400
Kawasaki[b]	534	—	—	—	240	1,335	—	—	—	480	1,869	—	—	—	800
Linz	400	600[a]	350	20,000	200	600	800[a]	600	30,000	300	800	1,000[a]	800	40,000	400
Milan[h]	250	—	200	10,000	—	500	—	400	30,000	—	—	—	—	—	—
Nagoya[b]	—	—	—	—	240	—	—	—	—	480	—	—	—	—	800
Vienna	400	600[a]	350	20,000	200	600	800[a]	600	30,000	300	800	1,000[a]	800	40,000	400
Kitakyushu[b]	—	—	—	—	240	534	—	—	—	—	—	—	—	—	800
Kobe[b]	267	—	—	—	240	534	—	—	—	—	—	—	—	—	800
Grenland	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Berlin[c]	600	1,100[d]	600	30,000	—	1,200	1,400[d]	1,000	45,000	—	1,800	1,700[d]	1,400	60,000	—
Hof[c]	600	1,100[d]	600	30,000	—	1,200	1,400[d]	1,000	45,000	—	1,800	1,700[d]	1,400	60,000	—
Zürich[e]	200	—	—	—	240	350	—	—	—	—	—	—	—	—	—
Osaka[b]	534	2,000	960	—	240	1,335	—	—	—	480	1,869	3,000	1,920	—	800
Rhine Ruhr[c]	600	1,100[d]	600	30,000	—	1,200	1,400[d]	1,000	45,000	—	1,800	1,700[d]	1,400	60,000	—
Sachsen[c]	600	1,100[d]	600	30,000	—	1,200	1,400[d]	1,000	45,000	—	1,800	1,700[d]	1,400	60,000	—
Sachsen-Anhalt[c]	600	1,100[d]	600	30,000	—	1,200	1,400[d]	1,000	45,000	—	1,800	1,700[d]	1,400	60,000	—
Los Angeles[b]	720	300	960	20,000	480	275	138	1,320	27,500	660	400	200	1,920	40,000	960
Netherlands[f]	150	450[g]	—	—	240	350	700[g]	—	—	360	[f]	[f]	—	—	[f]

[a] Austrian index: SPM + SO_2.
[b] Original values in ppb.
[c] After 72 hours the state of alarm is automatically advanced one level.
[d] German index: 2 × SPM + SO_2.
[e] Swiss pre-alarm values are twice the ambient standard.
[f] Decision of Councillor of the Queen.
[g] Dutch index: SPM + SO_2 − 10.
[h] After 120 hours pre-alarm is advanced to level 1 alarm.

The values used by different cities vary by about a factor of two. In a few cases, the thresholds for a level 1 alarm in a particular city are lower than the thresholds for a pre-alarm in other cities. For example, the SO_2 threshold for a level 1 alarm in Kobe (534 $\mu g\ m^{-3}$) is lower than the pre-alarm threshold for Berlin and other German cities (600 $\mu g\ m^{-3}$). These differences are justified, in part, by the differences in air quality between cities. For instance, if air quality is poor and the threshold is low, then alarms will be announced often, which can lead to an attitude that air pollution episodes are routine. This, in turn, can lead to a lack of enthusiasm for countermeasures, as occurred in Milan, where the 100 alarm days called over five years led to a general indifference to these warnings. Although there is justification for thresholds being different in different cities, they should at least be related to public health guidelines for air pollutants, since, after all, smog alarm systems are designed to help protect public health. However, these threshold values are all far from WHO guidelines. Some international harmonization of these thresholds is obviously needed.

Number of Hours a Threshold Exceeded

Table 2.3. Number of hours for which threshold must be exceeded before alarm is called (In some cases these are averaging times, in other cases duration of instantaneous measurements)

	Pre-alarm					Level 1 alarm					Level 2 alarm				
Smog area	SO_2	SPM	NO_2	CO	O_3	SO_2	SPM	NO_2	CO	O_3	SO_2	SPM	NO_2	CO	O_3
Graz	3	3[a]	3	3	3	3	3	3	3	3	3	3	3	3	3
Kawasaki	2	—	—	—	1	2	—	—	—	1	2	—	—	—	1
Linz	3	3[a]	3	3	3	3	3	3	3	3	3	3	3	3	3
Milan[g]	1	—	1	1	—	1	—	1	1	—	—	—	—	—	—
Nagoya	—	—	—	—	1	—	—	—	—	1	—	—	—	—	1
Vienna	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Kitakyushu	3	—	—	—	1	3	—	—	—	—	—	—	—	—	1
Kobe	3	—	—	—	1	3	—	—	—	—	—	—	—	—	1
Grenland	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Berlin[b]	3	24[c]	3	3	—	3	24	3	3	—	3	24	3	3	
Hof[b]	3	24[c]	3	3	—	3	24	3	—	—	—	—	—	—	—
Zürich[d]	24	—	—	—	1	24	—	—	—	—	—	—	—	—	—
Osaka	2	2	1	—	1	2	—	1	—	1	2	3	1	—	1
Rhine Ruhr[b]	3	24	3	3	—	3	24	3	3	—	3	24	3	3	—
Sachsen[b]	3	24	3	3	—	3	24	3	3	—	3	24	3	3	—
Sachsen-Anhalt[b]	3	24	3	3	—	3	24	3	3	—	3	24	3	3	—
Los Angeles	24	24	1	8	1	24	24	1	8	1	24	24	1	8	1
Netherlands[e]	24	24	—	—	1	24	24[f]	—	—	1	—	—	—	—	[illegible]

[a] Austrian index: SPM + SO_2.
[b] After 72 hours the state of alarm is automatically advanced one level.
[c] German index: 2 × SPM + SO_2.
[d] Swiss pre-alarm values are twice the ambient standard.
[e] Decision of Councillor of the Queen.
[f] Dutch index: SPM + SO_2-10.
[g] After 120 hours pre-alarm is advanced to level 1 alarm.

In addition to specifying a threshold value, most cities also specify a period of time for which the pollutant must exceed its threshold. This varies from 1 to 24 hours, based on the type of pollutant and the particular city or smog area. This period of time corresponds in many cases to the typical or required collection time of pollutants.

Additional smog alarm criteria: Forecast of Meteorological Conditions. Number of Stations Exceeded. Model support.

Figure 2.4. Additional criteria to smog alarms

	% of meas. sites exceeding threshold					Forecast of met. conditions (hours)[a]					Model support to predict episodes				
Smog area	SO_2	SPM	NO_2	CO	O_3[e]	SO_2	SPM	NO_2	CO	O_3	SO_2	SPM	NO_2	CO	O_3
Graz	33	33	33	33	2	12	12	12	12	—	—	—	—	—	—
Kawasaki	22	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Linz	33	33	33	33	2	12	12	12	12	—	—	—	—	—	—
Milan	50	—	50	50	—	—	—	—	—	—	model[b]	—	—	—	—
Nagoya	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Vienna	33	33	33	33	2	12	12	12	12	—	—	—	—	—	—
Kitakyushu	[c]	—	—	—	1	—	—	—	—	—	—	—	—	—	model
Kobe	[c]	—	—	—	1	—	—	—	—	—	—	—	—	—	model
Grenland	—	—	—	—	—	—	—	—	—	—	model	model	model	model	model
Berlin	33	33	33	33	—	24	24	24	24	—	—	—	—	—	—
Hof	[c]	[c]	[c]	[c]	—	24	24	24	24	—	—	—	—	—	—
Zürich	[c]	—	—	—	1	24	—	—	24	—	—	—	—	—	—
Osaka	[c]	—	[c]	—	1	—	—	—	—	—	model[d]	—	—	—	model
Rhine Ruhr	33	33	33	33	—	24	24	24	24	—	—	—	—	—	—
Sachsen	33	33	33	33	—	24	24	24	24	—	—	—	—	—	—
Sachsen-Anhalt	33	33	33	33	—	24	24	24	24	—	—	—	—	—	—
Los Angeles	[c]	[c]	[c]	[c]	[c]	—	—	—	—	—	—	—	model	model	model
Netherlands	[c]	[c]	—	—	[c]	—	—	—	—	—	—	—	—	—	model

[a]Numbers of hours unfavorable meteorological conditions forecasted to continue.
[b]Currently not in use.
[c]At least one station.
[d]Nonnumerical model based on a flowsheet diagram.
[e]Number of measurement sites.

An additional criterion that some cities use for calling or continuing a smog alarm is to require that unfavorable meteorological conditions be forecasted to continue. The period of this forecast is specified as either 12 or 24 hours. Some cities do not require this specific forecast.

It is not unusual for air pollution concentrations to vary somewhat from station to station within the same smog area because of the proximity of pollution sources or local variations in air ventilation. Consequently, smog ordinances often require that a specified minimum number of monitoring stations measure concentrations exceeding a threshold before a smog alarm is called or continued. On the average, one in three stations or one in two stations must record high pollutant levels.

Some smog areas use models to predict episodes. Models can also be used to calculate air pollution concentrations in areas where there are no or not sufficient measurement stations available.

Factors contributing to smog episodes

Emissions from various sectors contributing to smog episodes

Table 2.5. Sources of episodes

Smog area	Expected sources of local air pollution episodes[a]					Constituents relevant to smog ordinances					
	SO_2	SPM	NO_x	CO	O_3	No. of sub-districts	SO_2	SPM	NO_x	CO	O_3
Cities											
Graz	h,i	h	t,i	t	t		•	•	•	•	•
Kawasaki	i	—	t,i	t	t,i		•	—	—	—	•
Linz	i	i	—	—	t,i		•	•	•	•	•
Milan	h	h	t,h	t	—		•	—	•	•	—
Nagoya	—	i	t,i	t	t,i		•	—	—	—	•
Vienna	h	h	t	t	t,i		•	•	•	•	•
Kitakyushu	i	—	t,i	t	t,i		•	—	—	—	•
Kobe	i	—	t,i	t	t,i		•	—	—	—	•
Grenland	—	i	t,i	—	t,i		—	—	—	—	—
Berlin	ii,h,t,i	ii,h,i	t	t	—		•	•	•	•	—
Hof	ii	ii	—	—	—		•	•	•	•	—
Zürich	—	—	t	t	t		•	•	—	—	•
Smog alarm districts											
Osaka	i	—	t,i	t	t,i	7(3 SO_2)	•	•	•	—	•
Rhine Ruhr	i,h,ii	i,h,ii	t	t	t,it	5	•	•	•	•	—
Sachsen	i,h	i,h	i,t	—	—	10	•	•	•	•	—
Sachsen-Anhalt	i,h	i,h	i,t	—	—	10	•	•	•	•	—
Los Angeles	—	—	t,i	t	t,i	34	•	•	•	•	•
Netherlands[b]	ii	ii	t,i	t	t,it	12	•	•	—	—	•

[a]Opinion of local experts noted during July 1991 and April 1992.
[b]Not a smog area.
i = local industry
t = local traffic
h = local heating
ii = regional industry
it = regional traffic

There are three different kinds of emissions, coming from industry, domestic heating and traffic. In addition, there is differentiation between local and regional origin. High loads of emission imports make it more likely for local sources to exceed the alarm criteria. In addition, smog abatement is more difficult.

Table 2.6. Number of recent smog alarms

Smog area	Period years	Pre-alarm					Level 1 alarm					Level 2 alarm				
		SO_2	SPM	NO_2	CO	O_3	SO_2	SPM	NO_2	CO	O_3	SO_2	SPM	NO_2	CO	O_3
Graz	1987–1992	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—
Kawasaki	1981–1990	—	—	—	—	30	—	—	—	—	—	—	—	—	—	—
Linz	1980–1992	—	9	—	—	2[b]	—	—	—	—	—	—	—	—	—	—
Milan[a]	1987–1991	—	—	100	—	—	—	—	15	—	—	—	—	—	—	—
Nagoya	1990	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—
Vienna	1975–1992	—	—	—	—	6[b]	—	—	—	—	—	—	—	—	—	—
Kitakyushu	1974–1991	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kobe	1967–1991	97	—	—	—	4	16	—	—	—	—	—	—	—	—	—
Grenland	No regulation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Berlin	1980–1991	12	4	—	1	—	4	4	—	—	—	—	—	—	—	—
Hof (district)	1985–1991	6	—	—	—	—	—	—	—	—	—	1	2	—	—	—
Zürich (cantone)	1985–1991	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Osaka (region)	1965–1990	45	—	—	—	461	66	—	—	—	324	—	—	—	—	—
Rhine Ruhr	1979–1990	2	—	—	—	—	—	—	—	—	—	1	—	—	—	1
Leipzig(county)[c]	Nov–Dec 89	1(286)[d]	—	—	—	—	108[d]	—	—	—	—	1	—	—	—	—
Dresden(county)[c]	Nov–Dec 89	1(68)[d]	—	—	—	—	6	—	—	—	—	45[d]	—	—	—	—
Halle(county)[e]	Nov–Dec 89	1(72)[d]	—	—	—	—	>1	—	—	—	—	—	—	—	—	—
Los Angeles (region)	1980–1990	—	—	56	82	844	—	—	—	—	34	1	—	—	—	—
Netherlands (country)	May–June 89	—	—	—	—	13[f]	—	—	—	—	—	—	—	—	—	—

[a]No statistics available, approximate values for NO_2.
[b]Number of pre-alarm levels since May 1992 (May 1 to August 10, 1992).
[c]Currently part of Sachsen.
[d]Hours in excess.
[e]Currently part of Sachsen-Anhalt.
[f]Value from Noord-Brabant; pre-alarm levels occurred on from 4 to 13 days in 7 of 12 smog districts.

One interesting observation was that proclamations of alarm are rarely made by those communities with smog alarm systems. Compulsory measures are very rare. Five areas really experienced a level 2 alarm. In recent years, no Western area experienced a level 2 alarm. Another four areas experienced a level 1 alarm. For the majority of the smog areas described here (10 out of 19), no smog alarm leading to compulsory measures was announced.

Types of Countermeasures

There are some similarities among cities in the countermeasures they employ during the various stages of smog alarm. These measures can be grouped into four categories: (1) health advisories, (2) reductions of industrial emissions, (3) reductions of emissions from heating, and (4) reductions in emissions from traffic.

Table 2.7. Episode counter measures at different alarm levels

		Pre-alarm			Level 1 alarm			Level 2 alarm		
Smog area	Health advisory	Industry	Heating	Traffic	Industry	Heating	Traffic	Industry	Heating	Traffic
Graz[a]	•	—	—	—	•	•	•	•	•	•
Kawasaki	•	•	—	—	•	—	—	—	—	—
Linz[a]	•	—	—	—	•	•	•	•	•	•
Milan	•	—	—	—	—	—	•	•	—	•
Nagoya	•	•	—	—	•	—	—	•	—	—
Vienna[a]	•	—	—	—	•	•	•	•	•	•
Kitakyushu	•	•	—	—	•	—	—	•	—	—
Kobe	•	•	—	—	•	—	—	•	—	—
Grenland	•	—	—	—	—	—	—	—	—	—
Berlin	•	—	—	—	•	•	•	•	•	•
Hof	•	—	—	—	•	—	—	•	—	—
Zürich	•	—	—	—	—	—	—	—	—	—
Osaka	•	•	—	—	•	—	—	•	—	—
Rhine Ruhr	•	—	—	—	•	•	•	•	•	•
Sachsen	•	—	—	—	•	•	•	•	•	•
Sachsen-Anhalt	•	—	—	—	•	•	•	•	•	•
Los Angeles	•	•	—	•	•	—	•	•	—	•
Netherlands	•	—	—	—	•	—	—	•	—	—

[a]Currently only for winter smog alarm. Summer smog alarm systems scheduled to be operating by 1994.
•Measures implemented by local authorities.

During a pre-alarm, measures are usually recommended. However, all smog areas specify a health advisory during this stage, and some require emission reductions at industrial sites. Los Angeles also requires measures to reduce traffic during the pre-alarm stage. In many smog areas measures are recommended for reducing emissions from industry, heating and traffic. Some cities offer free rides on public transportation.

In the level 1 alarm, most areas require specific measures at industrial sites. These include banning of sulfur-rich fuels and reduction of energy consumption. Also included are actions to control heating emissions by requiring a reduction in room temperatures in public buildings. During this alarm stage it is also typical to restrict traffic somewhat by, for example, limiting areas in which private vehicles may be used or restricting usage of vehicles with odd or even license plate numbers.

When a level 2 alarm occurs, the measures prescribed are similar to level 1, but fewer exemptions are allowed. In some cases, industries are closed and large public gatherings are prohibited.

Table 2.8. Summary of most common countermeasures

	Pre-alarm	Level 1 alarm	Level 2 alarm
Industry	Lower capacity Use low-sulfur fuel Voluntary enforcement of reduction plan	Further capacity reduction Use low-sulfur fuel Enforcement of reduction plan	Close some plants Further capacity reduction Enforcement of reduction plan
Domestic heating	Reduce heating Reduce room temperature Advise use of low-sulfur fuel	Reduce heating Further reduction of room temperature Use low-sulfur fuel	Reduce heating Further reduction of room temperature Use low-sulfur fuel
Traffic	Use public transportation Avoid using private cars Organize car pools	Enforce traffic plan Restrict private car use Ban cars in certain areas on certain days	Weekend schedule Allow only emergency vehicles Ban all cars
Others			Ban public gatherings

Effectiveness of Countermeasures

Relatively little attention has been given to evaluating the effectiveness of episode countermeasures, and much work is needed in this area. Some measures may seem ineffectual, but have less obvious aims. As an example, certain cities call for reduction in traffic when high levels of SO_2 occur, although traffic emissions can lead to high levels of photo-oxidants but never to SO_2. Nevertheless, air pollution authorities in Germany believe that traffic restrictions in this case are worthwhile because they build public awareness of high levels of air pollution.

A more serious concern about countermeasures has to do with the origin of summer smog in Western Europe. Episodes can extend over large parts of Europe and originate from the long-range transport of pollutants. Hence, measures to reduce the local sources of smog may be fruitless in reducing the severity of episodes if they are caused by long-range transport.

Despite these problems countermeasures should, in principle, be able to reduce the severity of winter smog episodes, or at least the exposure of populations during these episodes. The most effective countermeasures can be identified with the help of computer models that establish the cause-effect relationship between sources, both local and distant, and the occurrence of episodic air pollutant levels.

Smog Alarm Communication and Emergency Action Centers

During a smog episode, the Emergency Action Plan is coordinated by the Emergency Action Center. This center is usually located in a main data processing center of a county or province, but can also be located at a national scientific institute (RIVM in the Netherlands) or within a municipality (as in several Japanese cities). Typically, the center is located in the offices of the weather service or environmental protection agency. In the case of Los Angeles, there are several emergency action centers located in the offices of county districts. As noted above, the local smog ordinance or Emergency Action Plan specifies the lines of communication during an episode. The Emergency Action Center contacts all main institutions involved in countermeasures via telephone or telefax. These institutions then pass the alarm on to institutions within their jurisdictions. For example, the local department of education will contact schools and the health department will notify hospitals, etc. In Los Angeles, large workplaces are required to have smog alarm coordinators for coordinating episode countermeasures. The Emergency Action Center also notifies the mass media which, in turn, informs the public. Some cities have additional means to notify the public in other ways, for example by a loudspeaker (Kawasaki) or electronic boards displaying ambient air quality values (Vienna). Other cities provide a telephone hot line for answering public inquiries about the smog situation.

Institutional Barriers in Implementing Smog Alarm Systems

Due to political considerations Western smog alarm systems are lagging behind in their potential uses. The regulations have not been updated to current needs and, with the exemption of former Eastern Germany, they no longer help (winter smog) or do not yet help (summer smog) to protect public health sufficiently or to further improve air quality standards.

Timeliness of Organizing Smog Alarm Systems
One troubling observation resulting from studying the smog areas in Western countries is that many smog ordinances came into effect long after air pollution episodes stopped being a local problem. This was the case in Japan, where winter smog alarm laws were not passed until 1978, four years after the last serious winter smog episode. The same can be said of many Western European cities with smog alarm systems, because they usually only regulate winter smog, which is not as much of a problem as summer smog. Only Austria has a summer smog law which foresees warnings but no short term measures. This is not to say that winter smog regulations should be eliminated (since an episode may still occasionally occur), but that effective winter smog regulations should be implemented sooner in Eastern Europe.

Business opposition
An additional problem is public or business opposition to the measures proposed to lessen the effect of an episode, such as traffic restrictions or reducing room temperatures. There have been many conflicts, and much resistance from the parties who would be forced to undertake measures. Industries initially opposed the idea. They were afraid of economic losses as a consequence of these measures. Finally, industry had to accept the establishment of smog alarm systems, and catalyzed general air quality measures. Industries which were risking interruption by an alarm had an incentive to improve facilities at an early stage. Nowadays, the former well-known smog areas in West Germany and Japan have good air quality in spite of their industrial activities, which are regulated very well by smog ordinances.

The other problem contributing to smog episodes was coal-fired heating in most households. This situation was improved by substituting centralized heating facilities based on cleaner fuels.

The most difficult problem was and still is the regulation of ever increasing motorized traffic. Countries like Germany and Italy were opposing stricter automobile standards in order not to harm their car industries.

Looking at the situations in the US and Japan one could ask if the existence of smog alarm systems contributed to a set of more stringent emission standards. One result has been the promotion of catalytic converters. The frequent summer smogs of Los Angeles or major Japanese cities forced the issue there, at a time when this problem was less severe in the densely populated areas of colder Europe. There it became only a problem in recent years and catalytic converters have since been introduced in the EC countries. Nowadays, politicians hesitate to introduce summer smog ordinances, because contrary to the situation in industry some years ago, many more people would be affected by these measures and unpopular measures might cost votes. This is so in spite of the fact that a summer smog law could be accompanied by the incentive to renew the car fleet much earlier than is done today.

Occasionally, opposition to measures originates at a different level of government, as in the case of Zürich, when measures adopted by the city to reduce summer smog episodes were vetoed by the canton (provincial) government. Experience in other cities has shown that if organizers of the smog alarm system consult early enough with these groups much of their opposition can be eliminated.

Unreliability of Measurement Stations

Another type of problem occurred in Milan where the breakdown of its monitoring stations led to difficulty in complying with its smog ordinance. In order to call an alarm, a threshold must be exceeded at several stations; however, because measurement devices at these stations failed to operate correctly, this requirement often could not be met.

Transboundary transport of smog pollutants

Some specific smog regions, e.g., former West Berlin or Hof (on the border to East Germany) had no chance to manage smog episodes on a local scale, because some 90% of the local pollution originated from outside the immediate area. In most cases, this situation was typical for some unfavorably situated areas, but during the winter of 1985 (Lübkert-Alcamo 1989) winter smog pollutants originating from the main industrial areas of former East Germany, the Czech Republic and Poland caused severe episodes in Germany, Netherlands and other parts of Europe that usually were not effected by emission imports. Local measures could only prohibit a more dramatic increase.

Still another problem is faced in the Netherlands, where measures against summer smog episodes would be ineffectual because much of the photo-oxidant pollution originates from the long-range transport of nitrogen oxides from outside the country.

Chapter 3

Bratislava, Budapest and Cracow:
A Survey of CEE Smog Alarm Systems

Measurement Network

Bratislava, Budapest and Cracow all have modern measurement systems. The largest system is in Cracow, where seven fixed and one mobile station were established. They measure all smog relevant constituents. In Bratislava there are four stations, all measuring SO_2, NO_X and SPM, and two of them measure O_3 and CO. In Budapest there are eight stations, all measuring SO_2, SPM, NO_X, CO and two of them O_3 and CxHy. Cracow has the densest measurement network concerning both the population and area. Budapest has the smallest in relative terms. In comparison to some western networks (Austria, Germany), the number of stations can still be considered low. In addition, almost all stations have been gifts from foreign institutions. Cracow is considering closing one or two stations that correlate nicely with those nearby, because no information would be lost and considerable money saved.

Smog Legislation

Bratislava can proclaim smog alarms next winter, because the law came into force in June, 1993. The Czech and the Slovak republics are the only countries in the CEE region where winter smog alarm laws are in force.

Hungary has no smog alarm law. The old regulation is no longer valid, the new one is not yet in force. Threshold values of the old regulation in Hungary was oriented to the German smog alarm law. The new regulation will overtake stricter Austrian threshold values.

The Polish national smog alarm law is elaborated, but has not yet been discussed in parliament due to many changes during the past months. Therefore, it is not certain if Cracow will have a fully functioning system in the winter of 1993/94. Threshold values derived from a statistical analysis are based on the values from Cracow during the last years. The premise was that pre-alarm can be announced only during seven winter days. This should guarantee that smog alarms remain seldom events.

Summer smog is not yet considered in each of the selected countries. At a meeting in Budapest in June 1993, the CEE countries agreed in principle that summer smog alarm regulations should be introduced. Considering the situation realistically summer smog laws could be ready by 1995 and become valid in 1996.

The national law of Slovakia and the draft of the national winter smog laws from Hungary and Poland provide the criteria for announcing alarms, how to inform the public and what measures have to be undertaken at the various alarm steps. In addition, the areas that have to be objects of the law are described. This enables the various provincial governments to elaborate a provincial smog ordinance, which is based on the national smog alarm law. Local smog alarm plans force main polluters to introduce measures to reduce emissions. Different specialized offices of the province and municipality have to provide control.

Differences in valid criteria for winter smog alarms.

Table 3.1: Threshold values for case study cities in microgram per cubic meter

SO_2	**Pre-alarm**	**Level 1 alarm**	**Level 2 alarm**
Bratislava	350	700	1050
Budapest	600	1200	1800
Cracow	200	200	200
SPM			
Bratislava	-	-	-
Budapest	600	1200	1800
Cracow	240	240	480
NO_2			
Bratislava	400	700	1000
Budapest	600	1000	1400
Cracow	-	-	-
CO			
Bratislava	10,000	15,000	20,000
Budapest	30,000	40,000	60,000
Cracow	-	-	-
SO2+2xSPM			
Bratislava	700	900	1100

Table 3.2. Other criteria for proclaiming alarms.

	Pre-alarm		Level 1	Alarm	Level 2	Alarm
SO2	**Time in hours**	**Number of stations**	**Time in hours**	**Number of stations**	**Time in hours**	**Number of stations**
Bratislava	3	2	3	2	3	2
Budapest	3	3	3	3	3	3
Cracow	24	3 (forecasted)	9	3 (measured + met. forecast)*	6	3 (measured + met. forecast)*
SPM						
Bratislava	3	2	3	2	3	2
Budapest	3	3	3	3	3	3
Cracow	24	3 (forecasted)	9	3 (measured + met. forecast)*	6	3 (measured + met. forecast)*
NO2						
Bratislava	3	2	3	2	3	2
Budapest	3	3	3	3	3	3
Cracow	-	-	-	-	-	-
CO						
Bratislava	3	2	3	2	3	2
Budapest	3	3	3	3	3	3
Cracow	-	-	-	-	-	-
SO2+2xSPM						
Bratislava	24	2	24	2	24	2

* The meteorological forecast for Cracow has to meet the following conditions: wind speed lower than 3m/s, fog, relative humidity over 80%, stationary anticyclone.

Likelihood of smog alarms based on the mentioned criteria

Threshold values for the four winter smog constituents are artificial values, according to guesses of experts, but they are not based on objective health criteria. Until now, a WHO plan to establish general valid smog alarm criteria has failed. The main reason is that smog alarm regulations are individually tailored for each country and conditions differ. Some CEE countries, like Hungary and Slovakia, in attempting to establish winter smog regulations, followed this Western practice, which might be justified if no data about smog areas is available yet. This was not the case in Bratislava, Budapest and Cracow, where a continuous measurement net has been working for some years.

Only Cracow based its values on statistical analysis. Cracow also developed a "smog alarm philosophy", which could also serve other CEE smog areas: (1) The alarm should maximize health protection and minimize economic losses deriving from smog measures. (2) Alarms should remain rare events. If more alarms are necessary, the event is not an emergency and long term measures are more appropriate. (3) Smog alarm systems should not be set up in a way that they are never used. (4) If the general air quality improves, alarm thresholds might be lowered. This will increase the level of health protection. (5) It is not advisable to adopt criteria from one city (area) to another without local specification.

Thresholds were determined according to data from the previous winters. On the one hand, the thresholds are set in such a way that it is not very likely for a smog alarm to be announced. But on the other hand, the thresholds are low enough to protect public health. Alarms will be announced if the conditions are really bad. However, the main obstacle in Cracow is that the law for winter smog has not yet been approved.

Bratislava has lowered its threshold criteria in a reasonable way. It would be desireable to adopt the "alarm philosophy" of Cracow and base the alarm criteria on observed data. But due to the special wind conditions, experts of Bratislava claim that this is not possible. Therefore a direct comparison between the cities is really difficult.

In Budapest, the winter smog criteria that were valid until now are no longer useful. In addition, alarm regulations were based on the different districts of the city. Budapest is going to change the alarm criteria. According to the old regulation, thresholds for winter smog are so high that it is almost impossible to overstep a pre-alarm. According to this regulation, measures are foreseen at level 1 and level 2 alarms, but will never be enforced. Overtaking the Austrian threshold values, as planned in the new regulation, would bring the Hungarian system quite close to the still stricter situation in Slovakia. Here also it would be advisable to base the threshold on the real situation as proposed by Cracow.

Smog Communication

The center of smog communication is the emergency action center (EAC). It is situated in different institutes. In Bratislava it is within the Slovak Hydrometereological Institute, in Budapest it is situated in the public health office of the city, and in Cracow it is placed at the environmental office of the mayor. The pollution data and meteorological data is gathered by the same institution in Bratislava. In Cracow and Budapest the EAC has to cooperate with partner institutes, the meteorological offices, to be able to arrange smog forecasts.

The political responsibility for announcing and cancelling alarms lies within the responsibility of the district office of environment in Slovakia, while in Hungary and Poland this responsibility is at the municipal level (the mayors of Budapest and Cracow), who officially proclaim alarms. All institutions that have to be informed are mentioned in the existing smog ordinance of Bratislava and the proposed ordinance of Cracow. So far no alarm has yet been executed. Therefore, no experience of a real alarm situation is available.

Often, the telephone lines do not function. It might be that because of intensified use (communication is mainly through fax and telephone) the communication system does not work during alarms.

Smog Information

The public is informed by the mass media. In Bratislava, there is a telephone hot line which gives information to citizens. In addition there is teletext information for every Slovak city - with at least two measurement sites - during week days, informing about the concentrations of the previous day. Since May 1993, there is a monthly air quality review bulletin. In Cracow, a monthly air quality bulletin is published and distributed to universities, schools, hospitals, risk groups and citizens. Teletext systems, which are used in Western countries, are not yet usual in Central and Eastern Europe. In Budapest how the information reaches the public is not clear. The different districts of the town are not unified in a general smog concept. A reorganization of the public information should be developed parallel to the new winter smog regulation.

Short Term Measures

So far no short-term measures have had to be undertaken. Smog alarm ordinances foresee smog alarm plans for the most important industrial plants. They indicate the temporary measures at each alarm step. These plans have to be approved by control officers working for the town or province. Certain energy intensive activities are forbidden and have to be postponed to smog-free periods. At level 2 alarms, industries might even be closed. However, only a portion of the emitters can be controlled this way. All the small industries or heating plants are not controlled at all, and today it is assumed that they contribute more to smog episodes than the main polluters do under episodes.

In Budapest and Cracow coal-fired heating is still very usual. Similar to the situation in industries, low sulfur content fuel should be distributed to individuals for use during episodes. Measures restricting car driving would be particularly valuable to prevent the generation of summer smog. In Los Angeles, major companies have to force their employees to ride in carpools. Other measures are free rides on public transportation, and the temporary closing of the town for any transit. The educational value of the measures might be even higher than the actual reduction of pollutants.

A couple of long-term measures are today responsible for the fact that the likelihood of smog and the necessity to enforce short-term measures have significantly decreased. In Bratislava and Cracow central gas heating plants were established and serve 90% and 50% respectively of the heating in private homes. This worked very favorably to counter low stack emissions.

Chapter 4

Further Implementation of Smog Alarm Systems in Central and Eastern Europe

The survey of western smog alarm systems and the analysis of the efforts from the three CEE cities may lead to a fast transfer of experience to the most smog endangered areas of the region. It is assumed that within the next few years operating systems could be in place wherever they are needed.

First of all, even in the absence of any measures, a smog alarm itself can fulfill an educational role by bringing air pollution problems to the attention of city residents. In principle, it can be used by local and provincial authorities to gain support for a needed (and expensive) program to reduce air pollution permanently. This educational aspect may be particularly important in Central and Eastern Europe because of the especially harsh competition for available public funds between pollution control and other public services. Second, a smog alarm system can reduce the exposure of an urban population to air pollutants by providing warnings to parents and educational and health authorities regarding children and other sensitive members of the population. Third, in cities where the source of pollution during an episode is primarily local (usually the case for the highly polluted cities of Central and Eastern Europe), a smog alarm system has the potential to actually reduce the severity of an air pollution episode by controlling local pollutant sources in the hours preceding an episode. The benefits of this are large because temporary measures during an episode can be quickly implemented and are likely to be much less costly than permanent air pollution controls. However, to realize this potential, the following steps are recommended:

1. A relatively complete inventory of air pollution emissions is necessary.
2. An identification of the sources that have the greatest impact on ambient pollutant levels is necessary. A computer modeling study can be helpful for this purpose.
3. It is necessary to conduct an engineering analysis to identify the sources most feasible to be reduced during an episode.
4. Results of steps (2) and (3) should be combined to develop a plan to implement reductions before an episode occurs. Good communication and enforcement procedures must be set up far in advance of an episode to accomplish these reductions during an episode.
5. Reducing sources before an episode occurs also requires an accurate prediction of episodes. This can be obtained by using a computer model which combines data on the trend of real-time air quality (monitoring network) with meteorological forecasts. The Cracow model is a good example and should be used also in other regions.
6. In case of an insufficient real-time measurement net, alarm information can be provided on the basis of the meteorological forecast and mechanical air pollution samples.

Implementation Schedule
There was a long process to establish smog alarm systems in Western countries. In the 50s several thousand people died because of winter smog in London and because of summer smog in Los Angeles. These events frightened people and studies were performed on how these situations could be avoided. The aim was to establish smog alarm systems that can enforce early measures. After 10 years, some heavy industrialized regions, e.g., the Rhine Ruhr area in Western Germany, established simplified local smog alarm systems. It took some 20 years in Western countries before these systems were established on a legal basis. At that time the general level of air pollution had already decreased remarkably.

The situation in Central and Eastern Europe to implement these systems is now different. Experience has been gathered about how these systems could work and how they actually function. Within a few years, the task of implementing smog alarm systems in the most polluted areas can be completed. Certain areas and even countries are more affected by air pollution than others. Priority should be given to the region with the worst situations concerning emissions, meteorological conditions and topography.

The meteorologic and topographic conditions have to be estimated on a local basis, where there is easy access to this information. According to existing emission inventories, it is possible to identify areas of priority within the Central and Eastern European region.

Affordable measurement networks
In many areas of the Central and Eastern European Region, which are less famous and less wealthy than Bratislava, Cracow and Budapest, there will not be a measurement network from local sources or an interest to establish one from outside funding.

Since monitoring systems require the largest capital investment in a smog alarm system, it is recommended that the network be designed to be as efficient as possible. This means giving the greatest amount of coverage to the greatest number of people within financial or other constraints. Costs can also be reduced by substituting labor for capital where possible. One example of this is Zürich, where the high capital costs of automatic real-time monitors are avoided by using manual measurements. Of course it is difficult to monitor a rapid increase in air pollutants using manual measurements as compared to automatic devices. However, in the short run, one can use the smog experience from other areas and simply work with meteorological data. Models using estimates of emissions, combined with the real meteorological condition could simulate the actual concentration. Differences between modeled and actual concentration of 30% are acceptable if one considers that the threshold values of most countries are artificial and vary in the countries of this case study by up to 250%. Even the enforcement of measures based on model calculation, as is the case in Los Angeles with summer smog, or in Cracow with winter smog, could be considered after a test period.

Overcoming of institutional barriers
Apart from possible financial barriers, there may also be formidable institutional barriers to setting up smog alarm systems in Central and Eastern European cities. Opposition to a local government's smog ordinance may come from a different level of government, which resents the local government taking on additional authority, or from industry opposed to countermeasures which may temporarily curtail its output, or from groups of citizens who feel that a smog alarm system is ineffectual in dealing with the root cause of a city's air pollution problems (which is correct in most cases). Experiences in many cities have shown that this opposition can be avoided if these groups and their concerns are included in the planning process of a smog alarm system. Moreover, the chance of success of countermeasures, such as reducing temperatures in private homes and curtailing vehicle usage, will be increased if they have the support of citizen and other groups.

Emission Inventories to Determine Priority Areas within the CEE-Region.
For the emission estimates it is necessary to have reliable inventories. In the last two years two sources became available at IIASA and could be used to mark out smog-critical areas. These inventories "Emission of Air Pollutants in the Region of the CEI" (1988) were not exclusively prepared to establish smog alarm systems, but could serve for other purposes, too. Therefore, they cover the region only partly. In the first case, the three Baltic countries and Albania are excluded, while in the second inventory Bosnia, Bulgaria, Croatia, Macedonia, Rumania and the other states of former Yugoslavia are also excluded. High emission rates, mountainous or basin landscapes indicate that there is a large chance to find a smog area.

Air Quality Estimates for the Central and Eastern European Region
(IIASA Toxic Pollution and the Eastern European Environment Project, J. Alcamo 1992)

Participants at the IIASA Task Force Meeting on "The Environment in Eastern Europe" were asked to subjectively rank air quality in their countries according to the following simple scheme: grade 1 - very good, grade 2 - good, grade 3 - medium, grade 4 - poor, grade 5 - very poor. This gives a good indication of where potential smog areas are situated and the following maps of the countries give an overview where these areas are located. For this purpose the OECD/EMEP European grid with a spatial resolution of 50km x 50km was used. The dark spots indicate very poor air quality, the almost dark spots poor air quality. 26% of the Bulgarian (Table 4.1) area have poor or very poor air quality. In the former CSFR 46% of the area are in the same category (Table 4.2), in Hungary 5% (Table 4.3), in Poland 14% (Table 4.4.), in Romania 20% (Table 4.5)and in former Yugoslavia 11% (Table 4.6).

Fig. 4.1. Air quality of Bulgaria

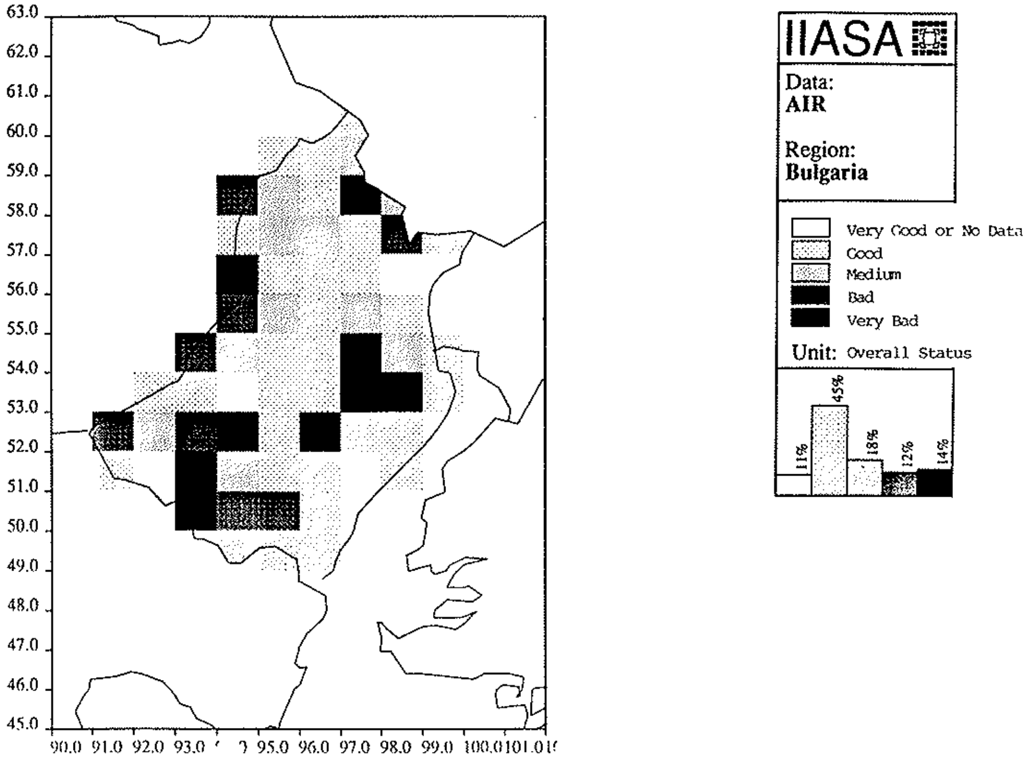


Fig. 4.2. Air quality of former CSFR

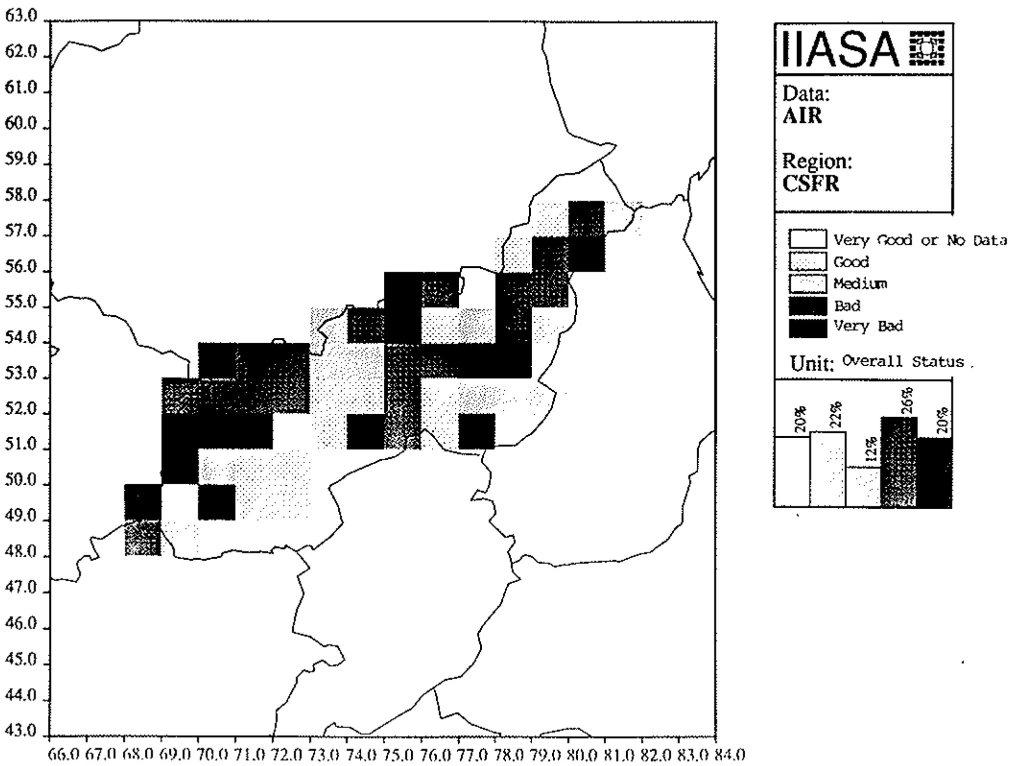


Fig. 4.3. Air quality of Hungary

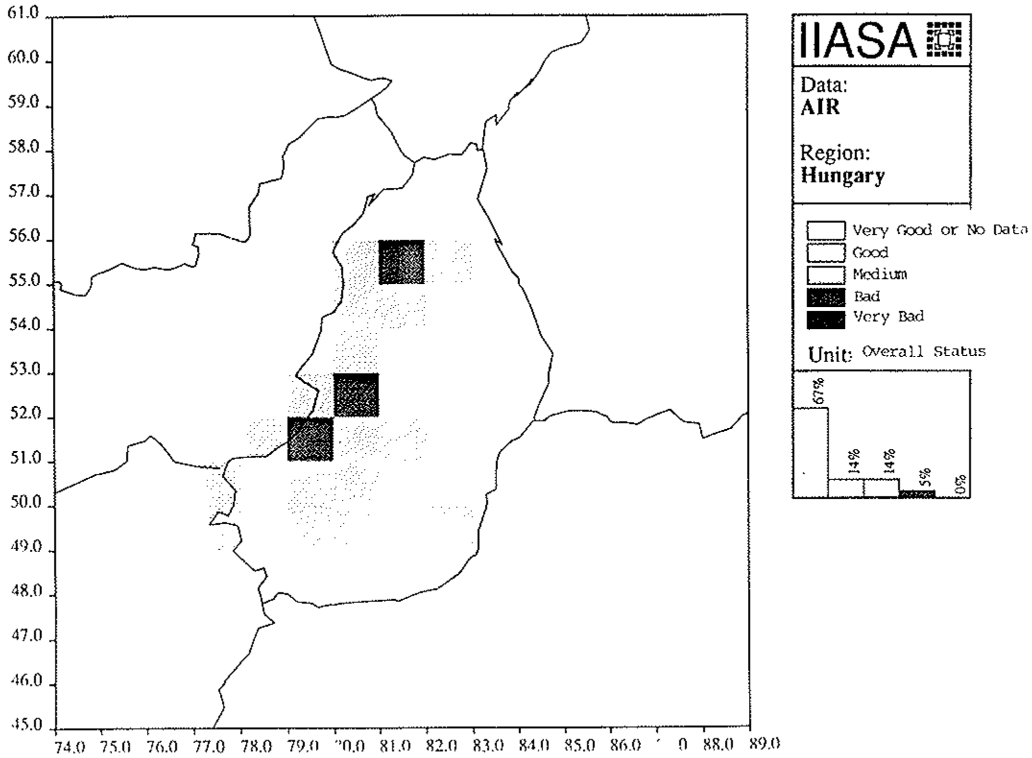


Fig. 4.4. Air quality of Poland

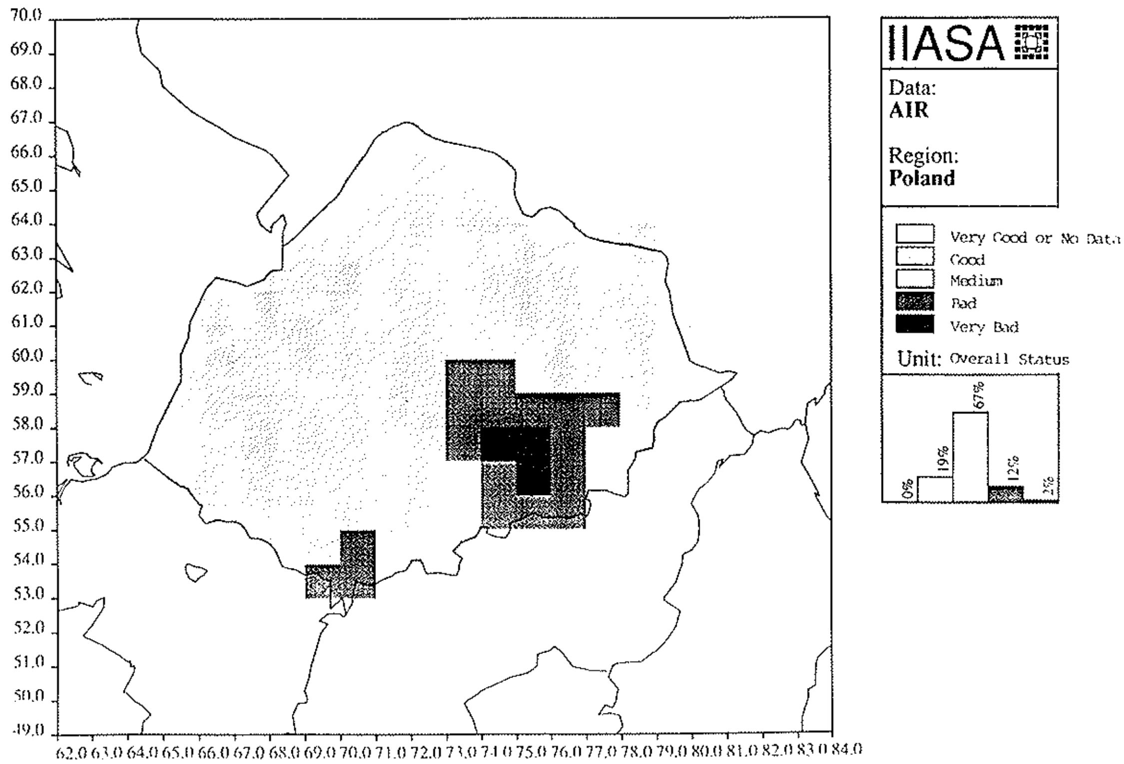


Fig. 4.5. Air quality of Rumania

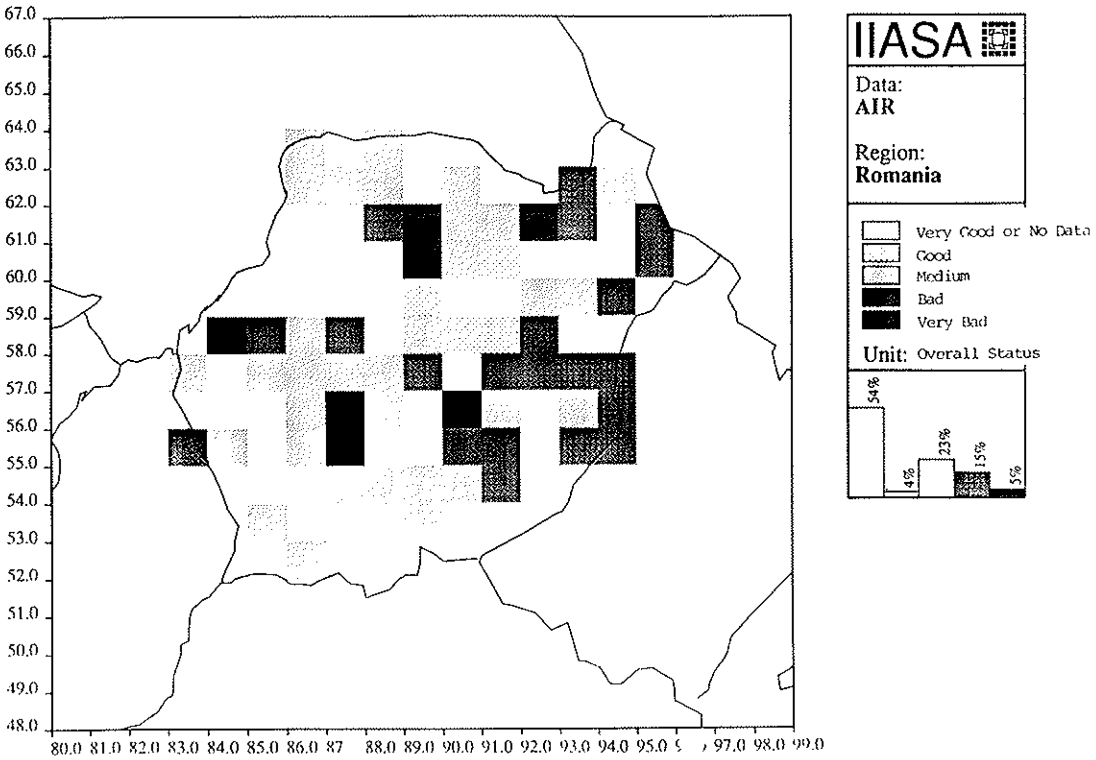
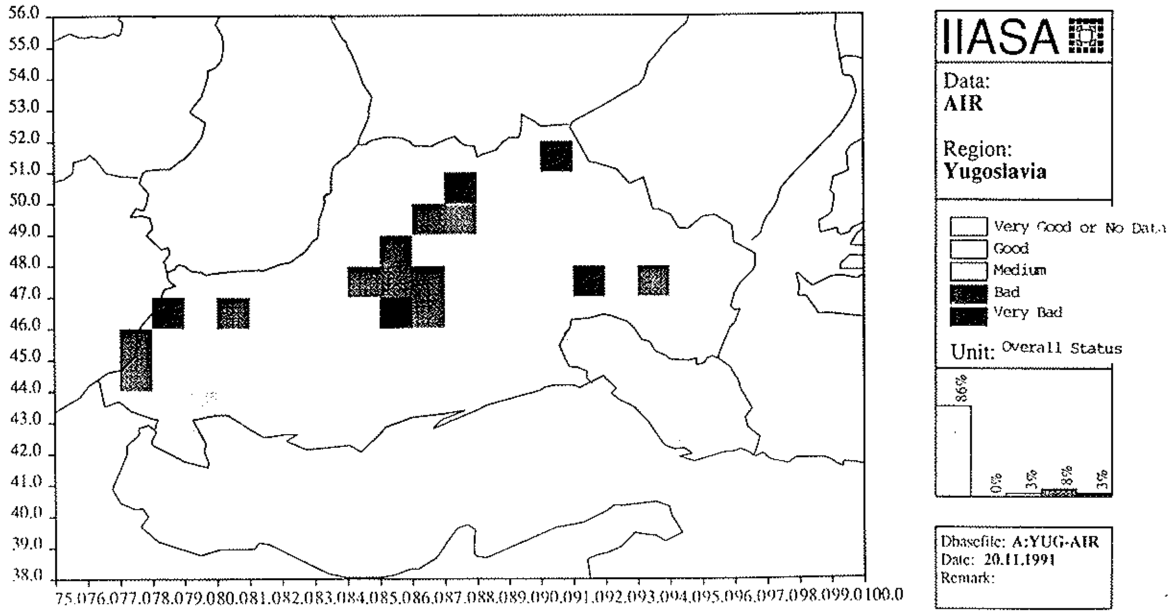


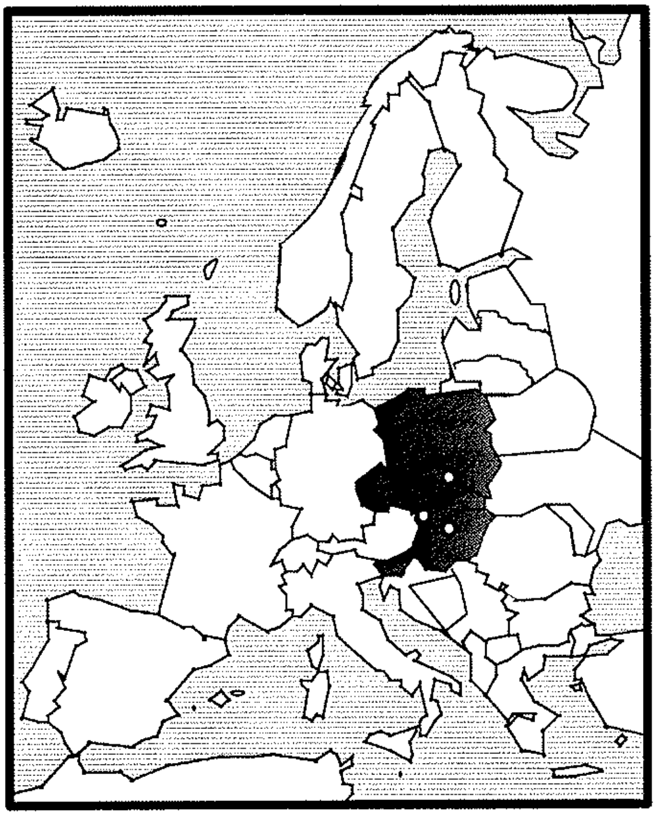
Fig. 4.6. Air quality of former Yugoslavia



Emission Inventory for the Central European Initiative
IIASA Transboundary Air Pollution Project (Z. Klimont et. al., 1993)

The CEI inventory could also become very useful to identify priority regions that would need smog alarm systems. The Central European Initiative includes Austria, Croatia, Czech Republic, Hungary, Italy, Poland, Slovak Republic and Slovenia. The methodology of the CEI emission inventory is based on the CORINAIR approach, which was developed to unify various emission formats within the European Community. Inventories were made for SO_2, PM (particulate matter), NO_X and CO_2 (which is not smog relevant and therefore not included here).

Map 4.7. The Central and Eastern European countries included in the CEI emission inventory of 1988



The reference year is 1988. The countries are subdivided according to their administrative units. Today, emissions are considerably lower than five years ago, mainly because of the decrease in industrial output. Currently, the data base for 1990 is being studied and will give more up-to-date data.

The following maps present emission densities at the level of administrative regions given in tons per km2 for SO_2, SPM and NOx

Figure 4.8. Area sources and point sources of SO_2

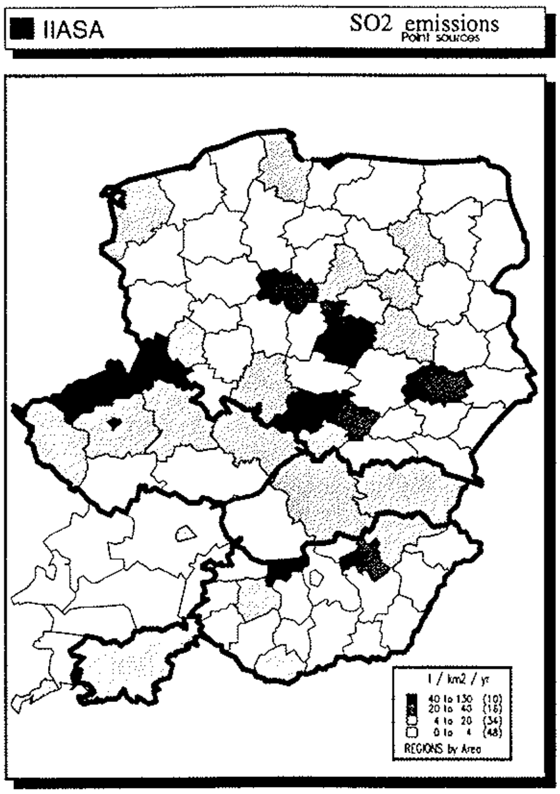


Figure 4.9. Area sources and point sources of SPM

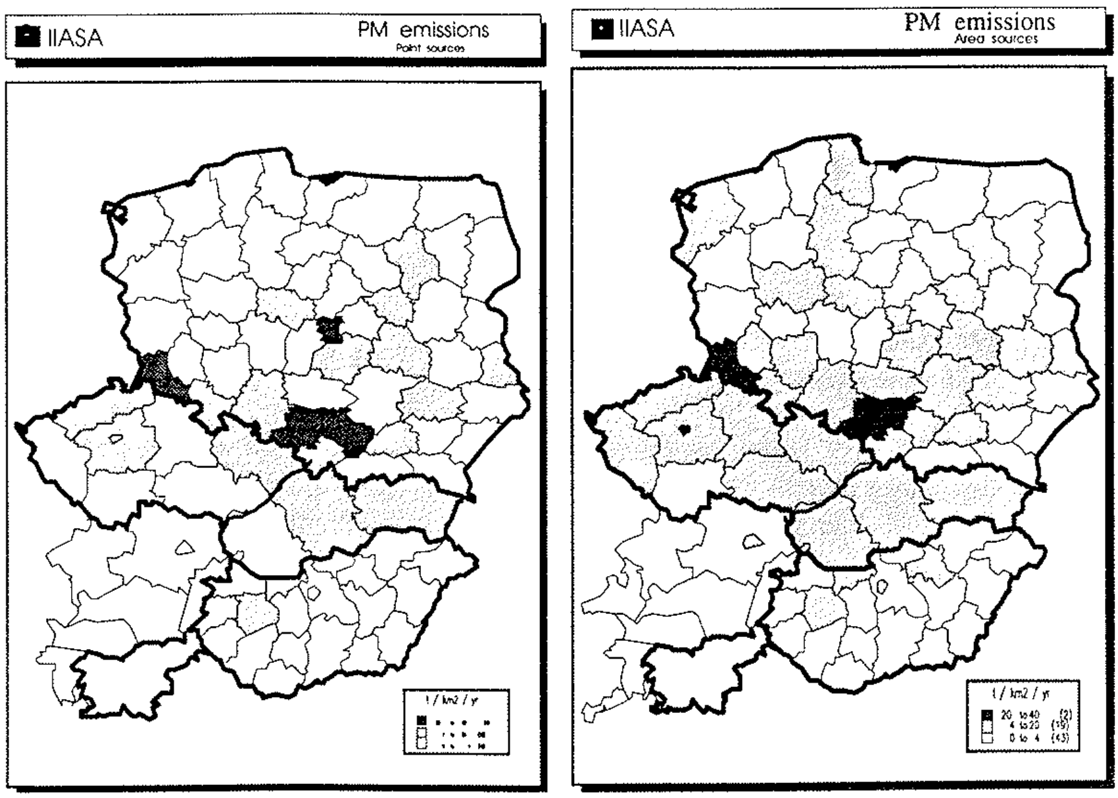
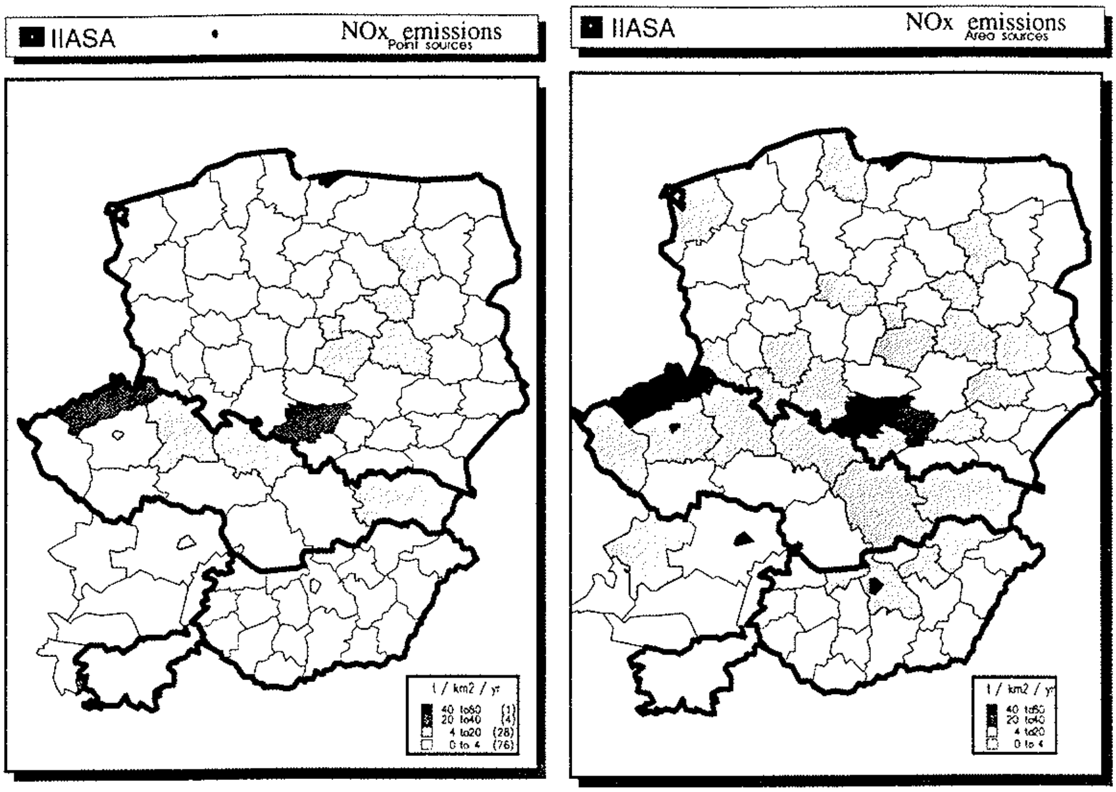


Figure 4.10. Area sources and point sources of NO_X



During normal days most of the air pollution is non-smog relevant because it is dispersed and transported away. The pollution will remain local only during an episode. This kind of presentation is not sufficient to evaluate the likelihood of episodes, but a simple first order estimate is possible. The yearly emissions can be divided according to days and hours, putting weighting factors of experts (low stack, high stack, urban, rural, winter, summer, topography, meteorology, weekday, weekend, rush-hour, night-hour) into consideration. The altitude of the inversion layer may give another estimation of the dispersion space during an episode and will allow the defining of a range of the actual concentrations of the pollutants during episodes. Focusing on the above first may then allow for a more realistic comparison between estimates and measurements.

Chapter 5

Budapest Conference

June 2 - 4, 1993

The Budapest conference on "Emergency Air Protection in Central and Eastern Europe" was meant to start a process of coordinated and focused international actions to promote and support the rapid and proper establishment of smog alarm systems in Central and Eastern European cities. One such action would be the development and adoption of a regional smog alarm protocol. This document would lay guidelines for developing and implementing smog alarm systems. The protocol would recommend:

- the types of pollutants to be covered by alarms;
- pollutant thresholds and other criteria for calling an alarm;
- basic design features of an air monitoring network;
- a "prototype" emergency action plan and smog ordinance;
- basic features of an emergency action center.

Such a protocol has to be based on a consensus of the countries involved in the Budapest conference. Rather than to go to Western regions to study single case studies, management practices should be evaluated from the locally available systems in the region. The conference had four main tasks; 1) to present the case studies from the CEE region; 2) to demonstrate some models which are useful for smog (alarm) management, 3) to evaluate emissions from the region and finally and most substantive 4) to discuss various smog topics in five workshop sessions with the aim of finding a consensus which would lead to harmonized strategies to counter smog episodes.

In addition, there was an excursion to the Emergency Action Center of Budapest and various social events, such as a reception hosted by the mayor of Budapest.

Presentation of Case Studies from Bratislava, Budapest and Cracow

Jacek Walcevsky from Cracow, C. Burda, H. Pifko and L. Ziak from Bratislava and B. Kelemen from Budapest presented the case studies of their cities. Results of their presentations were used for Chapter 3, the comparison of the case studies. In addition, Western experts prepared their comments as discussants, addressing the ongoing developments. The participants from Switzerland, H. Graf and W. Spillmann, commented on the case study of Bratislava; Martin Lutz from Germany, the case study of Budapest, and Sebe Buitenkamp from the Netherlands, the Cracow case study.

Models supporting smog administration

Several models were presented that support smog management in a direct or indirect way. Only a few of them could be presented in Budapest, since it was not the main task to focus on modeling. However, at a later stage it would be worthwhile to investigate this task in more depth.

The Cracow model

Jerzy Burzynski presented the smog forecasting model for Cracow. The forecast is done for each station individually. If at three stations the forecast exceeds the smog criteria for SO_2 or SPM, a pre-alarm is announced. The reliability of the model forecasts is some 80%. Cracow is the only city where pollution forecast can announce a smog pre-alarm.
The model was also used to define threshold values for Cracow, which are a compromise between the objective public health protection and the necessity to guarantee smooth economic operations without an unacceptable number of disturbances.

The TRIP model

Martin Lutz from Berlin municipality presented the TRIP model, which was developed at the Institute of Meteorology at the Free University of Berlin. Originally the model was developed to analyze increased radioactivity and for the early detection of nuclear accidents. As it is a meteorological model, the pollutants that are transported can be exchanged to SO_2 or O_3, the leading substances for winter or summer smog.
The model is particularly useful if smog episodes, which are actually local phenomena, start to move as a whole without being dispersed into higher atmospheric layers. During the winter of 1985 smog episodes originating from the "black triangle" (northern Bohemia, southern Silesia, southern part of eastern Germany) were transported over several hundred kilometers to Western Europe (Lübkert 1989). For summer smog how much ozone was generated locally and how much was generated elsewhere can be analyzed. In addition, the age of pollutants can be projected in hours.
The model can make trajectories of meteorological data provided by WMO-SYNOP, WMO-TEMP, METEOSATPDUS & NOAAHRPT. The data is processed and prepared at the Free University of Berlin and forwarded to institutions such as state ministries or municipalities, e.g., Berlin. These institutions are then able to interpret episodes.

The IIASA ACA Air quality model

Kurt Fedra and his team at IIASA developed a general air quality model for the city of Vienna which can also be used for smog alarm systems. It is a UNIX based system that allows the testing of air management strategies or the simulation of the efficiencies of smog measures during an alarm.
Another application of the model is in the "black triangle" between Dresden and Prague, where industrial pollution is (and in particular was) very high. The model is suitable for figuring out the most cost-effective strategies to control air pollution. In cooperation with the Polish System Research Institute in Warsaw a model originally developed for Warsaw was adapted for Northern Bohemia. The model uses a wind field generator that considers topography, surface roughness and surface temperature differences. The dynamic, multilayer, finite energy model can simulate the complex wind patterns of the region. The model has a regional as well as a local version that are combined and nested in a grid, meaning that the local model can be run with the regional one, using results of the regional simulation as boundary conditions and driving forces.

The IIASA RAP Smog Information System from Western Countries
Information on Western smog alarm systems (Austria, Germany, Italy, Japan, Norway, Netherlands, Switzerland and the US) deriving from the IIASA survey on smog alarm systems (Breiling, Alcamo 1992) was prepared as a computer model for PCs by Andreij Grishevski and distributed at no cost at the conference in Budapest. The idea of the smog information system is that it is easier and cheaper to spread information via a floppy disk than to publish reports. According to specific interests, the smog information base can give an overview or can go into details. The computer program allows direct access to particular information without reading non-specific information. Fast information about alarm criteria, smog communication and smog measures in the selected country is available. The program will be sent free of charge to people from Central and Eastern Europe and can also be transferred via Internet on request.

Excursion to the Emergency Action Center

Dr. Borbola Kelemen, the head of the institute of Hygiene in Budapest, organized a tour to the emergency action center of Budapest. In Budapest, alarms are proclaimed individually for each of the 25 districts.

IIASA TAP CEI Emission Inventory

During the Conference on Emergency Air Protection in Budapest, Zbigniew Klimont, one of the authors of the CEI study presented an overview. The usefulness of the inventory is described in Chapter 4.

Workshops

The first three workshops were organized in the same way as the methodological approach of the project. (1) How to evaluate experience from Western countries. (2) How was the implementation of SAS in three case study cities? (3) What strategies can be proposed for the further implementation of smog alarm systems throughout the CEE region?

The last two workshops considered technical and institutional aspects of smog alarm systems. Some points already mentioned in the first three workshops were covered in depth. The chairpersons (Z. Pauliniova, A. Takacova) and rapporteur (A. Kovar) of the sessions summarized the outcome.

It was clear from the beginning that it was not yet possible to agree on the approval of a general smog alarm protocol for the CEE region. However, an enormous step was taken to achieve this aim within the next one or two years.

The main results or the workshops were:

1) Agreement to introduce smog alarm systems throughout Central and Eastern European countries.

The participants of the Budapest conference had achieved consensus about the potential use of smog alarm systems in providing emergency air protection to their citizens. It involves considerable efforts to inform and involve the necessary institutions. At the beginning one may start with incomplete systems, e.g., when there are no funds available for a continuous measurement net of smog pollutants. The lack of funds, a common argument almost everywhere in the CEE region, should not restrict decision-makers and citizens to start with the establishment of certain elements of a smog alarm system.

2) Agreement on the principles of smog alarm systems: to protect public health by appropriate information and measures.

The main purpose is to protect public health in emergencies. Even just providing information is valuable, since individuals can take action to protect themselves. Mainly, risk groups, children or asthmatics will do so. However, the majority of the population will not care too much about the smog situation if they are not directly or indirectly affected by the measures. Only restricting measures to the main polluters can create adequate awareness among the entire population.

3) Harmonization of SAS criteria, common efforts of CEE countries

So far there harmonized criteria to define smog alarm episodes do not exist. The World Health Organization made some attempts to establish such criteria, but differences in individual countries are too large, and the chances to have globally accepted alarm thresholds and other criteria are highly unlikely.

In Western countries winter smog episodes are no longer a major problem, while in most developing countries, winter smog problems are not yet solved. Even a couple of other countries could benefit from such a program within CEE.

In spite of the differences in winter smog alarm criteria between individual Western countries (see Tables 2.1 to 2.7) the problem was solved because more expensive permanent air quality measures were put into effect that made a harmonization of winter smog alarm criteria superflues at least in the rich parts of the world.

First, some regional criteria to define summer smog, e.g., a common summer smog regulation for all EC countries or common criteria for the entire CEE region could be established. In fact, it might be even easier in CEE countries to establish a common summer smog regulation, because one need not expect heavy resistance from the local automobile industry or from a majority of the population that would feel restricted by measures with a temporary traffic ban (as proposed in Zürich Switzerland) because the level of motorization in CEE countries is still much lower than in the West.

4) Working winter smog regulations should be enforced quickly. Lead substances should be SO_2 and SPM.
Two lead substances were identified to regulate winter smog. These are SO_2 and suspended particulate matter, SPM. NOx and CO emissions are considered less relevant for the purpose of determining winter smog episodes. There are already two countries in the CEE region with working winter smog laws and regulations, since many countries were already working for some years to establish winter smog ordinances. Other countries have more possibilities to choose between a variety of strategies to counter winter smog, e.g., Poland developed its own "smog alarm philosophy" (Chapter 3).

5) Summer smog regulations should be drafted by the next meeting. Lead substance should be ozone (or NO_2.)
Until recently, summer smog was less relevant for most CEE countries in comparison to winter smog. Now it seems that the summer smog problem will become more important for most CEE areas. Summer smog episodes are expected to increase further, due mainly to the tremendous increase in urban automobile traffic. Many areas of the CEE region are not prepared to counter summer smog. In many areas ozone is not yet measured. Wherever there are no ozone measurement stations NO_2 should be as a preliminary lead substance.
Another problem with summer smog is the enforcement of temporary measures. So far no European country foresees them, therefore CEE countries should investigate more deeply the regulations of the United States (Los Angeles) and Japan to advance with their own summer smog regulations than Western European countries did during recent years.

6) The measurement net should be kept as small as possible.
Regarded relatively, the cost for the measurement network is much higher in CEE countries than in the West. The measurement network is just a necessary tool to provide emergency air protection, but cannot substitute for measure. Therefore, the measurement net should be kept as small as absolutely necessary. With the increasing number of measurement sites it becomes more and more difficult to manage the system and to handle the additional amount of data.

Budapest uses less than 25% of the measurement sites of those usual in Berlin-West with a comparable size (Chapter 3, Tab. 3.1. and Chapter 2, Tab. 2.1). Smaller cities, e.g., Bratislava, need comparatively more measurement sites per unit population.

7) Modeling should support the smog administration.
Smog measures are usually only undertaken if the criteria defined in the national smog alarm law and the provincial smog ordinance are met. In most cases, it is extremely late to protect the risk groups from major health damages. Therefore, some countries use computer models to at least proclaim prealarm. This is the case in Cracow with regard to winter smog, or in Los Angeles with regard to summer smog. There are substantial possibilities to improve smog alarm systems in CEE countries if smog forecast modeling is further developed.

Another possibility is to use modeling to identify the most important emission sources during an episode and to concentrate all efforts on the most important emission reduction measures.

8) CEE countries should exchange experts for mutual assistance in smog management
It turned out that the chosen CEE case studies of Bratislava, Budapest and Cracow developed their winter smog regulations in isolation from each other, in spite of the fact that all three case study cities were situated less than 500 km situated from each other. It can be assumed that it was easier to establish closer contacts to Germany (both Bratislava and Budapest were oriented to the German smog alarm law) or to the USA (this was the case in Cracow where the more sophisticated EPA approach was used) than to the close neighbors within the CEE region.

However, a lot of the expertise gained from western countries could also be obtained within the region. In addition the situation within CEE countries is more similar and there should be better understanding for certain existing constraints.

In cases where there cannot be organized an international conference (as was the case in Budapest), expert exchange programs could be organized. The visiting expert could analyze the SAS of the host area and learn about new approaches at the same time. The host area could get free consulting and use the arguments of the foreign experts to justify certain procedures.

9) Case study cities from other CEE countries should be included.
So far, three CEE smog areas had the opportunity to present their systems and get feedback from the other conference participants. However, the situation may differ in other countries of the CEE region. Therefore, other smog areas should present their situations at a possible next conference. There might be larger variations between smog alarm systems in a more careful analysis of Bulgaria or Rumania, on the one side, or the Baltic countries on the other. This is very important if one aims to have coordinated and harmonized smog alarm guidelines.

10) Closer cooperation between CEE countries and Western countries
Smog problems in CEE Europe do not enjoy the highest priority within Western European countries. Smog episodes are mainly local phenomena and pollution usually remains at its place of origin. However, Western European countries are interested in having reliable partners in solving the acidification problem and the long range transport of pollutants. The weighing of air pollution problems between and within East and West has to be more balanced. Before CEE countries generate a self-interest to solve the acidification problem, they first want to see the smog episode problem solved.

11) Small expert working groups should elaborate specific topics
The participants of the Budapest conference came from different disciplines and had different access to the smog problem. In order to fulfill the requirements of the interdisciplinary subject of smog alarm systems in more detail, specific topics should be taken up by different groups of professionals (lawyers, hygienists, meteorologists, engineers, political scientists and others) or citizens from several countries and elaborated in depth.
At a future meetings the plenum should decide whether the findings of the specialists are acceptable for all groups. Only where there are points of conflict there should be discussions how to overcome these obstacles. This may improve the quality of smog alarm systems. The time spent to find a harmonization between various interests may decrease considerably.

12) Main emphasis should be given to counter traffic emissions
While emissions from industry decreased and significant improvements were achieved in the public heating area, at least in major CEE cities, the most severe problem is the permanent increase in traffic emissions in the entire CEE region. Roads are not adjusted for the amount of current traffic. The danger of summer smog increases in particular around the major cities like Budapest.

13) The process started in Budapest should continue
Until most of the CEE countries have working summer and winter smog alarm regulations.the process started in Budapest shall continue. Bratislava will organize the next meeting, probably in October 1994, if sponsors will be found. The expected achievements until this period are legaly settled winter smog regulations in Hungary and Poland and perhaps some other CEE countries. Slovakia plans a draft version for a summer smog regulation to be discussed then. Other CEE countries than Hungary, Poland and Slovakia should be involved more actively.

Chapter 6

Conclusions and Outlook

Summary of project achievements

- There is a comprehensive description of smog alarm systems availaible. Their potential use and possibilities of implementation are demonstrated. This may help local decision-makers of CEE countries to judge whether or not these systems can fullfill certain expectations.

- CEE countries can use the experience from eight Western countries in planning their own smog alarm systems. They do not depend on limited information of only one or two reference countries.

- Three local case studies of smog alarm systems in CEE countries, Bratislava, Budapest and Cracow, are made availaible to other CEE areas. The experience of these cities can be used to implement SAS more rapidly in other elsewhere in the region. There is a similar recent history in all CEE countries and most of the known problems are similar.

- Priority areas in need for smog alarm systems are marked out for most countries of the CEE region due to emission inventories recently elaborated at IIASA.

- A process to achieve harmonized regulations for winter and summer smog was started in Budapest. Individual CEE countries can support each others efforts. The existing national attempts are no longer isolated. Assuming the necessary support will be provided, efficient smog alarm systems covering the most endangered areas could be working within the next few years.

Current development of winter and summer smog regulations

Winter smog alarm regulations

- Progress is going on in CEE countries. The Slovak Republic and the Czech Republic already have winter smog alarm laws. In Poland the law has been to the parliament.

- While Western countries in general have solved their problems with winter smog episodes, they still suffer from ongoing acidification, an accumulating problem.

- It is hoped that this paper can contribute to clarifying the difference between strategies to counter occasional smog episodes with acute health risks, and permanent long-range air pollution control to counter acidification in Europe.

- The main emphasis of Western-initiated projects in CEE countries is given, therefore, to measures aiming to reduce acidic air pollution (SO_2, NO_x) permanently. However, it is assumed that these initiatives might get more support if the local peak concentrations could be eliminated first, as long range transport is clearly not the priority from the local point of view.

- Smog alarm systems can help to educate people. Winter smog measures will restrict the whole population. Just to have knowledge about possible restrictions might give incentives to invest into permanent pollution reduction measures.

Summer smog alarm regulations

- Summer smog and ozone episodes are more important health problems than winter smog episodes and are expected to increase in the future. CEE countries will become the center of summer smog episodes if the current trends, e.g., the increase in car densities, mainly with worn out automobiles from Western countries, continues.

- Summer smog measures are more difficult than winter smog measures. Ozone, the lead substance of summer smog, is a secondary pollutant generated primarily by the coexistance of NO_x and VOC emissions. The concentrations are not behaving linear like this is the case with the primary pollutants regarded in winter smog ordinances.

- Early summer smog regulation in CEE countries can help to temper future smog episodes. Similar to the United States there could be established plans foreseeing short term measures. Short term measures in Western European countries are not practiced and will remain unlikely until certain sources of emissions are widely under control, e.g. equipping automobiles with catalytic converters.

- Ozone can be transported over several hundred kilometers. It is more likely that ozone episodes become transboundary issues than it is the case with winter smog. The cooperation between CEE countries and Western Europe should be considerably intensified.

Outlook for future activities within the CEE region

Information about SAS and emergency air protection should be provided in the national languages and distributed on a district level to guarantee a better coverage of the ideas within the local population.. Translations of this report are first planned into Hungarian, Polish and Slovak language.

- Some responsibles in CEE countries are highly motivated to continue activities leading to further implementation of SAS in the CEE region. The Academia Istropolitana in Bratislava, a postgraduate institute showed an interrest to coordinate the next conference scheduled for October, 1994 in cooperation with the organizers of the Budapest conference.

- There might be serious difficulties due to budget constraints almost everywhere within the CEE region. Therefore it is not only ment to continue the cooperation with the REC in Budapest, but also involve other potential funding agencies, such as the Soros foundation, or national governments from Western countries to fund various activities necessary to complete the implementation of smog alarm systems throughout the CEE countries.

Cooperation with Western Countries

It is assumed that in particular Western European countries have a selfinterrest in cooperating and assisting CEE countries in air pollution management and in particular smog episode management.

Austria and Germany may have a direct interrest in developing common strategies against summer smog with the neighbouring CEE countries. But also the more distant Western European countries, usually out of reach of the main episodic concentration from CEE generated smog may support smog abatement initiatives in CEE as a first step to general air quality measures. This might be an excellent base if one aims to solve other major current and future problems, such as acidification in Europe or to counter global climate change.

Recommendation for possible future research topics

Although far from being complete, several ideas for future research are provided here, covering various disciplines in an interdisciplinary character:

Technical issues
Methodologies to estimate real time concentrations without permanent measurement sites.
It would be a tremendous help to develop more sophisticated models to find out real time concentrations of constituents with or without strongly reduced use of continous ambient air quality measurement sites. There are some promising approaches where data from emission inventories is locally and timely disaggregated. This may give a first order estimate of the actual concentration which could be calibrated to the actual concentration with the help of mobile stations.
Improvements in episode modeling
Whereever these models are used, the degree of reliability is very high. (Some 80% of the forecasted values turn out to become real values.) Many countries do not yet use models at all in smog abatement management. Modeling may save a lot of money, which should be spent for additional measurement sites. Episode modeling could accelerate the implementation of smog alarm systems due to their possibility of saving funds. However, good models are expected to be developed individually for different smog areas.

Risk management issues and medical research issues

Combined effect of two or more smog constituents

Usually studies of hygienists focus on one constituent. There is only limited knowledge of the combined effects of pollutants. However, biologists and foresters proved that the coexistence of SO_2 and NO_x caused more damage to trees at lower concentrations than higher concentrations of just one constituent. There exists the hypothesis that lower ozone concentrations in city centers do more harm than higher ozone concentrations in the periphery due to the coexistence of several other pollutants in city centers.

Emissions most feasible to be reduced during episodes

Smog countermeasures should start with those measures that promise the highest efficiency. In most cases, it is not clear what the optimal procedures are and where to concentrate first.

Local engineering studies may find optimal short-term reductions in industries. Public behaviour studies may propose desirable procedures for short-term reductions in the domestic heating and the traffic sector.

Landscape research issues

Influence of topography to the generation of smog episodes

Certain landscape formations favor or disfavor the generation of smog episodes. Newly built industries, central heating facilities or road connections should be established in areas with smog-disfavouring topography. Main polluting caloric power plants or factories in smog-favoring locations (basins, mountain regions) should be closed.

Economic issues

Cost efficiency of smog alarm systems

Most arguments against the introducing of smog alarm systems consider the costs to establish them as well as the possible economic losses if a smog alarm is proclaimed. Hardly anywhere are the benefits for the public health system that save huge costs for treatments and compensation payments for lost working time due to illnesses listed. More detailed local analyses are necessary.

Compensation payments according to smog concentration

If an industry or power plant has to pay according to the amount emitted, e.g., in Poland, the amount per mass unit is the same all the time. There is no adjustment to temporary unfavorable metereologic conditions. Therefore, an industry has no economic incentive to weigh emissions according to public health considerations. Concepts attempting to realize self-regulating economic mechanisms in smog management would be highly desirable.

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Appendix

Participants of Budapest Conference:

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Vladimir Bencko	Head, 1st Medical Faculty, Charles University, Praha
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Gyorgy Lajos	ELTE Nature Conservation Club
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Keleman Borbala	Head, Public Health Service, Budapest
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(Rabai Attila	Budapest City Council)
Rakica Robert	Ministry of Environment
Sandor Valeria	Institute of Athmospheric Physics, Budapest
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* We appologize for not mentioning several other Hungarian representatives present.

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Switzerland

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Sakovics Lidia	IIASA, Hungarian NMO, Budapest

Abbreviations

CEE	Central and Eastern Europe
CEI	Central European Initiative
EAC	Emergency Action Center
SAS	Smog Alarm System
WHO	World Health Organization
OECD	Organization of Economic Cooperation and Development
REC	Regional Environment Center
RIVM	National Dutch Institute for Public Health
IIASA	International Institute for Applied Systems Analysis

Magyar Nemzet MAHIR ÖBSERVER MÉDIAFIGYELŐ 1993. JÚNIUS 5.

Smog is also dangerous in summer (article refers to a Conference on Smog Alarm Systems in Central and Eastern Europe held in Budapest 2-4 June)

Magyar Nemzet, **Hungary, 5 June 1993**

Smog is also dangerous in summer

A szmog nyáron is veszélyes

Végetért az a nemzetközi konferencia, amely a légszennyezés mérése, a megfelelő adatszolgáltatás mellett a rendkívüli szennyezésekkel, a szmog előlrejlezéssel és a kiépítendő *szmog-riadó rendszerekkel* foglalkozott június 2.-4. között a budapesti Regionális Környezetvédelmi Központban. A Nemzetközi Alkalmazott Rendszerelemzési Intézet (IIASA), a Magyar Tudományos Akadémia megfelelő intézménye valamint magyar, szlovák, lengyel környezetvédő csoportok által szervezett tanácskozáson térségünk országaiból és Nyugat-Európából negyvenen vettek részt.

A szakemberek tanulmányozták a mintának kiválasztott három város, *Budapest, Pozsony és Krakkó* szmog-riadó rendszerét, amelyek – ha tökéletlenül is –, de léteznek és amelyek eddig legalábbis nem riasztottak. Ez alól csupán Krakkó volt kivétel, ahol az idei télen háromszor is volt riadó, a szennyezőanyag koncentráció magas mértéke miatt.

A megfelelő eszeközök, kiépített rendszerek hiányán kívül a *jogi szabályozás és a tömegtájékoztatás hiányosságai* is nehezítik a korszerű védekezési és előrejelzési módszerek elterjedését. További nehézségeket okoz, hogy az egyes országokban eltérő határértékeket alkalmaznak, ezért is lenne fontos a szakértők és a döntéshozók nemzetközi együttműködése.

Az összegező záróértekezleten elhangzott, hogy *legközelebb Pozsonyban* vitatják meg a témát a szakemberek. Azért ott, mert Szlovákiában néhány nappal ezelőtt fogadták el a téli szmog-riadóról szóló rendelkezést.

s.m.

DAILY NEWS

MAHIR OBSERVER
MÉDIAFIGYELŐ
HUNGARY

11 — 17 JUNE 1993

Smog warning system inadequate

By Michael Müller

BUDAPEST has not yet heard the sirens wailing out a smog alert. However, don't be reassured by this fact. Compared with all other European capitals — according to a study of the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria — Budapest has got the most polluted air. So there is every reason for discussing the concept of emergency air protection which was exactly the aim of an international conference held in Budapest last weekend.

The conference on "Implementing Smog Alarm Systems in Central and Eastern Europe" was organized by the IIASA, the Regional Environmental Center (REC), Budapest, and the Hungarian Academy of Sciences. A comprehensive picture of the smog situation in the cities of Budapest, Bratislava and Cracow was presented.

One of the speakers, András Lukács from the Clean Air Action Group, Hungary, told DN the Budapest alarm system was in urgent need of improvement. A monitoring system exists, but precise regulations in the event of an emergency are still under preparation. "Moreover, the limits above which measures of various degrees are regarded as advisable, have been set very high," András Lukács says. "Representatives of the Ministry of Welfare present at the conference agreed with us, that corrections are necessary."

According to Mr. Lukács the spectrum of monitoring is too narrow. "One has to be aware of the fact that in Budapest's air there are more kinds of polluting substances in greater concentrations than are seen in Western cities. At present mainly the values of carbon monoxide, nitrogen oxide, sulphur dioxide and dust are measured regularly. But also the concentration of hydrocarbons, aldehydes and asbestos has to be taken seriously. The relatively high measured values of these substances can be attributed to the great number of old cars, among them many two-strokes, and to factories working with obsolete technology. Also the problem of ozone, formed under the effect of intense sunshine, demands much more attention."

"As an important criterion for the concept of the alarm system, the population's weakened state of health has to be taken in consideration," András Lukács claims. "The susceptibility to smog effects is greater in Budapest than elsewhere. To give an impression of the situation: within the last 20 years the number of asthmatics has increased 24 times, the number of carcinogenic diseases of the respiratory tract has doubled."

As a bright spot in the gloomy picture the decreasing lead content of the Budapest air, a result of oil refinery modernization, compulsory vehicle checks, less two-strokes and more vehicles equipped with catalytic converters — can be mentioned. But this in no way reduces the urgent need for a reliable smog warning system. Further significant relief for the air of the capital is expected from the planned new parking regulations in the downtown area. The building of a bypass diverting transit traffic is at an early stage and will not be completed for some time. Much could be gained by the extension of green areas. Generally 21 square metres of green space per inhabitant are regarded as desirable, currently for every Budapest inhabitant there are eight square metres on average.

Österreichische Firma erarbeitet Konzept zur Emissionssenkung

Umweltentlastung für Slowakei

Eine kleine Region in der Slowakei mit 230.000 Einwohnern erzeugt fast soviel Schwefeldioxid-Emissionen wie alle Betriebe und Haushalte in ganz Österreich zusammen. Zu diesem Ergebnis kam die Consulting-Firma agiplan. Ihr Umwelt-Sanierungskonzept für dieses Gebiet soll nun in die Tat umgesetzt werden.

Anti-Smog-Demonstranten wollen in Böhmen die Sanierung der Umwelt erzwingen. *Foto. AP*

Wilhelm Hantsch-Linhart

Wien – Das österreichische Consultingunternehmen agiplan hat ein Umwelt-Sanierungskonzept für die schwer belastete Region Horna Nitra/Ziarska Kotlina in der Slowakei erstellt.

Dieses soll in die Tat umgesetzt werden, sobald der Regierungsbeschluß der Slowakei dafür vorliegt und die noch offenen Finanzierungsfragen geklärt sind. Auftraggeber der Analyse sind zu je 50 Prozent das österreichische und das slowakische Umweltministerium.

Auch für den Raum Budweis in Böhmen soll die agiplan nun eine solche Studie erstellen. Der Auftrag dafür steht kurz vor dem Abschluß.

In der Slowakei wurden in der ersten Phase des Projektes die „Hot Spots", Unternehmen oder Einrichtungen mit hohen Schadstoffemissionen, identifiziert. Mittels „Umwelt-Audits" wurden die Abweichungen von Umweltnormen und Richtlinien festgestellt.

Dabei werden sowohl die Manager der betroffenen Unternehmen befragt, wie auch lokale Umweltexperten und Behördenvertreter. Die Methodik des „Umwelt-Audits" findet häufig auch bei internationalen joint ventures ihren Einsatz, da die westlichen Vertragspartner hohe Folgekosten durch notwendige Umweltsanierungsmaßnahmen im Zusammenhang mit Beteiligungen an östlichen Unternehmen ausschließen wollen.

Nach einer Darstellung der gegenwärtigen Umweltbelastungen folgten die Erarbeitung der Sanierungsvorschläge und der Umsetzungsmöglichkeiten.

Größter Verschmutzer

Die Menge an Schwefeldioxid (SO_2) beispielsweise, die in der betrachteten Region freigesetzt wird, beträgt mit rund 130.000 Jahrestonnen 90 Prozent der Menge, die in ganz Österreich im Jahr freigesetzt wird. Und das, obwohl es sich um ein kleines Gebiet mit nur 230.000 Einwohnern handelt.

Allein das dort gelegene Braunkohlekraftwerk Novaky bläst pro Jahr 100.000 Tonnen oder 77 Prozent der gesamten Schwefeldioxid-Emissionen der Region in die Luft.

Schon zwei Maßnahmen, nämlich der Einbau von Rauchgas-Entschwefelungsanlagen sowie die Umstellung auf Wirbelschichtfeuerung, würden eine Reduktion des Schadstoffausstoßes bei diesem Kraftwerk um 90 Prozent bewirken und die Luftqualität der Umgebung drastisch verbessern. Die erforderlichen Investitionen dafür werden mit 1,5 Milliarden Schilling veranschlagt.

Durch weitere Maßnahmen kann die SO_2-Belastung der Region kurzfristig – innerhalb von ein bis zwei Jahren – um 35 Prozent, langfristig sogar um 88 Prozent gesenkt werden.

Abwasser

Darüber hinaus wurden die Umweltbelastungspfade Abluft und Energie, Abfall sowie Abwasser in der Region untersucht. Für einzelne Verbrauchergruppen wurde ein Einsparpotential von 25 Prozent festgestellt. Die Abwassermenge kann durch verschiedene Maßnahmen um rund ein Sechstel reduziert werden. Die organische Schmutzfracht, ausgedrückt in BSB5, kann um über 90 Prozent vermindert werden.

Natürlich sind Umweltschutz-Investitionen im ehemaligen Ostblock um ein Vielfaches wirkungsvoller als in westlichen Industrieländern, die bereits einen hohen Umweltstandard besitzen.

Laut agiplan-Studie wird es 15 bis 20 Jahre dauern, bis diese slowakische Region westliche Umweltstandards erreicht. Die Kosten zur Realisierung aller Maßnahmen werden einen zweistelligen Milliarden-Betrag verschlingen. Darin sind aber auch langfristige Projekte enthalten, wie beispielsweise die Errichtung eines Fernwärme- oder Kanalisationsnetzes.

Bei der Finanzierung dieser Summen hofft die slowakische Regierung vor allem auf ausländische Partner, die in slowakischen Unternehmen einsteigen und sich an den Umweltmaßnahmen beteiligen würden. Ein Teil der Gelder soll aus dem staatlichen Budget abgezweigt werden. Österreichs Ökofonds hat auch rund 70 Millionen Schilling zugesagt.

Vier Oststaaten gegen den Smog

Wien – Polen, Ungarn, Tschechien und die Slowakei wollen im Kampf gegen die zunehmende Luftverschmutzung künftig eng zusammenarbeiten. In den kommenden Jahren soll ein grenzüberschreitendes Netz von Meßstationen errichtet werden – vor allem als Frühwarnsystem für Smog.

Darauf einigten sich die Teilnehmer-Länder der Konferenz „Emergency Air Protection" (Schutzmaßnahmen zur Luftreinhaltung im Notfall) Anfang Juni in Budapest.

Kernpunkt des Übereinkommens ist das Aufstellen von überregional gültigen Grenzwerten sowie gemeinsamen Richtlinien für Maßnahmen im Falle eines Smogalarms. Außerdem sollen Expertisen über Möglichkeiten der Vermeidung von Luftverschmutzung ausgearbeitet werden. (gall)

INHALT

GiroCredit und Sparkassen sorgen für leere Mülltonnen: „Abfallvermeidungspreis '93" stößt auf großes Interesse der Wirtschaft

Für möglichst leere Mülltonnen in Österreich soll der „Abfallvermeidungspreis '93 der GiroCredit und der Sparkassen" sorgen: Mit diesem Preis werden jene Unternehmen und Gemeinden ausgezeichnet, die beispielhafte Leistungen im Bereich von Abfallvermeidung und Abfallverwertung erbracht haben. Projekte dieser Art können noch bis Mitte November '93 eingereicht werden.

Nach den erfolgreichen Preisen der letzten beiden Jahre, die „Umwelt" und „Energiesparen" zum Thema hatten, hat sich die GiroCredit auch heuer für ein Motto aus diesem Bereich entschieden. Der „Abfallvermeidungspreis '93" wendet sich wieder an alle umweltbewußten Unternehmer und Institutionen. Die Vielzahl der Einreichungen für den „Energiesparpreis '92" und deren hohe Qualität im besonderen dokumentierten den wachsenden Stellenwert des Bereiches Umwelt in den österreichischen Unternehmen.

Der „Abfallvermeidungspreis '93" ist der zehnte einer Serie von Wirtschaftspreisen, die seit 1984 von der GiroCredit und den Sparkassen ausgeschrieben werden. Jährlich wurden die Leistungen der österreichischen Wirtschaft prämiert, etwa in den Bereichen Export, Wirtschaftlichkeit, Innovationen, Europa, Osteuropa und Umweltschutz.

Mit insgesamt 1.321 Einreichungen seit 1984 sind die bisherigen Wirtschaftspreise der GiroCredit und der Sparkassen der mit Abstand erfolgreichste Unternehmenswettbewerb in Österreich. Die Wirtschaftspreise greifen das Bedürfnis der Wirtschaft nach Anerkennung ihrer Leistungen auf: Unternehmen und kommunale Institutionen, die sich besonders engagieren, können so „vor den Vorhang gebeten" werden.

Wer kann teilnehmen?

Eingereicht werden können alle Aktivitäten und Investitionen zur Abfallvermeidung, die Einführung abfallvermeidender Technologien, der Einsatz wiederverwertbarer Materialen, die Einsparung von Verpackungsmaterial, die Entwicklung neuer Verwertungstechnologien, der Einsatz von wiedergewonnenen Rohstoffen oder die Installierung von Sammel- und Recyclingsystemen.

Der 1. Preis ist mit S 100.000,– dotiert, der zweite mit S 75.000,– und der dritte mit S 50.000,–. Teilnahmeberechtigt sind Unternehmen mit Sitz in Österreich sowie kommunale Institutionen aller Rechtsformen. Die Teilnahmebedingungen könne bei den Sparkassen oder der GiroCredit, Hrn Abt. Dir. Cibulka, Tel (0222) 711 94 - 2510 DW

Magyar Nemzet
MAHIR ÖBSERVER
MÉDIAFIGYELŐ
1993. június 11.,

Magyar Nemzet, **Hungary, 11 June 1993**

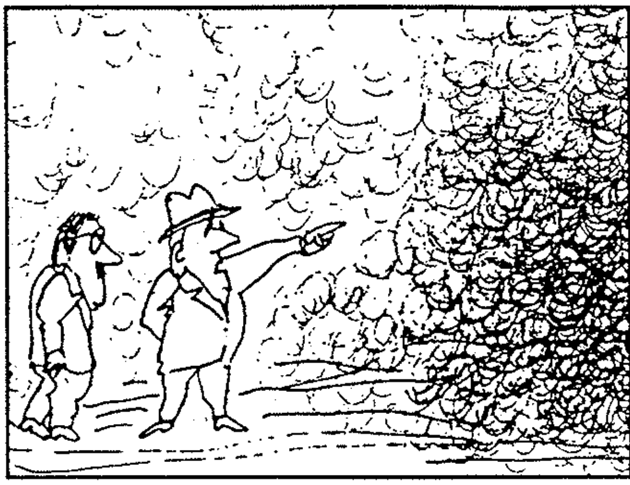
ncreasing danger of summer smog; opaque ayer above the city (article refers to a Conference on Smog Alarm Systems in Central and Eastern Europe held in Budapest 2-4 June)

Increasing danger of summer smog; opaque layer above the city

Opálbura a város fölött

Növekvőben a nyári szmogveszély

Hatalmas opálbura függ az égen. Az irizáló fény feloldja és kissé sejtelmessé teszi a kontúrokat. A jelenséget ismerem; ez a nyári, vagy fotoszintetikus, vagy Los Angeles-i szmog. Nevezzük bárminek, ma még kevéssé törődünk vele, figyelmünket egyelőre a téli szmog köti le.



Fábry János rajzai

Pedig nem ártana többet foglalkoznunk vele. A legújabb statisztikák szerint a közép- és kelet-európai országokban hétévenként megkétszereződő gépkocsiállomány ugyanis új nyári szmogközpontok keletkezését vetíti elénk. Másrészt az effajta környezeti ártalomnak tartósabban vagyunk kitéve, mert többet tartózkodunk a szabadban.

De mi is az a szmog, hogy alakul ki, és mi a különbség a téli és a nyári előfordulása között? A kérdés korántsem elméleti, pontos megválaszolása intézkedések sorát indíthatja el, amelyek végső soron az emberek egészségét védik. Nos, a szmog lokális jelenség, amely kedvezőtlen meteorológiai körülmények között fejlődhet ki, általában 100 és 1000 négyzetkilométer kiterjedésű térségben. Téli, illetve nyári jelzője is mutatja, hogy szezonális jellegű; a téli szmogot az olyan elsődleges szennyezők okozzák, mint a kén-dioxid, a lebegő szilárd részecskék, a nitrogén-oxidok és a szénmonoxid. A nyári szmog keletkezésében az ózon a bűnös. Ez a gáz maga másodlagos szennyezőnek számít, keletkezésében az egymással kémiai reakcióba lépő, már említett elsődleges szennyezők és meghatározott meteorológiai tényezők játszanak szerepet.

E jelenség, valamint a közép- és kelet-európai országok súlyos légszennyezettsége (nem tévesztendő össze a szmoggal!) volt a témája a közelmúltban megrendezett nemzetközi konferenciának, amelyen egy általánosan bevezethető szmogriadórendszer lehetőségeiről is tárgyaltak a szakemberek. Kiindulási alapként a laxenburgi Nemzetközi Alkalmazott Rendszerelemzési Intézet esettanulmánya szolgált, amely Pozsony, Budapest és Krakkó jelenlegi szmoghelyzetéről számolt be.

A részben budapesti székhelyű Kelet- és Közép-Európai Regionális Környezetvédelmi Központ által támogatott tanulmány megállapítása szerint topográfiai és meteorológiai adottsága miatt Pozsony van a legelőnyösebb helyzetben. Mégis a térség első, működő szabályozását ez év június 1-jén Szlovákia fogadta el, s ebben talán az is szerepet játszhatott, hogy az előrejelzések a helyzet rosszabbodásával számolnak.

Budapest – sajnos – mindkét szempontból súlyosabb körülmények között van. A szmog kialakulását elősegíti a forgalomsűrűség, a vizsgált városoknál melegebb klíma, a szélhiány és a kétütemű járművek még mindig magas száma. A városban téli és nyári szmog egyaránt előfordul, de új szmogriadórendszert még nem vezettek be, a régi meg már elavult.

A legsúlyosabb téli szmogot mégis Krakkónak kellett elviselnie, ami a város közelébe telepített két hőerőmű kibocsátásnak a következménye. Ezek egyenként is több kén-dioxidot és lebegő részecskét engednek ki, mint egész Ausztria.

A konferencia megtette az első lépéseket egy általánosan alkalmazható szmogriadórendszer bevezetésére, az IIASA-nál már dolgoznak a hároméves projekten. Mindehhez azonban szükség van a jogi, szabályozási, technikai és számos más kérdés helyi kidolgozására, egyeztetésére. E kérdések között is előkelő helyen szerepel a nagyközönség informálása, hogy az emberek tudják, adott helyzetben mit kell tenniök a maguk és a családjuk egészségének megóvásáért.

(sárvári)