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Groupe d'étude chargé de la mise en oeuvre du Programme d'action écologique pour l'Europe centrale et orientale (PAE)

Task Force for the Implementation of the Environmental Action Programmes for Central and Eastern Europe (EAP)

L'EXPOSITION DU PUBLIC AUX POLLUANTS D'INTÉRÊT RECENSÉSS DANS LE PLAN D'ACTION ÉCOLOGIQUE : BILAN DES CINQ ANNÉES ÉCOULÉES

PUBLIC EXPOSURE TO PRIORITY POLLUTANTS IDENTIFIED IN THE ENVIRONMENTAL ACTION PROGRAMMES: FIVE YEARS ON

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FOREWORD

In April 1993, environment ministers from OECD Member countries, Central and Eastern European Countries (CEECs) and the New Independent States of the former Soviet Union (NIS) met in Lucerne, Switzerland, and endorsed the *Environmental Action Programme for Central and Eastern Europe* (EAP), a framework for national actions and international co-operation. Research for the EAP showed that pollution levels in the region threatened the health of children and adults. It also urged governments to make the reduction of pollution-related health risks a priority for environmental action. Ministers gathered at Lucerne asked OECD to serve as the secretariat for the EAP Task Force, which has brought together Member countries, CEECs, NIS, and international organisations to implement the EAP. The Task Force has worked for over five years as an independently funded activity under the auspices of the OECD's Centre for Co-operation with Non-Members.

This report reviews CEEC and NIS progress over these five years in tackling the key environmental health problems identified in the EAP. It shows that the levels of health-threatening air pollutants such as sulphur dioxide and dust have fallen in many of the region's worst urban and industrial "hot spots". Despite these declines, levels remain high, indicating that further actions are needed. Further, data from the Czech Republic, Hungary and Poland show that levels of airborne lead – an important threat to children's health – have fallen in these new OECD Member countries. Unfortunately, data were not available for other CEECs and NIS. Similarly, few data were found on a third major health issue identified in the EAP, high levels of nitrate contamination in rural drinking water, suggesting that many countries have overlooked this potential threat to health.

Although the report focused on the issues identified in the EAP, it also notes a serious, emerging environmental health issue in the NIS: the quality of drinking water. The World Bank and other institutions have reported that, in many cities, drinking water treatment facilities are deteriorating in the current economic crisis. In addition, microbiological contamination of rural drinking water in Caucasus and Central Asian Republics presents an ongoing problem, as it is a direct cause of high infant mortality. Overall, the report suggests progress to tackle environmental health issues has not been as strong in the NIS as in CEECs. Indeed, at their latest conference, held in Aarhus, Denmark in June 1998, environment ministers from OECD, CEE, and NIS countries called on the EAP Task Force to re-focus its attention to assist the NIS in tackling priority environmental problems.

This report was prepared by Dr. Clyde Hertzman of the University of British Columbia, who undertook the research for the EAP in the early 1990s. The analysis, conclusions and opinions presented here are solely his own, and do not necessarily reflect those of OECD, the EAP Task Force, or other bodies. The report was prepared using a variety of official and academic data sources, which were not verified by OECD.

This report is published under the responsibility of the Secretary-General of the OECD.

AVANT PROPOS

En avril 1993, les Ministres de l'environnement des pays Membres de l'OCDE, des pays d'Europe centrale et orientale (PECO) et des nouveaux Etats indépendants de l'ex-Union soviétique (NEI), réunis à Lucerne, Suisse, ont adopté le *Programme d'action écologique pour l'Europe centrale et orientale* (PAE) qui définit un cadre pour les politiques nationales et la coopération internationale. Les recherches menées pour le PAE ont montré que les niveaux de pollution dans la région mettaient en danger la santé des enfants et des adultes, et que les gouvernements devaient faire de la réduction des risques liés à la pollution l'axe prioritaire de leur action environnementale. Les Ministres réunis à Lucerne ont demandé à l'OCDE d'accueillir le secrétariat du Groupe d'étude du PAE qui réunit les pays Membres, les PECO, les NEI et des organisations internationales aux fins de la mise en oeuvre du PAE. Le Groupe d'étude, qui bénéficie d'un financement indépendant, a travaillé pendant plus de cinq ans sous la tutelle du Centre pour la coopération avec les non membres.

Ce rapport analyse les progrès accomplis dans les PECO et les NEI au cours des cinq dernières années en étudiant l'évolution des principaux problèmes d'hygiène de l'environnement identifiés dans le PAE. Il montre que les concentrations de polluants dangereux pour la santé, tels que le dioxyde de soufre et les particules, ont baissé dans une grande partie des zones urbaines et industrielles les plus polluées de la région ; toutefois, en dépit de ces réductions, les concentrations restent encore élevées et les efforts doivent se poursuivre. Par ailleurs, les données de la République tchèque, de la Hongrie et de la Pologne montrent que les concentrations atmosphériques de plomb, qui constituent une grave menace pour la santé des enfants, ont reculé dans ces trois nouveaux pays Membres de l'OCDE. Malheureusement, il n'a pas été possible, faute de données, d'effectuer des comparaisons avec les autres PECO et NEI. De même, peu de données ont été obtenues sur le troisième problème sanitaire identifié dans le PAE à savoir, les fortes concentrations de nitrates dans l'eau de boisson en zones rurales, ce qui donne à penser que de nombreux pays ont négligé ce risque potentiel pour la santé. Bien que la rapport ait privilégié les problèmes recensés dans le PAE, il constate que la qualité de l'eau de boisson est en train de devenir un grave problème dans les NEI. Selon la Banque mondiale et d'autres institutions, dans de nombreuses villes, les installations de traitement de l'eau sont en train de se détériorer en conséquence de la crise économique ; de plus la contamination microbiologique de l'eau de boisson, directement responsable du taux élevé de mortalité infantile, continue de poser un problème dans les zones rurales des Républiques du Caucase et d'Asie centrale. D'une façon générale, le rapport indique que les progrès accomplis en matière d'hygiène de l'environnement ont été moins marqués dans les NEI que dans les PECO. A la dernière conférence, tenue à Aarhus, Danemark en juin 1998, les Ministres de l'environnement des pays Membres de l'OCDE, des PECO et des NEI ont demandé au Groupe d'étude du PAE de recentrer leurs activités en vue d'aider les NEI à traiter les problèmes d'environnement les plus urgents.

Ce rapport a été préparé par M. Clyde Hertzman de la British Columbia University, qui mène des recherches pour le PAE depuis le début des années 90. L'analyse, les conclusions et les points de vue exprimés ne concernent que leur auteur et ne coïncident pas forcément avec ceux de l'OCDE, du Groupe d'étude du PAE ou d'autres organismes. Les données utilisées dans le rapport proviennent de différentes sources officielles et universitaires et n'ont pas été vérifiées par l'OCDE.

Le rapport est publié sous la responsabilité du Secrétaire général de l'OCDE.

ACKNOWLEDGEMENTS

Several researchers obtained CEEC/NIS data for the preparation of this report. Andrey Semichaevsky at Central European University, Budapest, gathered data from several CEE countries as well as Ukraine and Georgia; Dima Shaposhnikov (formerly with the Harvard Institute for International Development's office in Moscow) obtained data from Russia and Kazakhstan. In addition, Elena Krasney in Belarus; Irje Lepik in Estonia; Mihaela Popovici in Romania and Svetla Yankova in Bulgaria each gathered data for the report. In addition, the following people reviewed and commented on the paper: Glen Anderson (OECD/EAP Task Force Consultant); Jan Bakkes (RIVM); Peter Bosch (EEA); and Michal Krzyzanowski (WHO-Bilthoven).

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1. INTRODUCTION

In April 1993, environment ministers from OECD Member countries, Central and Eastern European countries (CEECs) and the New Independent States of the former Soviet Union (NIS) met at the second *Environment for Europe* Conference, held in Lucerne, Switzerland, and endorsed *The Environmental Action Programme for Central and Eastern Europe* (EAP) as a framework for national and international actions for environmental improvement in CEECs and the NIS.

A review of environment and health issues in the region was a key building block of the EAP. Between 1989 and 1993, the effects of environmental pollution on human health in Central and Eastern Europe were reviewed closely. When the investigation began two very different questions were asked. The first, which was asked from the perspective of the environment, was "to what extent, and in what ways, has environmental pollution affected human health?" The second, which was asked from the perspective of health was, "to what extent was the *relative* decline in health status in Central and Eastern Europe explained by the effects of environmental pollution?" From a policy perspective the distinction between the two was significant, because the former question addressed the issue of whether or not human health protection ought to be a principal priority of environmental remediation, while the latter addressed the issue of whether or not control of environmental pollution ought to be a principal priority of public health.

In response to the first question, the results showed that pollution did have important effects on human health (see Hertzman, 1995, for a detailed review). For this reason, the EAP urged that countries in the region give priority to a set of key environmental health issues: (a) reducing exposures to lead; (b) reducing threats to respiratory health, and (c) controlling morbidity and mortality from nitrates in drinking water. This report, prepared five years after the EAP was endorsed at Lucerne, brings together data to help evaluate, *in toto*, the effects of the investments, policies, and institutional actions undertaken in the region – in concert with the effects of secular changes in industrial activity – in terms of reducing health damage from these pollution problems.

With regard to the second question, concerning the role of environmental pollution overall on public health, the results indicated that pollution played an important, but minor role in the striking differences between mortality rates in CEECs/NIS and western Europe. Public health authorities in the region have, in fact, devoted continuing attention to environmental health issues. (While the public health issues are not a focus of this report, the Appendix reviews the striking differences in European mortality rates between "East" and "West".)

The original analysis for the EAP focused on 10 countries: Poland, the former Czech and Slovak Federated Republic, Hungary, Bulgaria, Romania, Latvia, Lithuania, Estonia, Belarus, and Ukraine. Many other countries in the region have participated in the implementation of the EAP, including most NIS. This report also reviews data from three of these countries: Georgia, Kazakhstan and Russia.

1. INTRODUCTION

En avril 1993, les Ministres de l’environnement des pays Membres de l’OCDE, des pays d’Europe centrale et orientale (PECO) et des nouveaux Etats indépendants de l’ex-Union soviétique (NEI), se sont réunis à Lucerne, Suisse, à l’occasion de la deuxième Conférence *Un environnement pour l’Europe*, et ont adopté le *Programme d’action écologique pour l’Europe centrale et orientale* (PAE) qui définit un cadre pour les politiques nationales et la coopération internationale en vue d’améliorer la situation environnementale des PECO et des NEI.

Le PAE s’est essentiellement appuyé sur une étude des problèmes environnementaux et sanitaires dans cette région. Entre 1989 et 1993, les effets de la pollution environnementale sur la santé humaine en Europe centrale et orientale ont été étudiés de près. Au début de l’étude, deux questions très différentes ont été examinées. La première, qui se situe dans une perspective environnementale, était “dans quelle mesure, et de quelle façon, la pollution de l’environnement a affecté la santé humaine?”. La seconde question, envisagée dans une perspective sanitaire était “dans quelle mesure la dégradation *relative* des conditions sanitaires en Europe centrale et orientale est-elle imputable à la pollution de l’environnement?”. Du point de vue de l’action des pouvoirs publics la distinction entre ces deux questions était importante, la première consistant à se demander si la protection de la santé humaine devait, ou non, être la priorité n°1 de l’action environnementale et la seconde, si la lutte contre la pollution devait, ou non, constituer l’axe prioritaire des programmes de santé publique.

S’agissant de la première question, les résultats ont montré que la pollution avait effectivement des conséquences importantes pour la santé humaine (pour plus de détails, voir Hertzman, 1995). Pour cette raison, le PAE a recommandé que les pays de la région donnent la priorité à un certain nombre de problèmes sanitaires essentiels en (a) réduisant l’exposition au plomb ; (b) en réduisant les risques pour le système respiratoire et (c) en réduisant la morbidité et la mortalité imputables aux nitrates contenus dans l’eau de boisson. Ce rapport, préparé cinq ans après l’adoption du PAE à Lucerne, réunit les données nécessaires pour évaluer, globalement, les effets des investissements, des politiques et des actions institutionnelles engagés dans la région, en tenant compte des effets des changements tendanciels de l’activité industrielle, sur la réduction des dommages à la santé imputables à ces problèmes de pollution.

S’agissant de la seconde question concernant l’incidence globale de la pollution environnementale sur la santé publique, les résultats ont indiqué que la pollution jouait certes un rôle, mais un rôle mineur dans les différences énormes entre les taux de mortalité des PECO/NEI et des pays d’Europe occidentale. De fait, les administrations chargées de la santé publique dans les pays de la région se sont toujours préoccupées des problèmes d’hygiène de l’environnement. (Les problèmes de santé publique ne font pas partie des sujets traités dans le présent rapport, mais on trouve dans l’Appendice un examen des énormes différences entre les taux de mortalité des pays européens de l’est et de l’ouest.)

L’analyse réalisée pour le PAE portait initialement sur dix pays : Pologne, ex république fédérative tchèque et slovaque, Hongrie, Bulgarie, Roumanie, Lettonie, Lituanie, Estonie, Bélarus et Ukraine. De nombreux autres pays de la région ont participé à la mise en oeuvre du PAE, notamment la plupart des NEI. Le rapport passe également en revue les données de trois de ces pays : Géorgie, Kazakhstan et Russie.

2. THE PRIORITY ENVIRONMENTAL HEALTH PROBLEMS IDENTIFIED IN THE EAP

A four-step process for determining environmental pollution priorities was undertaken in the original review for the EAP:

1. Identifying human health problems associated with environmental pollution based on a critical appraisal of the existing data.
2. Based upon this review, making generalisations about the principal types of environmental pollution affecting human health.
3. Comprehensively identifying places where populations were exposed to these types and levels of pollution.
4. Developing an overall strategy for remediating these locations.

2.1 Overview of the approach

At the outset of research for the EAP, it was entirely unclear whether or not any generalisations about pollution and health would be tenable across the region. It was possible that each place would have had entirely different problems due to special conditions of exposure. It was also conceivable that these problems would have been related to highly specific chemical exposures that would only be recognisable following sophisticated analysis of environmental samples. Instead, the EAP studies identified a wide range of locations where, within the limitations of the available evidence, certain *common* environmental exposures were of disproportionate public health significance. These were lead in air and soil; airborne dust, sulphur dioxide and other gases; and nitrates in water. These findings *simplified* the task of identifying priorities for environmental action, since, until their public health significance were drastically reduced, the priorities would be dust, sulphur dioxide, lead, and nitrates in rural water supplies, and not an infinity of other things.[1]

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[1] In the CEEC/NIS region, the effects of environmental pollution on human health are strong enough to be epidemiologically detectable. Yet other investigators, using different evaluation techniques, argued that risks which were too small to be epidemiologically detectable could, nevertheless, be priorities if population exposure were widespread. In other words, a theoretical risk to a large population (from, say, chlorinated compounds in drinking water) could be as important as a measurable risk to a smaller population. There is no principled way to resolve this difference. In the end, it was decided that the epidemiologically detectable risks, which put the region outside the experience of the rest of Europe and North America, would be of first priority, and tiny risks spread over large populations ought to be addressed later.

2.2 Outcomes

As a result of step one of the process, the following health problems associated with environmental pollution were identified in the 10 countries of region studied:

a) In 37 locations in 7 countries, overexposures to lead among children were documented at levels likely to cause neurobehavioral deficits. Evidence of neurobehavioral deficits was found in several of these places.

b) In 53 locations in 10 countries, acute respiratory and irritant conditions, such as sinusitis, pharyngitis, bronchitis, and conjunctivitis, were associated with airborne exposures to dusts, sulphur dioxide and other gases.

c) In 35 locations in 10 countries, chronic respiratory conditions, primarily chronic bronchitis and asthma, were associated with airborne exposures to dusts and gases in an epidemiologically credible manner.

d) In 8 locations in 3 countries there was evidence of excess mortality in relation to environmental pollution, particularly between lung cancer and air pollution, and infant mortality and air pollution.

e) In 19 locations in 7 countries there was evidence of abnormal physiological development associated with air pollution including abnormal pulmonary, hematologic, or immunologic development, growth retardation or congenital anomalies.

f) In 6 countries, there was evidence of widespread nitrate concentrations in drinking water high enough to require water replacement to protect new-borns against methemoglobinemia, or associated with endemic morbidity and mortality from methemoglobinemia.

g) Other, less frequently occurring problems were identified, included exposure to arsenic in air and water, infectious disease outbreaks from microbiologically contaminated drinking water, increased incidence of thyroid cancers in some communities following the Chernobyl accident, incidences of fluorosis due to exposure to emissions from aluminium smelters, and diseases associated with exposures to chlorinated hydrocarbons and pesticides.

These observations lead directly to the identification of the pollutants that had the greatest impact on human health in Central and Eastern Europe:

- *Lead in Air and Soil* from emissions from lead and zinc smelters and, in certain cities, emissions from transport due to the use of leaded fuels.

- *Airborne Dust* from coal burning in household furnaces, small-scale enterprises, power and heat plants, and metallurgical plants.

- *Sulphur Dioxide* and other gases from power and industrial plants, and households burning high-sulphur coal or high-sulphur fuel oil.

- *Nitrates in Drinking Water* from inadequately maintained/designed rural septic tanks, feed lots and agricultural enterprises, and inappropriate fertiliser application.

The identification of priority pollutants in turn lead to the EAP’s proposals for short-term priorities for environmental investments in the region:

1. The installation of dust collection systems and filters to non-ferrous metal smelters which were located within 5 km upwind of significant centres of population.

2. The installation of equipment to reduce emissions of dust, smoke and soot, and carbon monoxide from iron and steel plants, especially those relying upon open hearth furnaces.

3. Investments either to replace coal by gas or to permit the burning of smokeless solid fuels in district heating plants, commercial premises and households in those towns and cities where the average ambient concentration of particulates during the winter months exceeds 150 micrograms per cubic meter.

4. Assistance to facilitate the installation of domestic septic tanks and the appropriate disposal of manure from intensive livestock operations in rural areas where levels of nitrates in drinking water drawn from shallow wells typically exceed 10 milligrams of nitrate-N per litre.

Finally, the evaluation identified a need for better data to track environmental health issues. In particular, governments in the region needed to collect and evaluate data on the effectiveness of actions to tackle the key environmental health issues identified in the EAP.

This report is a first attempt to bring together data that might help fill this evaluative need. It is being written five years after the EAP was endorsed at Lucerne. Since then, many countries other than the 10 in the original evaluation have entered the EAP process. In addition, the infrastructure and institutions necessary to evaluate the effectiveness of environmental health measures were not in place in many countries of the region five years ago. Indeed, much of what has been accomplished over the past few years is in the way of infrastructure and institution building, rather than conducting disciplined evaluations *per se*. Both of these factors, however, limit the comprehensive of this review.

3. METHODOLOGICAL CONSIDERATIONS

This report reviews progress in three key areas: first, dust and sulphur dioxide, which are the respiratory contaminants with the greatest public health impact; second, lead exposures to children; and third, nitrates in rural drinking water. For each area, the objective is to answer a discrete question, namely: is there evidence that exposures to these priority pollutants are dropping in the countries? In other words, it is about ambient air and water quality as it is breathed and drunk by citizens and, with respect to lead, it is about body burdens in children. In answering this question, several important methodological issues need to be considered.

For example, ambient conditions, by definition, include the sum total of influences including economic change, planned remediation, and climatic forces. The economic changes have been considerable.

Between 1990 and 1995, total primary energy supply in CEE and NIS dropped by nearly 30% [2]. Thus, emissions of priority pollutants across the region have been dropping for economic reasons, before the impact of pollution control policies can be factored in.

In addition, the original evaluation for the EAP found that risk was not evenly distributed among population groups in the region. Instead, it was concentrated in three types of places: large regional hot spots with shared air sheds and a large number of point sources; rust belt towns with a few major pollution sources; and local areas where "bad town planning" had led to a specific point source being very close to a residential area. The focus of this report, where possible, is data from those places which fall into one of these categories. As such, this report investigates whether or not there has been progress in "at risk" areas, rather than focus on average conditions across the region as those average conditions were not judged to be of public health significance.

Further, this review covers a time of rapid change in Central and Eastern Europe and the NIS, including privatisation and the consequent transformation of work places. Moreover, many countries in the region have developed National Environmental Action Plans (NEAPs) and National Environmental Health Action Plans (NEHAPs)[3] designed to address pollution and its public health consequences. It is not an objective of this contribution to analyse these national policies or industrial strategies. Nor is the objective to re-evaluate exposure pathways; re-estimate the public health impact of environmental pollution; or assess the contribution of economic decline and de-industrialisation on pollution and public health. This is because, although the answer to the question "is there evidence that exposures to priority pollutants is dropping in the countries which were part of Environment for Europe?" is *related* to these changes, it is not necessarily *determined by* them.

Why? Trends in industrial emissions are more sensitive to technological and policy intervention than ambient air or water quality is. This is because ambient conditions arise from a complex set of factors: local emissions, distant emissions, climate, geography, and aerosol and solute deposition/sedimentation characteristics. Yet, it is the ambient air and water quality that is of public health significance, not the local emission characteristics alone. With respect to dust, "natural" sources also combine with industrial, domestic and transportation sources; all of which have similar public health significance, based upon particle size and shape. Understanding trends in ambient air and water quality is, thus, a separate activity from studying emissions. However, the principal strategy available to policy makers to influence ambient air and water quality is emission control. Thus, the analysis of ambient air and water quality answers the question "have we done enough with respect to emission control to protect public health?" but relies on separate analyses of emissions to define the most efficient ways to make further improvements.

Is there evidence that exposures to the priority pollutants are dropping in the countries which are part of Environment for Europe? Although the question appears to be a simple one to answer, in practise it is not. Ideally, it requires valid, consistent measurements of pollutants from the same locations over time; under comparable meteorological conditions; with health trend data to match; and dates and details of remedial policies and interventions available for comparison. In practise, these conditions are seldom met. Thus, this report will provide partial answers, based upon prudent interpretations of incomplete data. The concluding section will deal with the question of what should be done to improve data quality, availability, and reporting in ways to will help assess progress over time.

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[2] See: OECD/IEA (1997), Energy Statistics and Balances of Non-OECD Countries.

[3] The 1994 Helsinki Conference on Environment and Health in Europe encouraged countries to develop National Environmental Health Action Programmes (NEHAPs). Although this initiative arose separately from the EAP, some countries in the region have linked national work on NEAPs and on NEHAPs.

The data used in this contribution was provided by researchers in Central and Eastern Europe and the NIS who collected it from the agencies in each country responsible for environmental, public health, and statistical matters. These data were supplemented with papers found in the published literature. Usually, these papers were written by academic investigators in the region who undertook special studies that complemented official data gathering. Wherever possible, comparisons will be made with data from before 1993, in order to facilitate pre- and post-analysis of the period during which the EAP has been in place. There are a few important considerations concerning the data used.

- Most of the data in this report refer to averages or 95th percentiles, rather than short-term high exposure levels, despite the fact that these latter may be more relevant to health impact. There are two reasons for this. First, average and 95th percentiles are most easily available. Second, both average and (to a greater extent) 95th percentiles tend to vary in direct proportion to short-term maxima. Thus, they are an adequate surrogate for short-term excursion values.

- Frequently, relevant data were not found. This is not conclusive evidence that they do not exist; but it does mean that it has not been compiled in an accessible form, at least for independent review. Indeed, many countries in the region are in the midst of reforming their environmental and environmental health information systems to improve the quality and availability of relevant data. In addition, data from ongoing studies, such as the CESAR project financed by the European Commission, were not available in useable form for this review.

- There is a broad range in the types and quality of data available. This stems in part from the wide range in technical capacities and monitoring “traditions” among the countries studied. Thus, while this report assumes that data is broadly comparable between countries – and within each country, that pre-1993 data is comparable with recent data – this may not be true in all cases. Evidence of the quality control problem can be seen in the table below, which shows air quality data for Latvia from two sources. The places and dates overlap, so the data should agree with each other. As can be seen, however, the sulphur dioxide data differs radically between the two sources, and the dust data is heavily influenced by “end digit preference,” wherein rounding makes it too imprecise for making comparisons.

Table 1. **Contradictions in air quality data, Latvia** (concentrations in μg/m^3)*

City	Data Source 1 (1991-94)		Data Source 2 (1994)	
	Dust	SO_2	Dust	SO_2
Daugavpils	100-200	<10	<100	20-40
Jurmala	100-200	<10(<30)**	<100	27-65
Liepaja	<100	<10	<100	32-39
Riga	100-200	<10(<30)**	<100	46-74
Rezekne	<100	<10	<100	----
Ventspils	<100	<10	<100	15-24

* average annual concentrations
** summer level (winter level)
Source: Latvian Environment Data Centre (Data Source 1); Semichaevsky , 1998 (Data Source 2).

4. DETAILED FINDINGS

Please note that the Annex Figures and Tables mentioned in this section are found in the Statistical Annex, starting p. 22.

4.1 Dust[4] and Sulphur Dioxide

Czech Republic -- The most useful compilation of air quality data, suitable to assess progress over time, comes from the Czech Republic. Annex Figures 1 and 2 present the trends in average annual dust and sulphur dioxide levels, respectively, in Ostrava, in Northwest Bohemia, and in Prague: the regions with the highest ambient levels in the past. They also show the 95th percentile of daily values, which express an upper excursion limit. Annex Figure 1 shows that, between 1982 and 1995, there has been progress in reducing both average and maximal ambient dust levels. The average annual levels have dropped by 50% or more in each location and 95th percentiles have dropped two- to three-fold. However, Annex Figure 1 suggests that most of the progress was made before the EAP process began. Annex Figure 2 shows similar trends for sulphur dioxide. However, in this case, declines in annual average concentrations seemed to accelerate in the mid-1990s. A similar pattern is detectable regarding the 95th percentile levels. A new downward trend began in 1993, coinciding with the adoption of the EAP.

Annex Figures 3 and 4 show average annual dust and sulphur dioxide levels, respectively, by city in the Czech Republic, as well as the proportion of days which exceed the excursion level. Annex Figure 3 shows that approximately half of the monitored cities still have average annual dust concentrations above 50 $\mu g/m^3$. In general, the proportion of days where the excursion levels have been exceeded is low, never more than 6%. Annex Figure 4 suggests that a similar level of progress has been made against sulphur dioxide exposures. Only one location has an average annual level above 50 $\mu g/m^3$, and daily exceedances were nowhere more than 9 days in 1995. Annex Table 1 shows, on the other hand, that when specific monitoring stations are considered, there are still highly localised zones of chronic exceedance of standards. Thus, it is fair to conclude that dust exposure and, to a lesser extent, sulphur dioxide, are still of public health significance despite the progress which has been made. No other country's data is as convenient to use as that from the Czech Republic. For each other country, comparisons will be made to Annex Table 36, which presents ambient dust and sulphur dioxide concentrations before the implementation of the EAP (the data was collected for the EAP's preparation). This data is incomplete but it does provide a basis of comparison with the present.

Latvia -- Table 1 above shows the available data from Latvia. As was pointed out above, these data are fraught with methodological difficulties which limit their interpretative value. Yet, by comparing with

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[4] Unless otherwise stated, "dust" will be used in this document to refer to total suspended particulates (TSP), which is the principal measurement available. In contrast, dustfall is a poor measure from a public health perspective, while fractionated measures of suspended dust, such as PM10 or PM2.5, are not commonly enough collected in the region for comparison purposes.

data in Annex Table 36, it is possible to state unequivocally that there is no evidence of progress toward reduction of dust or sulphur dioxide in the measured locations in Latvia.

Hungary -- With respect to dust, Hungary poses a special problem because this parameter previously was simply not measured. The fact that dust measurements are now available from at least 22 locations is an important achievement of the last few years. Annex Table 2 shows these data for the summer of 1995 and the winter of 1995/96. Dust levels are high in almost all locations. If 50 µg/m^3 is taken as a benchmark, then 20 of 22 locations consistently exceed that level. Sixteen locations averaged above 100 µg/m^3, 8 locations averaged above 200µg/m^3, and 4 locations averaged above 250 mg/m^3. Dust is clearly of public health significance in all of these locations, especially those where the annual averages exceed 100 µg/m^3. This includes most of the major population centres in the country, including Budapest.

Annex Table 2 also shows sulphur dioxide concentrations in 25 locations in Hungary, six of which are also found in Annex Table 36. Annex Table 2 shows three locations: Ozd, Miskolc, and Kazincbarcika, where winter sulphur dioxide concentrations exceeded 50 µg/m^3. Otherwise, the measured locations show low ambient levels. Comparison with Annex Table 36 suggests that some progress has been made. In three locations – Dorog, Tatabanya, and Pecs – sulphur dioxide concentrations appear to be down sharply; though not in Miskolc, Ozd, or Budapest.

Poland -- Annex Table 3a shows the range of average annual sulphur dioxide levels from all of the monitoring stations in selected provinces in Poland in 1994/95. It also shows the range of 98th percentiles of average daily concentrations. During these two years, only Katowice Province shows levels above 50 µg/m^3. Comparison with the data from 1987/88 in Annex Table 36 shows marked declines in ambient sulphur dioxide concentrations in all nine of nine comparison provinces. In eight of nine cases, the declines are greater than 50%. Annex Table 3b shows that only one monitoring station in the country averaged more than 50 µg/m^3. Taken together, these data suggest that sulphur dioxide has gone from being a widespread problem to being a sporadic problem in Poland.

In contrast, Annex Table 4 shows that 25 of 26 monitored cities had average annual dust levels above 50µg/m^3, and 13 of 26 were above 100 in 1995. The 1996 data, which is more sporadic than the 1994-95 data, is more hopeful, but still shows a majority of locations above 50µg/m^3. Annex Table 36 has 1987 dust levels for cities in Katowice Province only: nonetheless, eight cities in that province are found in both Annex Table 4 and Annex Table 36. In all cases there were large reductions in the average annual dust level from 1987 to 1995: from 50 - 75%. Despite this evidence of large declines, the evidence in Annex Table 4 shows that dust is still a widespread public health problem in Poland.

Bulgaria -- Annex Table 36 presents sulphur dioxide and dust levels in Bulgarian cities from 1989/90. With respect to dust, there are 11 cities in common with Annex Table 5; which presents comparable data from 1995/96. All 15 of the cities listed in Annex Table 5 show high dust levels. Fourteen of 15 are above 200 µg/m^3 and 9 of 15 are above 300. In comparison with Annex Table 36, five cities show declines, five show increases, and one is equivocal. Moreover, it should be noted that the three cities with the highest dust levels in 1995/96, Pleven, Varna, and Burgas, do not appear in Annex Table 36. Five of 9 cities show unequivocal evidence of decline in sulphur dioxide levels, one shows an increase, while three others (Kurdjali, Sofia, Ruse) do not show clear-cut declines. Nonetheless, all of the cities shown in Annex Table 5 still have at least one monitoring station where the average annual concentration is above 50 µg/m^3, and 7 of 9 have at least one which was above 100. Moreover, measurements from 1996 are generally worse than 1995. Thus, both dust and sulphur dioxide are still widespread public health problems in Bulgaria.

The table below gives more detailed dust monitoring data from two different sites over time in Kurdjali. This came from a different source than the information in Annex Table 5 and Annex Table 36, so it can serve as a validity check on the trends described above. Fortunately, in this case the data in Table 2 below support the comparison made in the previous paragraph, which increases my confidence that the data may be giving a reliable picture of the trends.

Table 2. Range of mean monthly dust levels over time at 2 monitoring stations in Kurdjali, Bulgaria (µg/m^3)

Range of Monthly Means		
Year	**Site 1**	**Site 2**
1990	150-530	110-260
1991	100-280	140-280
1992	130-390	117-450
1993	129-207	94-167
1994	123-227	109-159

Source: Bainova, 1995

Romania -- Assessing trends in Romania is hampered by the fact that the data found in Annex Table 36 and the most recently available data (found in Annex Table 7) are generally from different places. Only four cities – Bucharest, Zlatna, Galati, and Hunedoara – are found in both tables. With respect to sulphur dioxide, only 3 locations – Brasov, Baia Mare, and Copsa Mica – had elevated concentrations in 1993/94. None of these locations were found in Annex Table 36. Annex Table 8 suggests that sulphur dioxide levels did not decline in Baia Mare between 1992 and 1994, while they did appear to decline in Copsa Mica over that time period.

Annex Table 8 shows that 18 of 19 monitored cities had average annual dust levels above 50 µg/m^3 in 1993/94, 8 of which were above 100. Comparison with Annex Table 36 shows an inconsistent pattern of change since 1990. Dust levels appear to have declined in Galati, risen in Hunedoara, and remained largely unchanged in Bucharest and Zlatna. On the other hand, data in Annex Table 8 suggest that dust levels have declined in Hunedoara between 1992-94, and risen slightly in Galati and Bucharest. Nonetheless, the information in Annex Table 7 shows that dust continues to be a widespread public health problem in Romania while sulphur dioxide seems to be a more sporadic problem.

Lithuania and Estonia -- Data for cities in Lithuania are found in Annex Table 9. The table shows that sulphur dioxide is a minor issue, but average annual dust levels in 9 of 10 monitored cities was above 50 µg/m^3, and 7 of 10 were above 100. However, these data are marred by “end digit preference” wherein all the data appear to be rounded to the nearest 10 or 50 µg/m^3. Comparison with Annex Table 36 (1990 data) shows that dust levels have declined in 4 of 5 cities for which comparisons can be made. Nonetheless, dust continues to be a widespread public health problem in Lithuania.

Annex Table 10 gives four years of sulphur dioxide and dust data from monitoring stations in Tallinn and Narva. Data from the former location show ranges of average monthly and maximum daily concentrations, while data from the latter show monthly averages only. Sulphur dioxide is not a public health problem in either Tallinn or Narva. Dust levels, however, were above 50 µg/m^3 at most monitoring stations in both cities. In comparison with Annex Table 36, dust levels do not seem to have declined in

Tallinn since 1990, and have only declined slightly, if at all, in Narva. Dust continues to be a public health problem in Estonia.

Belarus -- Annex Tables 11 and 12 present air quality data for Belarus over time which, like that available from the Czech Republic, facilitates comparison. Until 1994, the dust data showed a marked problem of rounding, based upon the fact that it was reported in milligrams rather than micrograms per cubic metre. Annex Table 11 suggests that dust levels did not decline in Belarus from 1985 to 1994, but began to decline when the rounding error was removed. This problem makes the dust data difficult to interpret. On the other hand, sulphur dioxide declined markedly from the mid-1980s. This is consistent with the data in Annex Table 36, which suggests that the massive decline in sulphur dioxide exposures began in 1991. Thus, Belarus appears to be like several other countries in Central and Eastern Europe in that sulphur dioxide has become a sporadic problem.

Annex Table 12 shows that only four cities in 1994 had short-term excursions of sulphur dioxide above 150 µg/m^3, whereas excursions above 500 µg/m^3 were found for dust in all but one location. This, in conjunction with data in Annex Table 11 which shows that most monitored locations still had dust levels above 50 µg/m^3, shows that dust is still a widespread public health problem in Belarus.

Ukraine -- Data for Ukraine is found in Annex Table 13 and Annex Table 36. Unfortunately, sulphur dioxide data have been reported in sparse and inconsistent locations, so no comparisons can be made with past data. However, the data from 1996 in Annex Table 13 suggests that sulphur dioxide is a public health problem in all five cities for which data are available. Annex Table 13 also presents average annual dust concentrations for 9 locations and maximum daily levels for a tenth. It shows that dust levels were above 200 µg/m^3 in all locations. Comparison with 1990 data in Annex Table 36 was possible for 5 locations. In 2 cases unequivocal declines were seen. The evidence was equivocal from the other locations. Sulphur dioxide and dust both appear to be widespread public health problems in Ukraine.

Countries not part of the original evaluation -- Air quality data is available from three NIS that were not part of the original evaluation: Georgia, Kazakhstan and Russia. The pattern in Georgia (Annex Table 17) appears to be the same as in many other countries in Central and Eastern Europe. Dust levels appear to be of public health significance virtually wherever they are measured, and are among the highest reported in the region, while annual average sulphur dioxide levels are of a much more marginal significance. The data from Kazakhstan are of good quality for assessing trends over time. With respect to dust, 16 of 20 monitored cities have average annual levels above 50 µg/m^3 and 5 of 20 are above 200. Since 1990, there have been unequivocal declines in 6 locations, increases in one location, and little change in the other 13. Thus, dust is a widespread public health problem in Kazakhstan. Only 3 locations had sulphur dioxide levels above 50 µg/m^3, but there was little evidence of decline over time.

Annex Table 15 presents dust and sulphur dioxide data from Russia for 1995 for 36 locations, all of which reported average annual dust levels above 100 µg/m^3; nine reported levels above 300 µg/m^3. Thus, dust is a widespread public health problem in Russia. On the other hand, sulphur dioxide levels are only reported at four locations, two of which show average annual concentrations of public health significance. Annex Table 16 supplements these observations by showing that short-term excursions of dust and sulphur dioxide can be prodigiously high in selected locations.

4.2 Lead

Lead exposure, especially to children, comes from a variety of sources. Usually, the most important of these is airborne deposition of dust on surfaces accessible to children. Direct inhalation of lead in air;

ingestion of lead in food or in paint; and ingestion of lead in drinking water are also potential routes of exposure. In the previous evaluation, lead in paint and drinking water did not appear to be a major issue in Central and Eastern Europe. Thus, lead in air is the common pollution element in exposures of public health significance in the region. At the other end of the process, blood lead in children continues to be the most easily accessible, sensitive, and valid measure of human health risk available. Accordingly, this section focuses on ambient airborne lead measurements and studies of blood lead among children. The former tend to come from government data sources. The latter are often found in the scientific literature, based upon studies carried out under the auspices of research institutes or academic centres.

Current thinking in public health recognises lead as a substance with “no safe level”, in that the dose-response relationship to threats to children’s cognitive and behavioural development is linear, with no threshold level identified. Nonetheless, it is possible to identify benchmarks for comparison. In North American communities with no leaded gasoline and no point sources, average blood lead levels fall below 5 µg/dl; values above 10 µg/dl are seen as elevated. In communities with point sources of lead, average blood lead levels among children usually fall in the range of 10 - 13 µg/dl. Blood lead levels above 20-25 µg/dl are seen as requiring individual treatment to bring them down. This does not mean treatment with chelation agents but, rather, efforts made to reduce environmental exposures.

Czech Republic -- Annex Table 18 presents blood lead data from one recognised hot spot and five other industrial centres in the Czech Republic. The data from Pribram is particularly important because it was identified in the previous evaluation as an area of high exposure to children. The Annex Table shows that, in the late 1980s, average blood lead levels near the smelter were more than three times higher than in the mid-1990s. The average level of 37.2 µg/dl was several times above Western norms. The average level of 11.4 in 1992-94 is, however, in the range of smelter communities in the West. Data from the other five communities shows average blood lead levels below 5 µg/dl. It would appear that the proportion of children above 10 µg/dl is less than 10% and falling. Missing from these data is information from those areas of Prague, and other cities, where exposures to automobile emissions may be of public health significance for children.

Poland -- Annex Table 19 presents the range of lead concentrations in air for selected provinces in Poland. Because of the multiple routes of entry of lead into the body, it is not easy to identify benchmarks for air lead levels. Roughly speaking, however, levels below 0.2 µg/m^3 imply low airborne exposure; levels above 1.0 µg/m^3 imply high exposure; and the range in between is a grey zone. Annex Table 19 shows that levels from three provinces fall into the grey zone and one, Katowice Province, which falls in the high range. Annex Table 20 disaggregates the Warsaw monitoring stations and shows that, over time, airborne lead seems to have come down in the areas of highest exposure. Annex Tables 21 and 22 summarise, respectively, blood lead data among children around the country, and those in the cities of Katowice and Chorzow in Upper Silesia. In general, average blood lead levels are now comparable to the West in areas like Cracow and Lodz. Similarly, the values around smelters are similar to those in western European and North American communities with large smelters, but the proportion of children with blood lead levels greater than 10 µg/dl is unacceptably high. Once again, as in the Czech Republic, no blood lead values are available from the highest traffic areas in Warsaw.

Hungary -- Annex Table 23 surveys airborne lead concentrations in cities in Hungary. It shows that there are several cities where airborne lead levels reach into the grey zone, but only one, Salgotarjan, where they are high. There is no blood lead data from this location. Annex Table 24 shows that progress has been made in reducing airborne lead in high traffic areas. In Budapest, levels have fallen more than 10 fold since the mid-1980s, as they have in Szolnok. Annex Table 25 suggests that, where traffic is the only source of lead exposure in smaller communities, blood lead levels are approaching those in similar western European communities. Annex Table 26 complements Annex Table 24 by showing how blood lead levels appear to have fallen approximately three-fold among children in Budapest since the mid-1980s.

Bulgaria -- Blood lead data on children from Bulgarian cities is found in Annex Table 27a. Unlike Hungary and the Czech Republic, the blood lead levels among those living near traffic sources in Bulgaria continue to be two to three times higher than in similar locations in western Europe. Average blood lead levels range from 9.9 to 15.2 µg/dl, and some children show blood lead levels above 20 µg/dl. It should be noted that those locations with the highest blood lead levels among children in the previous evaluation are not represented here. Nor are children living in the highest traffic areas of Sofia. Annex Table 27b shows that most monitored locations have airborne lead levels above 0.50 µg/m^3. Comparison with Annex Table 36 suggests that, although some of the highest levels may have declined, others, such as Sofia, appear to have increased.

Other Locations – Some lead data were also found for Romania, Latvia, Ukraine, and Russia. Annex Table 29 shows airborne lead data for two Romanian hot spots. These data suggest that airborne lead is now virtually non-existent in these smelter communities, where, in the previous evaluation, children were demonstrated to have lead-associated neurotoxicity. Although the new data are promising, a more complete re-evaluation of the situation is needed to make conclusions. Annex Table 30 suggests that airborne lead exposures are not a significant public health problem in Latvia. This is not in disagreement with what was found on the previous evaluation. Annex Table 31 presents airborne lead levels over time in Ukraine. Only one location has levels which are consistently in the grey zone. No blood lead studies of Ukrainian children, even for those in smelter communities, were found in the public health literature. In the absence of such data, the data reported in Annex Table 31 are impossible to interpret. Finally, Annex Table 32 presents the only blood lead study found of children in Russia, done in the community of Saratov. Saratov was chosen because it had both an increasing burden of traffic and several industrial point sources near the city. The variability in the average blood lead level, and in the maximum values shown in Annex Table 32 suggest that both traffic and point sources may be of public health significance.

4.3 Nitrates in Drinking Water

The original EAP evaluation identified 6 countries where high nitrate levels in rural drinking water were found, and were causing methemoglobinemia in new-borns (see Hertzman, 1995): Hungary, Slovakia, Romania, Bulgaria, Lithuania, and Belarus. On the basis of these findings, the EAP proposed that these and potentially other countries in the region should make the remediation of rural water sources a short-term investment priority. However, research for this review found current data on nitrates in drinking water in only one of the six affected countries: Romania. These data are presented in Annex Table 33. They show that elevated nitrate levels are still very common in shallow wells in 9 counties, in some cases exceeding the limit by more than tenfold. Elevated levels are also found in nearly 12 percent of deep wells. Moreover, the burden of morbidity and mortality from methemoglobinemia among new-borns has not declined over the past several years and is still unacceptably high.

Ironically, the most thorough evaluation of nitrates in drinking water was done in Estonia, which was not identified as a problem country before. Annex Table 34 shows that approximately 4000 wells were tested each year from 1993 to 1996, and that three to five percent showed nitrate levels above 45 mg/l. Data on methemoglobinemia were not forthcoming. Finally, some 1996 data from Kazakhstan were found (Annex Table 35). These show that nitrate levels far exceed acceptable levels in artesian wells and in the Syrdaria River in the Kzylorda region.

5. MAIN CONCLUSIONS AND RECOMMENDATIONS

5.1 Changes in environmental health threats

Progress has been made in reducing *ambient levels of sulphur dioxide and dust* in many regions of Central and Eastern Europe. In the case of sulphur dioxide, the public health problem can be said to have been reduced from widespread to sporadic and localised in most, though not all, countries in the region (for instance, Bulgaria is an exception). On the other hand, most of the monitored population centres still have dust levels which are of public health significance: dust is still a widespread problem in the region. These observations are consistent with emission trends, which have fallen in most countries in the region.

In the Czech Republic, Hungary and Poland, there has been progress towards reducing *the lead problem* to the dimensions of other OECD countries. Nonetheless, data were not found to systematically evaluate all communities with high traffic or point sources of exposure in these countries. In Bulgaria, there is sufficient data to suggest that few gains have been made. The evaluation, however, is seriously incomplete. In other countries, data is sporadic and largely uninformative of the situation as a whole. In the NIS, environment and public health authorities need to make systematic evaluations of children’s blood lead in all communities with non-ferrous smelter; and similar evaluations in areas of high traffic. In Romania and Bulgaria, better monitoring is likely needed in the “hot spot” communities identified in the previous evaluation.

The problem of *nitrate pollution* does not seem to have been taken as seriously as the other short-term investment priorities in Central and Eastern Europe. Acceptable data were found for only one of six countries identified as having a public health problem suggesting that little attention has been devoted to this issue. Proper monitoring would involve bringing systematically collected data on nitrates in rural water supplies together with data on cases of methemoglobinemia among new-borns.

5.2 Improving data collection and information systems

It appears that many CEECs and NIS need to improve their data on priority pollutants. Locations for collection need to be made consistent over time; reporting needs to be standardised; contradictory results between data sets need to be assessed; and nonsensical values need to be scrutinised. Furthermore, if more attention were paid to the type and source of particulate matter, simultaneously with collection of data with public health relevance, it would help in identifying and remediating the problem sources. Finally, the problems of using imprecise units (such as mg/m^3, rather than µg, for dust or sulphur dioxide) and reporting by end-digit preference need to be addressed.

Collection methods and reporting formats also need to be addressed. It is useful for data from each monitoring station to be reported separately, and then the range of values for a city or region presented for easy reference. Also, reporting the 98th percentile of daily values probably gives the most useful estimate of upper excursions. Presentations of trends over time are in particular useful from a policy standpoint. Annex Figures 1 and 2, from the Czech Republic, illustrate this approach. The Baltic Countries and Belarus, in particular, would benefit from establishing continuous, rather than intermittent monitoring, and using methods of dust collection which allow more precise estimates of ambient air quality.

It appears that quality control in laboratories is a continuing problem in a number of countries. In many countries, laboratories may have difficulties financing the hard currency costs of equipment, reagents, and maintenance, as well as their participation in inter-laboratory quality control exercises. Ideally, governments should provide quality control information in their annual statistical reports of pollution data; where possible, the data and information should also be available on the World Wide Web. Indeed, in many countries appropriate data may be collected, but is not easily available, either among government agencies or to the public – this is a major area where governments need to improve their environmental and environmental health information system (OECD, 1998).

In order to get an accurate picture of the impact of pollution on health, it is necessary to iterate between public health information sources and environmental sources. Data from both environment and public health authorities, as well as from academic sources, need to be considered together wherever possible, and evidence from one source used to stimulate inquiry into the other. Ministries usually have data from a wide variety of locations. But this data tends to be "thin," in the sense that it provides a superficial evaluation of the public health significance of the environmental exposure in question. Other sources may have detailed, or "thick" data, but on highly circumscribed populations. Both types of data can be useful. It is necessary to establish a free and open flow of information among a wide variety of agencies, institutions, and individuals which have knowledge of significant environmental exposures and health outcomes. (Hertzman, 1998)

Moreover, many countries in the region still need to establish ongoing programs to monitor for dust and sulphur dioxide in air; nitrates and bacteria in water; and blood lead. Indeed, in developing their NEAPs and NEHAPs, countries in the region should ensure that valid baseline data is available on each of these pollutants. At this point in time, it does not appear that any country has fully comprehensive data on these pollutants.

For example, with respect to dust and sulphur dioxide, “comprehensive” data would mean continuous monitoring over at least a year at each locality where the given pollutant could be expected to be a public health problem, based upon the nature/volume of industry, heating sources, and transportation, as well as climatic considerations. In terms of lead, it means sampling children aged 3 to 12 in all locations where there are point sources of lead, and/or heavy traffic flows. In terms of nitrates, it means nitrate testing in all rural areas where nitrate-rich fertiliser has been used over time. With respect to microbiological pollution of drinking water, it means, first, collating existing test data on major drinking water supplies, identifying gaps and filling them; and cross-classifying information from waterborne outbreak investigations with routinely collected data. Data so collected, and subjected to appropriate quality control, would then be used to map the public health concerns in the Region, and allow follow-up work to proceed on a more cost-effective, problem-oriented basis.

5.3 Emerging environmental health issues

This report has focused on the environmental health issues identified in the 1993 EAP, and on the CEE countries that were the main focus of the work to prepare the EAP. Recent reports have indicated that contaminated drinking water is a major and growing problem in the NIS (World Bank, 1998). One reason is that urban drinking water treatment plants are falling into disrepair amid the region’s ongoing economic crisis – as a result, microbiological contaminants have been linked to increased outbreaks of disease. Further, in Central Asia in particular, drinking water infrastructure is poor in urban and especially rural areas: as a result, infant mortality from intestinal infectious diseases is reportedly several times higher in the Central Asian Republics than in other NIS (in comparison, these diseases are generally not a health threat in western Europe or advanced CEE countries such as Hungary or Poland). Clearly, these issues deserve further study and priority attention.

STATISTICAL ANNEX

Annex Table 1: Stations with the worst air quality in the Czech Republic (ug/m^3)

SO_2		Dust		PM_{10}	
Station	**Annual Average**	**Station**	**Annual Average**	**Station**	**Annual Average**
N. Visko u D.	90	Trinec-Kanada	123	Beroun	91
Komari Viska	78	PS-Svornosti	102	Pl-n. Republiky	74
Kladno-Sverm.	78	Ostrava-ZOO	97	Ostrava-Zabreh	72
Litvinov	77	Tisice	90	PS-Mlynarka	71
Rudolice v H.	70	Cesky Tesin	83	Pl0-Vrsovice	70
Medenec	68	Trinec-Kosmos	81	Bohumin	70
Horni Halze	67	P8-Sokolovska	79	Ostrava-Fifejdy	69
Plzen-Masar,tr.	60	Uzice	76	Ostrava-Rady	64
Pl-nam. Republiky	55	Bohumin-Casl	76	Cesky Tesin	61
Kostomlaty	53	Lovosice-MU	76	Vsechlapy	61

Source: Czech Hydrometeorological Institute

Annex Table 2: Average seasonal air quality in Hungary, 1995-96 (ug/m^3)

	Dust average of		Sulfur Dioxide average of	
City	1995 Summer	1995/96 Winter	1995 Summer	1995/96 Winter
Budapest	204.38	217.43	15.00	34.45
Dorog	--	--	4.28	24.88
Dunaujvaros	181.14	186.73	18.00	21.02
Gyor	56.33	91.03	6.81	37.03
Kaposvar	141.83	194.33	1.83	8.32
Pecs	204.71	282.88	4.34	22.67
Szekszard	157.08	285.80	6.95	8.90
Szekesfehervar	157.68	181.44	17.40	29.84
Szombathely	226.17	187.00	2.25	11.72
Tatabanya	55.33	74.73	5.37	19.40
Varpalota	--	--	3.14	35.39
Veszprem	61.78	96.89	1.82	15.25
Zalaegerszeg	142.06	115.55	2.35	2.94
Bekescsaba	256.65	358.40	13.79	20.00
Debrecen	76.39	140.83	13.52	14.06
Kecskemet	176.19	252.17	2.98	17.75
Nytregyhaza	222.67	330.83	3.08	8.85
Szeged	231.25	415.23	10.58	10.35
Szolnok	153.54	204.75	14.44	4.52
Vac	278.57	268.90	1.36	2.93
Eger	56.17	91.50	8.56	12.62
Kazincbarcika	29.20	52.49	16.40	54.32
Miskolc	21.76	46.16	21.17	64.01
Ozd	--	--	10.13	102.87
Szlgotarjan	137.13	179.00	8.61	18.59

Source: Hungarian Central Statistical Office, Statistical Yearbook, 1995

Annex Table 3a: Range of sulfur dioxide levels in selected Polish provinces, 1994-95 (ug/m^3)

	1994		1995	
Province	**Range of Annual Average**	**Range of 98th Percentiles**	**Range of Annual Average**	**Range of 98th Percentiles**
Warszawskie	4-19	24-72	6-17	31-82
Bialostockie	4-13	16-43	5-7	27-30
Bielskie	27-44	86-132	21-43	83-174
Bydgoskie	6-21	17-127	6-18	32-96
Chelmskie	15-30	58-132	7-23	37-114
Czestochowskie	7-27	28-111	16-26	55-117
Gdanskie	15-32	61-111	10-27	30-109
Jeleniogorskie	18-75	61-204	16-26	66-113
Kaliskie	23-39	60-115	25-33	86-116
Katowickie	24-107	69-506	14-61	51-273
Krakowskie	16-46	55-123	23-43	66-158
Legnickie	11-35	46-123	12-27	55-114
Lodzkie	9-36	35-182	12-26	44-101
Nowosadeckie	14-34	51-131	11-31	29-106
Opolskie	6-29	29-72	5-18	20-119
Pilskie	11-25	48-104	16-21	85-114
Piotrkowskie	18-24	45-79	27-32	90-114
Poznanskie	11-36	35-197	7-37	34-190
Sieradzkie	16-58	29-128	17-48	42-111
Tarnowskie	6-21	33-123	8-27	41-102
Torunskie	6-17	46-124	8-21	41-108
Wolbrzyskie	4-46	18-182	12-43	65-163
Wroclawskie	13-28	53-88	13-24	59-108
Plockie	9-26	62-113	8-45	55-145

Annex Table 3b: Monitoring Stations with average annual sulfur dioxide greater than 40 ug/m^3, 1996

Location	Annual Average
Chorzow	40
Bielsko-Biala	41
Jaworzno	53
Krakow-Krowodrza	49
Krakow-Podgorze	40
Ruda Slaska	44
Torun	41
Zabrze	43

Source: Central Statistical Office of Poland, Air quality in Poland in 1995

Annex Table 4: Dust levels in selected cities in Poland, 1994-95 (ug/m3)

City	1994 Annual Average	 98th* Percentile	1995 Annual Average	 98th* Percentile	1996 Annual Average
Bielsko-Biala	135	364	114	380	74
Oswiecim	133	323	126	339	---
Gdansk	111	327	87	221	29
Katowice	99	242	106	320	120
Bukowno	64	155	77	171	---
Bytom	156	360	142	342	62
Chorzow	109	247	122	317	129
Chrzanow	91	221	90	191	---
Laziska Gome	70	172	107	272	---
Mystowice	95	229	105	356	---
Olkusz	84	173	90	228	---
Piekary Slaskie	65	121	108	517	---
Pszczyna	84	207	96	334	---
Raciborz	76	184	81	243	---
Ruda Slaska	116	236	98	249	---
Rybnik	91	215	91	296	102
Toszek	92	204	111	322	---
Wodzislaw Slaski	101	240	100	308	---
Zabrze	118	294	126	356	147
Zawiercie	78	144	95	198	---
Lodz-Srodmiescie	157	347	160	377	87
Plock	46	98	49	140	24
Rzeszow	120	336	52	202	29
Mielec	51	151	62	185	---
Tarnow	46	180	93	345	22
Walbrzych	135	475	130	394	34

* daily values
Source: Central Statistical Office of Poland, Air quality in Poland in 1995

Annex Table 5: Average annual dust levels in Bulgaria, 1995-1996 (ug/m^3)

City	1995	1996
Dimitrovgrad	>180	456
Devnya	100	----
Kurdjhali	150	238
Sofia	300	323
Ruse	300	454
Plovdiv	340	372
Stara Zagora	320	361
Asenovgrad	160	211
Varna	320	380
Pernik	>180	540
Pleven	>500	----
Burgas	>450	491
Gabrovo	>250	---
Vratsa	----	298
Srednogorie	----	327

Source: Bulgarian National Report on the State of the Environment, 1995 ; Semichaevsky, 1998

Annex Table 6: Average annual sulfur dioxide levels in Bulgaria, 1995-1996 (ug/m^3)

City	1995	1996
Dimitrovgrad	30-50	----
Devnya	140	150
Kurdjhali	100	----
Sofia	15-50	----
Ruse	30-100	----
Plovdiv	50-100	131
Stara Zagora	50	120
Asenovgrad	120	140
Pernik	160	----
Varna	110	130
Eliseyna	160	350
Galabovo	----	135
Zlatitsa	160-180	48
Blagoevgrad	180-200	420

Source: Bulgarian National Report on the State of the Environment, 1995 ; Semichaevsky, 1998

Annex Table 7: Air quality in Romanian cities, 1993-94 (ug/m^3)

	Dust		Sulfur Dioxide	
City	Average Yearly	Max Daily	Average Yearly	Max Daily
Zlatna	181	--	50	326
Alba Iulia	556	2070	--	--
Arad	84	260	--	--
Bacau	--	--	2	140
Oradea	43	135	21	213
Botoasani	--	--	4	81
Brasov	--	--	73	255
Braila	63	270	15	172
Resita	144	283	4	920
Calarasi	--	--	4	56
Constanta	125	436	30	245
Stantu Gheorghe	70	140	1	8
Craiova	--	--	29	45
Galati	79	490	1	4
Rovinari	--	--	10	40
Miercurea	67	464	10	49
Hunedoara	159	1729	12	139
Iasi	90	147	7	214
Baia Mare	125	391	185	1040
Turnu Severin	--	--	15	120
Roznov	--	--	4	153
Slatina	--	--	5	198
Ploiesti	110	290	31	140
Copsa Mica	83	720	64	940
Timisoara	112	279	9	139
Tulcea	73	375	3	92
Vaslui	--	--	20	248
Ramnicu Valcea	--	--	28	100
Focsani	90	660	18	170
Bucharest	84	312	3	175

Source: National Commission for Statistics, Romanian Statistical Yearbook, 1994

Annex Table 8: Air quality in Romania over time, selected cities (ug/m^3)

Pollutant	City	1992		1993		1994	
		Average Yearly	Max Daily	Average Yearly	Max Daily	Average Yearly	Max Daily
Sulfur Dioxide							
	Baia Mare	204	5180	190	6439	260	5030
	Copsa Mica	71	1250	64	940	30	1090
Dust							
	Hune doara	280	2500	159	1729	160	555
	Galati	45	699	79	490	55	148
	Bucharest	58	263	62	278	84	312

Source: National Commission for Statistics, Romanian Statistical Compendium, 1994

Annex Table 9: Ambient air quality in Lithuanian cities, 1995 (ug/m^3)

City	Dust		Sulfur Dioxide	
	Average Annual	Daily Max	Average Annual	Daily Max
Vilnius	100	150	7	200
Kaunas	120	800	low	100
Klaipeda	50	400	15	150
Siauliai	110	1400	low	low
Mazeikiai	50	500	5	50
Panevezys	low	300	5	50
Jonava	150	800	7	100
Kedainiai	105	800	7	50
Naujoji Akmene	150	1400	low	25
Venta	110	600	5	25

Source: National data

Annex Table 10: Ambient air quality in Estonia, 1994-1997 (ug/m^3)

I. Tallinn

Year	Dust	Sulfur Dioxide		
	Range of Monthly Averages	Range of Daily Maxima by Month	Range of Monthly Averages	Range of Daily Maxima by Month
1994	----	----	1.0-27.0	14.0-87.0
1995	53-124*	75.2-348.7	2.0-17.0	8.2-117.7
1996	40-268	58.9-456.0	1.0-20.0	6.0-41.0
1997	40-338	86.4-492.4	3.4-14.0	6.5-52.0

II. Narva

Year	Dust	Sulfur Dioxide
	Range of Monthly Averages	Range of Monthly Averages
1994	84-145	1-2
1995	56-204	3-13
1996	52-153	5-10
1997	38-108**	5-9

* 8 months reporting
** 10 months reporting, one monitoring station rather than 2
Source: National data

Annex Table 11: Ambient air quality in Belarus over time, (annual averages, in ug/m^3)

		Year					
	City	**1985**	**1990**	**1992**	**1994**	**1995**	**1996**
(a)	**Dust**						
	Brest	100	100	100	<100	49	41
	Pinsk	100	100	100	100	64	99
	Vitebsk	100	100	100	100	97	157
	Orsha	300	200	----	100	189	167
	Polotsk	100	100	100	200	---	---
	Novopolotsk	100	100	100	100	33	---
	Gomel	100	100	100	100	82	---
	Svetlogorsk	100	100	100	100	57	52
	Mozyk	100	200	200	100	173	158
	Grodno	100	100	100	100	70	---
	Minsk	200	100	100	<100	30	41
	Mogilev	100	100	100	100	67	49
(b)	**Sulfur Dioxide**						
	Brest	100	40	9	9	8	6
	Pinsk	60	70	7	8	9	13
	Vitebsk	90	60	11	10	10	10
	Orsha	90	110	12	15	14	14
	Polotsk	100	40	12	7	6	6
	Nevopolotsk	50	30	10	6	6	6
	Gromel	100	60	7	12	9	10
	Svetlogorsk	10	10	2	2	2	2
	Mozyk	120	80	10	14	9	10
	Grodna	100	110	5	4	3	3
	Minsk	30	20	2	1	1	2
	Mogilev	60	60	16	8	3	3

Source: Ministry of Statistics, Belarus, 1995 and 1997

Annex Table 12: Ambient air quality in Belarus over time, (maximum daily concentrations, in ug/m^3)

		Year				
	City	**1985**	**1990**	**1992**	**1993**	**1994**
(a)	**Dust**					
	Brest	1000	900	700	500	400
	Pinsk	500	800	2700	600	2100
	Vitebsk	1100	2000	1600	1400	900
	Orsha	2500	900	100	1100	400
	Polotsk	1000	900	900	1400	1500
	Novopolotsk	1400	500	600	500	400
	Gomel	2400	2300	2100	2400	1400
	Svetlogorsk	600	1400	1200	600	600
	Mozyk	1800	1000	4200	1600	1200
	Grodno	1400	1700	1900	2000	1300
	Minsk	1700	2100	800	1800	500
	Mogilev	2100	1400	700	2800	700
(b)	**Sulfur Dioxide**					
	Brest	840	760	219	502	149
	Pinsk	650	200	112	108	190
	Vitebsk	2240	870	142	803	315
	Orsha	290	190	24	20	28
	Polotsk	4960	3150	215	282	241
	Nevopolotsk	4450	2060	720	412	165
	Gromel	740	650	50	41	48
	Svetlogorsk	290	90	41	23	21
	Mozyk	460	810	73	173	85
	Grodna	1370	1700	87	47	66
	Minsk	550	270	40	58	50
	Mogilev	1960	1640	1894	180	115

Source: Ministry of Statistics, Belarus, 1995

Annex Table 13: Ambient air quality in the Ukraine, 1994 and 1996 (ug/m^3)

a. Dust

City	1994	1996	
	average annual	average annual	daily max
Donetsk	250	255	--
Krivoi Rog	250	255	--
Odessa	280	285	--
Zaporozhe	250	255	2200
Dnepropetrousk	250	255	2400
Makeevka	--	300	--
Vinnitsa	--	300	--
Tevnopil	--	285	2300
Svitlovodsk	--	255	--
Sevastopol	--	--	4500

b. Sulfur Dioxide

City		1996	
		average annual	daily max
Krivoi Rog	--	--	550
Donetsk	--	--	500
Enakievo	--	60	--
Odessa	--	55	--
Khmelnitsky	--	50	--

Source: Semichaevsky, 1998; Ukrainian National Report on the State of the Environment (1996)

Annex Table 14: Average annual concentrations of air pollutants in Kazakhstan, 1990-1996 (ug/m^3)

			Year						
City	**Pop.thous.**	**Pollutant**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Akmola	280	Dust	135	180	105	105	90	90	45
		SO2	5	5	5	5	5	5	5
Aktay	155	Dust	405	420	420	525	510	705	930
		SO2	60	75	55	40	35	40	55
Aktiubinsk	258	Dust	120	75	90	60	60	60	60
		SO2	40	35	30	30	25	30	30
Almaty	1 158	Dust	270	315	300	285	195	180	150
		SO2	10	15	20	20	20	15	20
Atyrau	148	Dust	180	195	150	150	165	45	180
		SO2	5	5	5	5	5	5	0
Balkhash	98	Dust	195	180	180	195	195	225	210
		SO2	35	30	45	65	75	65	40
Dzezkazgan	113	Dust	315	300	255	255	135	225	315
		SO2	20	20	20	15	15	35	30
Zyrianovsk	49	Dust	480	450	405	390	330	--	345
		SO2	70	30	30	25	25	25	30
Karaganda	557	Dust	75	90	75	75	90	105	45
		SO2	10	10	5	10	10	35	10
Kostanai	225	Dust	45	60	45	60	45	30	45
		SO2	20	20	20	20	25	20	25
Leninogorsk	65	Dust	225	210	180	165	165	165	150
		SO2	40	60	140	115	130	135	105
Pavlodar	331	Dust	90	90	120	105	120	105	120
		SO2	10	5	5	5	10	10	5
Petropavlov	231	Dust	120	90	60	60	75	105	60
		SO2	10	10	10	10	10	10	10
Semipalatinsk	315	Dust	360	345	330	195	150	195	195
		SO2	15	20	20	15	10	10	10
Taraz	..	Dust	210	270	255	165	150	150	135
		SO2	20	20	15	15	20	25	30
Temirtau	204	Dust	255	315	300	225	210	270	240
		SO2	10	10	15	20	15	5	5
Uralsk	247	Dust	30	15	15	15	15	30	30
		SO2	25	35	30	30	25	25	20
Ust-Kameno	322	Dust	180	105	150	135	135	120	135
		SO2	90	115	125	125	135	100	155
Shimkent	..	Dust	405	330	375	270	240	225	300
		SO2	15	15	15	20	20	5	5
Ekibastuz	141	Dust	90	120	90	75	90	105	75
		SO2	5	5	5	5	5	5	5

Source: Ministry of the Environment and Natural Resources of Kazakhstan, National Environmental Action Plan for Sustainable Development, national data

Annex Table A15: Annual average concentrations in Russian cities, 1995 (ug/m^3)

City	Pop, thousands	SO_2	Dust
Barnaul	596	--	300
Berezniki	200	--	150
Bijsk	224	--	150
Vladivostok	632	--	150
Volgograd	1023	--	105
Voronej	975	--	300
Irkutsk	632	--	150
Kemerovo	501	--	210
Komsomolsk	309	--	300
Krasnodar	764	--	300
Krasnoyarsk	869	--	150
Kurgan	363	--	150
Kyzyl	93	--	150
Lipetsk	502	--	300
Magadan	135	--	150
Magnitogorsk	425	--	300
Moscow	8717	--	150
Naberezhnyo	520	--	150
Nizhni Novg	1386	--	150
Novokuznet	569	--	150
Novosibirsk	1418	--	300
Norilsk	159	140	150
Orenburg	557	--	150
Prokopievsk	250	--	150
Rostov on-Don	1013	--	300
Samara	1264	--	150
St-Petersburg	4276	--	150
Toliatti	697	--	150
Tomsk	497	--	150
Tiumen	547	--	225
Ulan-Ude	366	--	150
Usolie-Sibirsk	106	--	225
Khabarovsk	618	175	300
Chelyabinsk	1115	30	--
Chita	323	40	150
Shelekhov	50	--	150
Yakutsk	221	--	225

Source: National data

Annex Table 16: Russian cities where 20-minute ambient air quality standard was exceeded by a factor of 10 or more in 1996

Pollutant	City	Maximum Excursion
Dust	Kumertay	5200 ug/m^3
	Novorosijsk	12,500
	Novosibirsk	5900
	Komsomolsk on Amur	5000
Sulfur dioxide	Norilsk	13,300 ug/m^3

Source: National data

Annex Table 17: Ambient air quality in Georgia, 1994 (ug/m^3)

City	Dust	SO2
Tbilisi	300	7
Rustavi	400	50
Kutaisi	500	--
Zestaponi	350	40
Kaspi	500	60
Batumi	200	50
Akhaltsikhe	700	--

Source: Semichaevsky, 1998

Annex Table 18: Blood lead among children in selected cities in Czech

(a)	Elementary school children within 3 km of smelter in Pribram, mean blood lead*	
	1986 - 1990	37.2 ug/dL
	1992 - 1994	11.4 ug/dL

(b)	Children from Benesov, Plzen, Ulsti nad Laben, Zd’av n/S**		
		1994	**1995**
	number of samples	712	599
	mean blood lead (ug/dL)	3.8	4.0
	90% percentile (ug/dL)	11.1	9.7

* Source: Cikrt, 1997

** Source: National Institute of Public Health, Prague, 1996

Annex Table 19: Average monthly air lead in selected provinces of Poland, 1994 and 1995 (ug/m^3)

Province	No of Districts	Range of air lead across districts 1994	1995
Warsawskie	6	0.081-0.248*	0.057-0.219
Bialostockie	1	0.170	0.095
Bielskie	5	0.091-0.167	0.051-0.084**
Kieleckie	8	0.044-0.146	0.028-0.074***
Legnickie	6	0.060-0.198	0.051-0.118
Ostroleckie	5	0.050-0.361	0.130-0.214***
Piotrkowskie	5	---	0.094-0.547
Przemyskie	3	0.127-0.191	0.135-0.153
Katowickie	-	0.095-1.630 (1993)	--

* 5 zones; ** 2 zones, *** 4 zones
Source: National data; Gzyl, 1997

Annex Table 20: Average monthly air lead in the administrative districts of Warsaw over time (ug/m^3)

Year	Range of air lead in 6 districts
1992	0.076 - 1.541
1993	0.107 - 1.264
1994*	0.081 - 0.248
1995	0.057 - 0.219

* 5 districts reporting
Source: World Bank, 1996; national data, 1995

Annex Table 21: Blood lead levels in children under 10 years of age, various regions of Poland, 1992-1994

	Area	No.	Mean BLL	% > 10 ug/dl
1	Legnica	69	5.0	--
2	Lodz-Center	211	5.2	2%
	Krakow:			
3	Nowa Huta	33	5.4	12%
4	Ludwinow-Debniki	28	3.0	--
5	Center - Al. Krasinskiego	38	6.3	11%
6	Walbrzych	48	4.6	--
7	Wloclawek	128	4.3	--
	Vicinity of the zinc mill:			
8	Miasteczko Sl. < 1 km	189	11.4	54%
9	Zyglin 1-5 km	83	10.0	50%
10	Lasowice 5-10 km	153	7.6	24%
	Vicinity of the copper mill (Gogow):			
11	Zone I < 5 km	24	9.4	46%
12	Zone II 5-10 km	78	8.4	27%
13	Zone III 10-12 km	39	8.3	28%
14	Zone IV > 12 km	141	7.4	21%

Source: Jakubowski, 1996

Annex Table 22: Blood lead levels among children in two locations in upper Silesia, 1994-1995 (ug/dl)

Age	**Katowice**				**Chorzow**			
	Boys		***Girls***		***Boys***		***Girls***	
	Mean BLL	**%>10**	**Mean BLL**	**%>10**	**Mean BLL**	**%>10**	**Mean BLL**	**%>10**
2 - 6	6.5		6.2		7.1		5.2	
		17.2%				15.0%		
7	8.3	30.6%	7.6	26.6%	8.1	30.4%	7.8	21.2%

Source: Zejda, 1995; Zejda, 1997

Annex Table 23: Ambient air lead in various locations in Hungary (ug/m^3)

Location	**Summer season, 1996/97**	**Winter season, 1996/97**
Budapest	0.21	0.24
Pecs	0.22	0.20
Kecskemet	0.08	0.12
Bekescsaba	0.27	0.21
Kazincbarcika	0.05	--
Miskolc	0.09	0.15
Asotthalom	0.37	--
Szeged	0.18	0.25
Nyiregyhaza	0.12	0.14
Szolnok	0.06	0.06
Szekszard	0.03	0.03
Szombathely	0.06	0.27
Veszprem	0.03	0.06
Zalaegerszeg	0.05	0.07
Dunaujvaros	0.22	0.15
Szekesfehervar	0.14	0.16
Gyor	0.07	0.05
Debrecen	0.21	0.36
Eger	0.07	0.08
Dorog	0.02	0.06
Tatabanya	0.03	0.07
Salgotarjan	0.59	1.62
Vac	0.09	0.22
Kaposvar	0.05	0.03

Source: National data

Annex Table 24: Lead in air over time in selected locations in Hungary (ug/m^3)

	Location		1985 - 1986	Summer 1996-97	Winter 1996-97
A.	Budapest	- traffic area 1	5.3	--	--
		- traffic area 2	2.9	--	--
	Budapest	(average)	--	0.21	0.24
B.	Szolnok	- traffic area 2.0	0.06	0.06	

Source: World Bank, 1996; National data

Annex Table 25: Blood lead over time among children in other towns in Hungary*

Year	Type of Area	Age Range	N	Mean BLL (ug/dl)	% > 10
I. Vac					
1990	--	9-10	14	--	0
1990	--	6-10	14	--	7
1994	low traffic	9-10	78	6.7	9.7
1994	traffic	9-10	64	6.9	6.2
1994	traffic	9-10	67	7.6	11.9
II.Gyor					
1985	industrial	0-6	125	21.9	--
1991	--	9-10	139	--	1
III. Sopron					
1992	traffic	9-10	182	--	12
1993	traffic	9-10	183	--	8
IV. Tata					
1994	traffic	9-10	154	6.7	6.5

* Miskolc: 6.3% of childrens' tooth lead > 10 ug/g, 1995 (Selypes, 1997)
Source: Bitto, 1997; World Bank, 1996

Annex Table 26: Blood lead measurements on children in Budapest over time

Year	Type of Area	Age Range	N	Mean BLL (ug/dl)	% > 10
1985 - 86	heavy traffic	7-9	33	27.3	91
1985 - 86	traffic	7-9	37	22.5	95
1986	downtown	7-9	70	25.0	89*
1986	suburb	7-9	59	8.0	7*
1990	near lead plant	0-14	415	7.7	21
1990	traffic	6-8	193	--	17
1991	traffic	3-6	21	--	67
1992	traffic	9-10	98	--	11
1993	traffic	6-14	24	8.2	13
1993	traffic	14-18	20	6.7	5

* % > 12 ug/dl
Source: Bitto, 1997; World Bank, 1996

Annex Table 27a: Mean blood lead levels of children in the towns of Kurdzhali, Ostrovitsa, and Haskovo, Bulgaria, 1995

Location	children	Age of tested	Number ug/dL	BLL Range
Kurdzhali*	5-7	16	12.1	8.2 - 22.8
Kurdzhali*	7-14	22	10.0	5.2 - 17.7
Kurdzhali**	10-14	17	9.9	5.2 - 16.5
Kurdzhali and Ostrovitsa	5-7	21	12.7	8.2 - 22.8
Ostrovitsa	5-7	5	14.4	--
Ostrovitsa	7-14	21	15.2	--
Haskovo*	5-7	13	10.1	5.5 - 19.8
Haskovo*	7-14	15	11.4	7.3 - 19.8

* schools near road or motorway

** same 17 children, analyzed in 1991: Mean BLL 14.3 ug/dL (range 10.0 - 22.2 ug/dL)

Source: Bainova, 1995

Annex Table 27b: Annual average concentration of lead aerosols, 1996

Location	ug/m^3
Sofia	0.61
Plovdiv	0.53
Pernik	0.70
Kurdjali	0.71
Assenovgrad	0.62
Veliko Turnovo	0.40
Yana	0.47
Dolni Voden	0.59

Source: Semichaevsky, 1998

Annex Table 28: Average annual airborne lead concentrations in Kurdjali, Bulgaria (ug/dL)

Year	Location 1	Location 2
1990	0.94 (3.2 - 0.1)*	1.2 (4.0 - 0.3)
1991	1.45 (2.6 - 0.2)	1.1 (2.5 - 0.3)
1992	1.42 (3.5 - 0.5)	1.4 (3.9 - 0.3)
1993	1.09 (2.7 - 0.5)	0.6 (2.0 - 0.2)
1994	0.96 (2.3 - 0.3)	0.9 (1.9 - 0.1)

* mean (monthly maximum - minimum)
Source: National data

Annex Table 29: Average annual and maximum daily airborne lead concentrations in Romanian hot spots (ug/m^3)

Location	1992	1993	1994
Baia Mare	0.001 (0.054)*	0.007 (0.053)	0.005 (0.034)
Copsa Mica	0.068 (5.153)	0.003 (0.037)	0.002 (0.029)

* average annual (maximum daily)
Source: National Commission for Statistics, Romanian Statistical Yearbook, 1994

Annex Table 30: Average annual air lead concentrations, Latvian Cities, 1994 (ug/m^3)

Location	Concentration
Daugavpils	0.010
Jurmala	0.014
Liepaja	0.040
Riga	0.070
Ventspils	0.008
Olaine	

Source: National data

Annex Table 31: Ambient average annual air lead concentrations in Ukraine (ug/m^3)

Location	1990	1991	1992	1993	1994	1995	1996
Dniprepetrevsk	0.07	0.09	0.08	0.07	0.20	0.09	0.09
Donetsk	0.13	0.82	0.37	0.22	0.14	0.06	0.11
Kiev	0.02	0.01	0.08	0.10	0.15*	0.07	0.07
Kremencheug	0.02	0.08	0.14	0.07	0.10	0.06	0.05
Lugansk	0.04	0.07	0.01	0.02	0.10	0.04	0.07
Mariupol	0.05	0.14	0.06	0.05	0.08*	0.02	0.08
Odesa	0.11	0.12	0.03	0.03	0.06	0.03	0.02

Location	1990	1991	1992	1993	1994	1995	1996
Kharkiv	0.10	0.14	0.08	0.04	0.05	0.05	0.08
Kherson	0.04	0.01	0.03	0.04	0.24	0.10	0.12
Kostyantynivka	0.31	0.61	0.39	0.23	0.39	--	--

* maximum of 24 hour values: Kiev 0.75, Mariupol 1.2
Source: Central Geophysical Observatory, Ukraine

Annex Table 32: Blood lead levels in kindergarten, Saratov, Russia, May 1996

	No. of children	Age in years x, (range)	Blood lead level ug/dL, Gx, (range)
Kindergarten 1	48	4.9 (2.2 - 7.5)	6.0 (3.4 - 16.1)
Kindergarten 2	45	5.6 (3.6 - 7.6)	9.0 (4.7 - 19.2)
Kindergarten 3	25	5.9 (2.0 - 8.5)	7.4 (5.0 - 20.3)
Kindergarten 4	45	5.6 (1.9 - 7.6)	14.9 (6.9 - 28.8)
Kindergarten 5	35	5.3 (2.9 - 7.7)	6.7 (3.1 - 35.7)
Kindergarten 6	43	5.7 (2.4 - 12.1)	6.8 (3.3 - 18.0)
Kindergarten 7	63	5.3 (2.3 - 7.4)	7.4 (4.0 - 15.1)
Kindergarten 8	38	5.6 (3.4 - 7.5)	6.7 (3.3 - 17.3)
Kindergarten 9	40	5.1 (2.1 - 8.1)	9.0 (4.6 - 20.5)
Kindergarten 10	63	6.4 (2.3 - 10.6)	8.2 (3.6 - 17.7)
Kindergarten 11	53	6.0 (2.9 - 13.6)	6.1 (3.0 - 17.1)
Kindergarten 12	31	5.2 (2.1 - 7.5)	8.2 (4.2 - 14.2)
Kindergarten 13	27	5.7 (2.7 - 7.2)	6.1 (3.6 - 10.6)
Orphanage	21	2.4 (1.2 - 6.1)	7.4 (4.6 - 16.9)
Totals	579	5.4 (1.2 - 13.6)	7.7 (3.0 - 35.7)

Source: Rubin, 1997

Annex Table 33: Nitrates in Well Water in Romania, 1995

(a) Well depth %_	With nitrates > 45 mg/l
0 - 10 metres	44.5%
10 - 20 metres	25.4%
> 20 metres	11.9%

(b) 200-220 cases of acute methemoglobinemia per year among those aged 0-1 with a mortality rate of 6%
(c) some drinking water samples 100-500 mg/l
(d) most affected areas: Dolj, Iasi, Buzau, Giurgui, Bacau, Mehedinti, Teleorman, Botosani, Olt counties
Source: Romanian Institute for Hygiene & Public Health, 1997

Annex Table 34: Nitrates in well water in Estonia

Year	% of Samples > 45 mg/l	Estimated Population Exposed to Levels > 45 mg/l
1993	4.0	3850
1994	3.0	3798
1995	4.9	4130
1996	4.9	4140

Source: Estonian response to data collection for WHO monograph "Water Resources and Human Health," 1997

Annex Table 35: Average annual nitrate levels, Kazakhstan, 1996

	Location	Mean nitrates (mg/l)
(a)	**Kzylorda Region: Artesian Wells**	
	"Steppe"	46.3
	Arasol	46.8
	Joint Stock Company "EM"	301.5
	Private Sector Housing Areas	75.1
	Hidkova/Karatugai Housing Areas	< 10
(b)	**Kzylorda Region: Syrdaria River**	
	near Zhanakorgan	218.7
	near Kyzlorda	184.5
	near Kazalinsk	321.3
(c)	**Irtysh River**	
	near Chinese Border	1.26 - 3.6
	near Shulbinsk	3.6

Source: Ministry of the Environment and Natural Resources of Kazakhstan, National Environmental Action Plan for Sustainable Development of the Republic of Kazakhstan, 1997

Annex Table 36: Baseline ambient air quality data from Central and Eastern Europe before the Environment for Europe initiatives

Country/City	TSP	SO_2	Lead
Belarus (1991)			
Orsha	395	8	--
Vitebsk	166	11	--
Polotsk	135	19	--
Mogilev	133	14	--
Grodno	111	8	--
Gomel	103	9	--
Minsk	101	4	--
Novopolotsk	86	10	--
Brest	64	13	--
Bulgaria (1989-90)			
Dimitrovgrad	530	119	0.7
Srednogorie	400	440	--
Devnya	350	28	0.3
Panagiurishte	320	350	0.5
Kurdzhali	310	103	1.5
Sofia	303	67	0.4
Ruse	300	32	0.4
Plovdiv	280	306	1.0
Stara Zagora	275	120	--
Asenovgrad	270	485	2.6
Pernik	245	469	0.5
Vratsa	160	59	0.3
Ukraine (1990)			
Donetsk	500	40	--
Krivoi Rog	400	30	--
Odessa	300	50	--
Zaporozhe	300	20	--
Dneprodzerzhinsk	300	10	--
Dnepropetrosk	200	10	--
Marioupol	200	20	--
Makeeva	160-200	84-250	--
Kiev	100	100	--

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Annex Table 36: Baseline ambient air quality (cont'd)

Country/City	TSP	SO_2	Lead
Poland (TSP data for 1987, SO_2 data for 1987 o 1988)			
Katowice:			
Dabrowa Gorn.	477	36	--
Chorzow	440	70	--
Myslowice	342	42	--
Swietochlowice	336	67	--
Katowice	311-327	29-75	0.5-2.6
Ruda	318	55	--
Charzanow	315	128	--
Tarn. Gory	314	112	--
Zawiercie	297	51	--
Wodzislaw	288	75	--
Rybnik	276	45	--
Gliwice	267	42	--
Pilica	225	29	--
Tosek	209	107	--
Bytom	279	48	--
Zabrze	174	49	--
Ielenia Gora:			
Kamienna Gora	--	129	--
Bolkow	--	112	--
Lubawka	--	99	--
Zgorzelec	--	82	--
Krakow:			
Krakow	138	105	--
Legnica:			
Chojnow	--	115	--
Piotrkow:			
Tornaszow Maz.	--	88	--
Poznan:			
Gniezno	--	96	--
Torun:			
Torun	--	149-584	--
Walbrzych:			
Zarow	--	289	--
Swiebodzice	--	280	--
Jaworzyna Sl.	--	277	--
Strzegom	--	271	--
Swidnica	--	197	--
Lazdec	--	193	--
Walbrzych	--	57-187	--
Dlugopole Zdroj	--	183	--
Polanica	--	179	--
Wroclaw			
Wroclaw	105	70	--

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Annex Table 36: Baseline ambient air quality (cont'd)

Country/City	TSP	SO_2	Lead
Romania (1990)			
Bucharest	14-285	1-8	1-9.6
Piatra Neart	250	33	--
Zlatna	204	128	2.3
Drobeta Turnu Severin	188	--	--
Galati	166	3-4	--
Craiova	75-140	6-7	--
Tirgu Jiu	120	16	--
Tirgu Mures	116	--	--
Slatina	113	15	0.8-4
Medias	107	--	--
Satu Mare	107	--	--
Hunedoara	99	11	--
Isalnita	84	4	--
Czechoslovakia (range of annual averages, 1981-88)			
N. Bohemia (average region)	63-223	43-184	0.27-0.40
Usti nad Labem	94-223	70-98	--
Litvinov	70-161	59-184	--
Decin	91-150	60-126	--
Most	75-127	55-176	0.18-0.43
Teplice	63-111	87-141	0.15
Chomutov	66-106	58-120	--
C. Bohemia			
Beroun	85-134	9-34	--
Prague	77-107	26-117	--
Kladno	64-98	30-72	--
Melnik	52-85	46-72	0.8-1.6
S. Bohemia			
Sokolov	74-129	24-50	--
Plezen	47-118	16-113	--
Other			
Ostrava	102-139	47-77	--
Ziar nad Hronom	>100	--	--
Brno	63-86	23-55	--
Estonia			
Narva	200	50	--
Tallin	100	90	--

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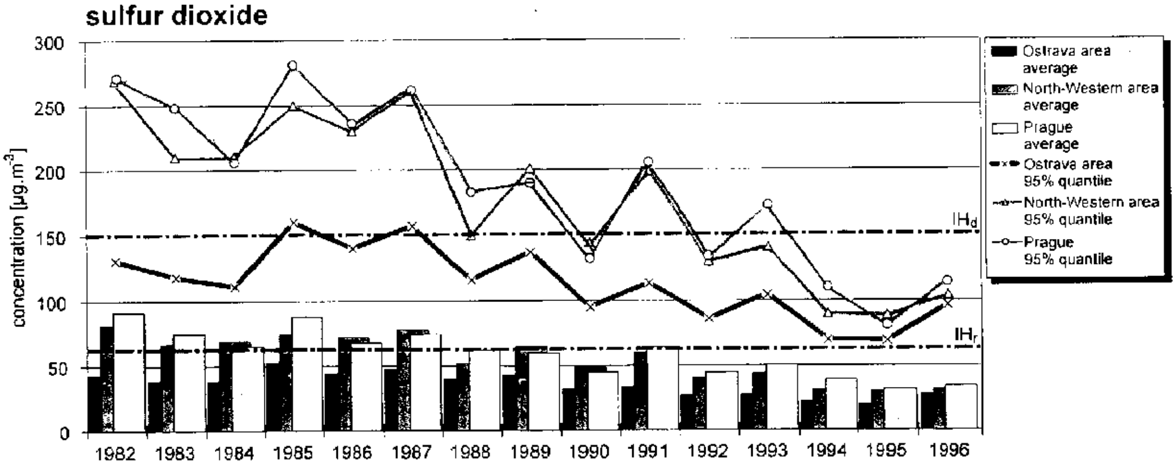
Annex Table 36: Baseline ambient air quality (cont'd)

Country/City	TSP	SO_2		Lead
Hungary		Winter	Annual	
B-A-Z industrial zone				
Izsofalva	--	133	72	--
Miskolc	--	48	27	--
Ozd	--	61	34	--
Sajoszentpeter	--	55	30	--
Budapest				
(site 1)	--	20	13	5.3
(site 2)	--	--	--	2.9
N.Transdanubian:				
Dorog	--	114	94	--
Esztergom	--	100	57	--
Komarom	--	90	52	--
Tata				
Tatabanya	--	101	62	--
C. Transdanubian:				
Ajka	--	42	28	--
Baranya Country:				
Pecs	--	32	22	--
Szaszvar	--	51	29	--
Szolnok	--	--	--	2.0
Latvia (1989)				
Ventspils	100	20		--
Daugavipils	100	< 10		--
Liepaja	100	< 10		--
Riga	100	10		--
Olaine	100	< 10		--
Lithuania (1990)				
Kaunas	300	10		--
Siauliai	300	10		--
Kedainai	200	10		--
Vilnius	100	10		--
Klaipeda	100	10		--
Jonava	100	10		--

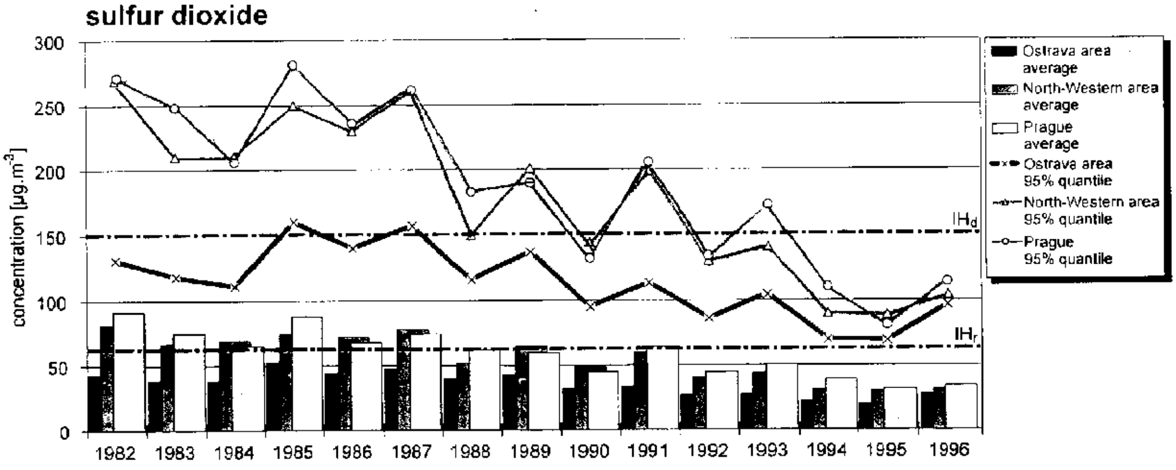
Source: Hertzman, Environment and Health in Central and Eastern Europe, 1995

Annex Figure 1: Yearly trends in ambient sulfur dioxide levels in Ostrava Region, Northwest Bohemia, and Prague, 1982-1995



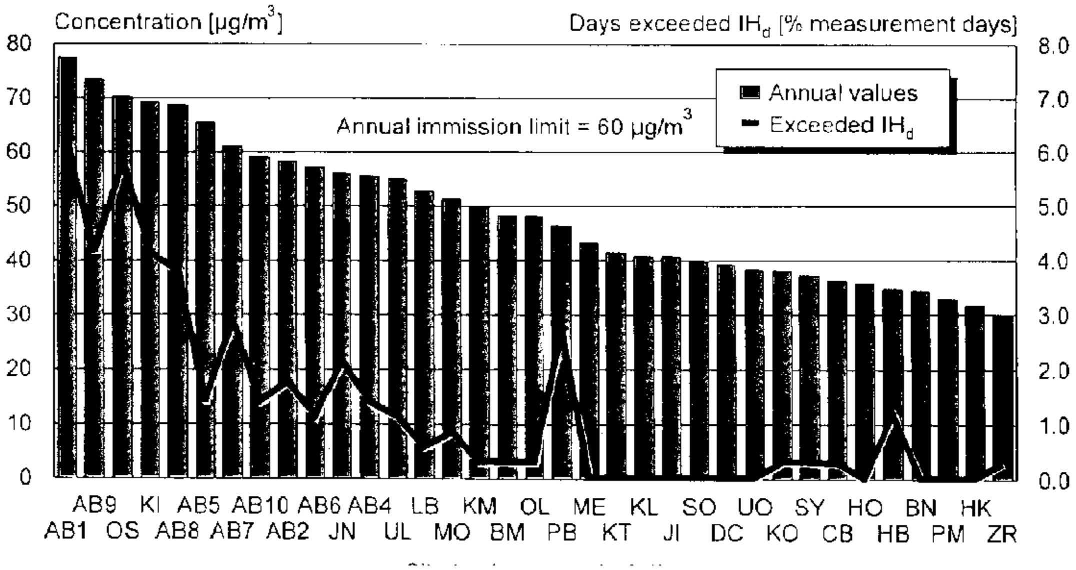
Source: National Institute of Public Health, Prague

Annex Figure 2: Yearly trends in ambient dust levels in Ostrava Region, Northwest Bohemia, and Prague, 1982-1995



Source: National Institute of Public Health, Prague

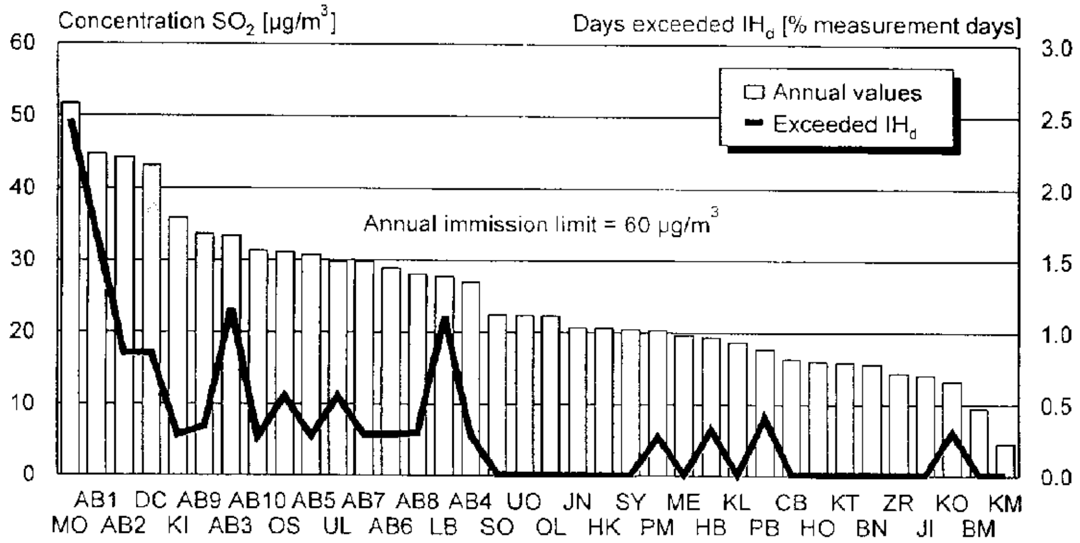
Annex Figure 3: Average annual dust levels and daily excedances of the limit for Czech cities, 1995



City codes		Frýdek-Místek	FM	Kladno	KL	Olomouc	OL	Šumperk	SU
Blansko	BK	Havlíčkův Brod	HB	Klatovy	KT	Ostrava	OS	Tábor	TA
Benešov	BN	Hodonin	HO	Kolín	KO	Plzeň	PM	Uherské Hradištč	UH
Brno	BM	Hradec Králové	HK	Kromčříž	KM	Praha	AB	Ústí n.L.	UL
České Budčjovice	CB	Jindřichův Hradec	JH	Liberec	LB	Přibram	PB	Ústí n.	UO
Cheb	CH	Jablonec n. N.	JN	Litomčřice	LT	Pardubice	PU	Znojmo	ZN
Chrudim	CR	Jihlava	JI	Most5	MO	Sokolov	SO	Žďár n.S.	ZR
Dččín	DC	Karviná	KI	Mčlník	ME	Svitavy	SY		

1 Hd=150 ug/m3
Source: National Institute of Public Health, Prague

Annex Figure 4: Average annual sulfur dioxide levels and daily excedances of the limit for Czech cities, 1995



City codes		Frýdek-Místek	FM	Kladno	KL	Olomouc	OL	Šumperk	SU
Blansko	BK	Havlíčkův Brod	HB	Klatovy	KT	Ostrava	OS	Tábor	TA
Benešov	BN	Hodonin	HO	Kolín	KO	Plzeň	PM	Uherské Hradiště	UH
Brno	BM	Hradec Králové	HK	Kroměříž	KM	Praha	AB	Ústí n.L.	UL
České Budějovice	CB	Jindřichův Hradec	JH	Liberec	LB	Přibram	PB	Ústí n.	UO
Cheb	CH	Jablonec n. N.	JN	Litoměřice	LT	Pardubice	PU	Znojmo	ZN
Chrudim	CR	Jihlava	JI	Most5	MO	Sokolov	SO	Žďár n.S.	ZR
Děčín	DC	Karviná	KI	Mělník	ME	Svitavy	SY		

1 Hd=150 ug/m^3
Source: National Institute of Public Health, Prague

APPENDIX: EXPLAINING THE EAST-WEST LIFE EXPECTANCY GAP

I. OVERVIEW

Since World War II, life expectancy in Central and Eastern Europe and the western NIS has undergone three phases. During the first, lasting from the late 1940s until the mid 1960s, rapidly declining infant mortality rates led to a near convergence of life expectancy between most of these countries and those in western Europe. During the second phase, lasting from the mid-1960s to 1989, the “East-West” differentials in survival re-emerged, based primarily upon differential survival starting in middle age (36). During the third phase, which began in 1989, there has been a further decline in health status in those countries of Central and Eastern Europe, as well as those of the former Soviet Union, where economic and social dislocation has been greatest (38). This decline, which is most marked in adult males aged 40 - 60, has been so much sharper and quicker to unfold than the gradual decline of the previous 25 years that it constitutes a separate phase of development.

Indeed, within three years of the sudden political and economic changes of that year, real wages in every country of the former Warsaw Pact had fallen significantly; between 15 and 35 percent (38,39). These changes were accompanied by increases in the proportion of household income being spent on food in some countries in the region, especially Russia, Ukraine, Bulgaria, and Romania, and average per capita consumption of meat, fish, and dairy products declined. At the same time there was marked disruption of the social environment, as demonstrated by 19 to 35 percent declines in crude marriage rates and reductions in pre-primary school enrolment. By 1993, death rates had risen dramatically in all of the former Warsaw Pact countries except Hungary (38,39)[5]. Among young males aged 30-49, mortality rose as much as 70-80% in Russia; 30-50% in Ukraine; and 10-20% in Hungary, Bulgaria, and Romania. Among females, mortality in the same age range rose 30-60% in Russia; 20-30% in Ukraine; and more modestly in Hungary, Bulgaria, and Romania (41).

Taken together, the trends of the second and third phase have created a "life expectancy gap" between Central and Eastern Europe countries and the NIS, on the one hand, and the original 24 countries of the OECD, on the other. There are several competing approaches to explaining the life expectancy gap, which emphasise different classes of determinants of health status. These approaches are analysed in detail elsewhere (36, 37); a summary follows.

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[5] Since the mid-1990s, health trends in Central and Eastern Europe have begun to change again, but it is too early to say what exactly the new trends are, and how they can be interpreted.

The limited role played by *health care services* can be shown by evaluating the historical evolution of East-West differentials in standardised mortality rates for medically avoidable causes of death. The principal driving force was heart disease during the Soviet period, supplemented by accidents and violence in the post-Soviet period. Thus, less than ten percent of the life expectancy gap can be attributed to poorer quality health care services in the East than the West (40). The importance of *lifestyle* is supported by evidence that smoking and dietary animal fat are more prevalent in Eastern Europe than in the OECD countries. Until phase three of the life expectancy gap emerged after 1989, this approach had some credibility. However, it is powerless to explain how mortality could increase so rapidly in so short a time after the political and economic changes of the late 1980s and early 1990s. Smoking and diet change gradually over time, and simply cannot explain abrupt increases in adult mortality, especially when suicide and violence were the primary causes of death, driving the recent increase in mortality.

The leading hypothesis, in fact, to explain the life expectancy gap affirms that the *socio-economic and psychosocial environment* in CEECs and the NIS (not the physical environment) has been the principal determinant. This hypothesis is discussed in section 3.

II. THE IMPLICATIONS FOR ENVIRONMENT AND HEALTH

In the end, *chemical contamination of the physical environment* turned out to be less important than the psychosocial and socio-economic environments (and the latter's' direct consequences for housing, working conditions, etc.). The relative decline in life expectancy has taken place in both heavily polluted and relatively unpolluted parts of the region, a fact that puts a conceptual ceiling on the impact of environmental pollution. It should be emphasised, however, that exposures to respirable dust in polluted regions, alone, were able to "explain" an important proportion of excess mortality, on a level roughly comparable to that of inadequate health services leading to medically avoidable deaths: on the order of 10% of total excess mortality. However, pollution, if anything, has declined across the region since 1989 as industries have modernised or shut down (45).

Perhaps the most important point, from the perspective of public health, is that certain effects of environmental pollution are exacerbated by socio-economic deprivation. The best example of this is lead exposures among children. The central concern with lead is its effect upon cognitive development, which can be measured using various neurobehavioral scales, including IQ. The best estimate of dose-response in wealthy countries is an IQ decrement of 4.4 to 5.3 points as blood lead levels rise from 10 to 30 µg/dl. But, based upon data from Hungary and Poland, an estimate of 10 IQ points decrement per 20 µg/dl blood lead increase was produced (36). This higher estimate may be as a result of lower nutrition (including iodine deficiency) and fewer opportunities for stimulation of children in socio-economically deprived environments. These factors, acting alone, have the capacity to influence child cognitive development in the same way as lead and might, therefore, exaggerate the effects of lead on cognitive development when they are present together.

Lead is not the only example where the effects of environmental pollution are exacerbated by factors in the socio-economic environment. The effects of borderline nutrition on the immune system may increase vulnerability to, complicate, and prolong respiratory conditions caused by air pollution. In fact, in heavily polluted communities, the impacts upon children can be astonishingly widespread. Between 1989 and 1993, research for the EAP documented communities in Central and Eastern Europe where, by age 14, the average lung capacity of children was nearly one litre less than expected; others where more than half the children had neurobehavioural dysfunction consistent with lead overexposure; and still others where the prevalence of low birth weight was 20% greater than elsewhere, or where only 18% of the children were completely normal on a clinical developmental screen. The protection of children during a period of political and economic transformation, and in a context of widespread environmental pollution, should be a high priority.

III. THE LEADING HYPOTHESIS

Why did the health disaster in CEECs and the NIS occur? The leading hypothesis can be stated in a voice of advocacy, as follows: the socio-economic/psychosocial environment is the principal determinant of the life expectancy changes in the region. Changes in smoking and diet, even if they occur over a very short period of time, cannot have their impact on health status so quickly.

The principal causes of death which have contributed to increased mortality since 1989 – injuries and heart disease – are overwhelmingly incidence-driven, and therefore not particularly sensitive to medical care provided after the incident event. This latter point bears explaining. It is clear that there is no lack of medical care in many parts of Central and Eastern Europe. There are high doctor-population ratios, lots of hospital beds, and high consultation rates. If medical care is a cause of the life expectancy gap, it is quality of care that is at issue, not quantity. Medical care intervenes at the level of altered physiology and at the interface between physiology and disease and death. Therefore, if a large part of the life expectancy gap were due to medical care, international variations in the incidence of disease would have to be less important than the quality of treatment after disease onset. As an empirical observation, this has not been the case.

The socio-economic/psychosocial determinants of health operate at three levels of social aggregation. At the most "macro" level, there are the broad socio-economic factors of a society, for instance, GDP per capita, the level of industrialisation and urbanisation, and level of unemployment. At the "meso" level, there is the quality of the social capital found in civil society; that is, those features of social organisation, such as networks, norms, and trust (including the psychosocial environment at work), that facilitate co-ordination and co-operation for mutual benefit (53), and the extent to which those features facilitate successful life courses and buffer stress. Finally, at the "micro" level, there is the intimate realm of the family and social support network.

Richard Rose makes the most compelling interpretation of the relationship between these three levels of society by describing Russia, in particular, as an "hourglass society" (54). This is a society which is wide at the top and bottom, but thin in the middle. The image is of a society with an elite at the top which gleans all the available economic and political benefits; a failed or non-existent civil society in the middle, the lack of which makes daily life hell for the average person; and, at the bottom, an overlarge reliance on the intimate realm of family and personal support to compensate for the lack of a civil society and the indifference of the elite.

Before the political changes of 1989, the relationship between the top and bottom of the hourglass was one of a buy-off of the bottom by the top. After 1989, the twin ideologies of individualism and the free market gave those at the top license to abandon those at the bottom. With no civil society to fall back upon, life became nastier, more brutish, and, for some, a great deal shorter, than before. The character of the variations in mortality, by marital status, geographic region, and age fit the model well. In an hourglass society, those with the weakest social support systems will be most vulnerable. Moreover, those in early and middle adulthood, who are dependent on civil society functions to start careers and build families, may well be more vulnerable *in the short run* than the very young and the very old; whose well-being depends, to a greater extent, on the intimate realm of the family.

REFERENCES

Bainova, A. (1995), “Lead exposure and human health in Bulgaria”, technical study for the report on *Lead exposure and health in Central and Eastern Europe*, The World Bank, Washington, DC.

Bellinger, D., Leviton, A., Waternaux, C., Needleman, H. and Rabinowitz, M. (1989), Low-Level Lead Exposure, Social Class, and Infant Development, *Neurotoxicology and Teratology,* 10: 497-503.

Bitto, A., Horvath, A., Sarkany, E. (1997), “Monitoring of blood lead levels in Hungary”, *Central European Journal of Public Health,* 5(2):75-78.

Central Statistical Office of Poland, (1995), *Air quality in Poland*, Warsaw.

Cikrt, M., Smerhovsky, Z., Blaha, K., Nerudova, J., Sediva, V., Fornuskova, H., Knotkova, J., Roth, Z., Kodl, M., Fitzgerald, E. (1997), “Biological monitoring of child lead exposure in the Czech Republic”, *Environmental Health Perspectives* 105(4):406-411.

Dutkiewicz, T., Sokolowska, D., Kulka, E. (1993), “Health risk assessment in children exposed to lead compounds in the vicinity of mine-shelter plant “orzel bialy”, *Polish Journal of Occupational Medicine and Environmental Health,* 6(1):71-78.

Forster, D.P. and Jozan, P. (1990), “Health in Eastern Europe”, *The Lancet,* 335:458-460.

Grantham-McGregor S.M., Powell C.A., Walker S.P., Himes J.H. (1991), “Nutrirional Supplementation, Psychosocial Stimulation, and Mental Development of Stunted Children: the Jamaican Study”, *The Lancet,* 338:1-5.

Grantham-McGregor, S., Powell, C., Walker, S., Chang, S., Fletcher, P. (1994), “The Long-term Follow-up of Severely Malnourished Children Who Participate in an Intervention Program”, *Child Development,* 65:428-439.

Gzyl, J. (1997), “Assessment of Polish population exposure to lead and cadmium with special emphasis to the Katowice province on the basis of metal concentrations in environmental compartments”, *Central European Journal of Public Health,* 5(2): 93-96.

Hertzman, C., Kelly S., Bobak, M. (eds) (1996), “East-West Life Expectancy Gap in Europe: Environmental and Non-environmental Determinants”, NATO ASI Series #2, *Environment,* Vol. 19, Kluwer Academic Publishers, Dordrecht.

Hertzman, C. (1995), *Environment and Health in Central and Eastern Europe,* The World Bank, Washington DC.

Hertzman, C. (1995), “Human health and the environment: lessons from Central and Eastern Europe”.Third Annual World Bank Conference on Environmentally Sustainable Development, Washington DC.

House, J. S., Landis, K.R., Umberson, D. (1988), “Social relationships and health”, *Science,* 241: 540-544.

Hungarian Central Statistical Office (1995), *Statistical yearbook*, Budapest.

Jakubowski, M., Trzcinka-Ochocka, M., Razniewska, G., Christensen, J. M., Starek, A. (1996), “Blood lead in the general population in Poland”, *International Archives of Occupational and Environmental Health,* 68:193-198.

Janousek, V., Krijt, J., Malbohan, M., Cibula, D., Lukas, W., Zejda, J. E., Lammers, W., Huisman, M., Boersma, E. R., van Der Paauw, C. G., Vogelaar, E. F., Winneke, G., Schmidt, E., Steingruber, H. J. (1994), “Cord blood levels of potentially neurotoxic pollutants (polychlorinated biphenyls, lead and cadmium) in the areas of Prague (Czech Republic) and Katowice (Poland). Comparison with reference values in the Netherlands”, *Central European Journal of Public Health*, 2(2):73-76.

Karasek, R., Theorell, T. (1990), *Healthy work: stress, productivity, and the reconstruction of working life,* Basic Books, New York.

Latvian Environment Data Centre, Web page http://www.vdc.lv/LATVIA/soe94.htm.

Lutynski, R., Steczek-Wojdyla, M., Wojdyla Z. (1996), “The concentrations of nitrates and nitrites in food products and environment and the occurrence of acute toxic methemoglobinemias”, *Przeglad Lekarski,* 53(4):351-355.

Lovei, M., Levy, B. S.(eds) (1995), *Lead exposure and health in Central and Eastern Europe. The impact on children: evidence from Hungary, Poland and Bulgaria,* The World Bank, Washington, DC.

Lovei, M. (1996), *Phasing out lead from gasoline: an effective way of reducing human exposure to lead in Central and Eastern Europe,* The World Bank.

Main Geophysical Observatory of A.I. Voievova, *Air Quality Trends in Russian Cities,* St.Petersburg.

Ministry of Environment and Energy, The Danish Environmental Protection Agency (1997), “Second meeting of the task force on the phaseout of lead in gasoline”. Working document presenting the results of country surveys, part 2, draft final, September.

Ministry of the Environment and Natural Resources of Kazakhstan (1997), *National Environmental Action Plan for Sustainable Development of the Republic of Kazakhstan* (draft).

Ministry of the Environment of Bulgaria (1995), *Bulgarian National Report on the State of the Environment,* Sofia.

Ministry of the Environment of Lithuania (1997), *State of the Environment Report in Lithuania*.

Ministry of Environmental Protection and Nuclear Safety of Ukraine, (1996), *National Report on the State of the Environment in Ukraine,* Kiev.

Ministry of Environmental Protection and Nuclear Safety of Ukraine (1997), *Ukrainian National Programme for reduction of lead emissions* (draft).

Ministry of Statistics and Analysis of the Republic of Belarus (1995), *Environmental protection and rational use of natural resources*, Statistical Compendium, Minsk.

National Commission for Statistics (1994), *Romanian Statistical Yearbook,* Bucharest.

National Institute of Public Health (1996), *System of monitoring the environmental impact on population health of the Czech Republic*, Summary Report - 1995 , Prague.

Pach, J., Kamenczak, A., Panas M. (1996), "The frequency of toxic methemoglobinemias in people living in the vicinity of refuse dumps in Barycz", *Przeglad Lekarski* 53(4):348-50.

Pikhart, H., Prikazsky, V., Bobak, M., Kriz, B., Celko, M., Danova, J., Pryl, K., Pretel, J. (1996), "Association between ambient air concentrations of nitrogen dioxide and respiratory symptoms in children in Prague, Czech Republic. Preliminary results from the Czech part of the Saviah study", *Central European Journal of Public Health,* 5(2):82-85.

Putnam, R.D. (1993), *Making democracy work: civic traditions in modern Italy,* Princeton University Press, Princeton.

Putnam, R.D. (1993), "The prosperous community: social capital and public life", *The American Prospect*, Spring:35-42.

Rose, R. (1995), "Russia as an hour-glass society: a constitution without citizens", *East European Constitutional Review*; 4:34-42.

Rose, R., Haerpfer, C. (1994), "New democracies barometer III: learning from what is happening", *Studies in Public Policy 230*, Centre for the Study of Public Policy, University of Strathclyde, Glasgow.

Rose, R. (1995), "New Russia barometer IV: survey results", *Studies in Public Policy 250,* Centre for the Study of Public Policy, University of Strathclyde, Glasgow.

Rubin, C. H., Esteban, E., Jones, R., Noonan, G., Gurvich, E., Utz, S., Spirin, V., Revich, B., Kruchkov, G. I., Jackson R. J. (1997), "Childhood lead poisoning in Russia: a site-specific pediatric blood lead evaluation", *International Journal of Occupational Health* 3(4): 241-248.

Selypes, A., Banfalvi, S., Bokros, F., Gyory, E., Takacs, S. (1997) "Chronic lead exposure in children living in Miskolc, Hungary, on the basis of teeth lead levels", *Bulletin of Environmental Contamination and Toxicology,* 58:408-414.

State Committee on Ecology and Nature Use Control, *Azerbaijan National Environmental Action Program,* Draft.

Semichaevsky, A., (1998), "Data on environmental health in CEECs", (unpublished background paper for OECD), Central European University, Budapest.

UNICEF (1994), *Central and Eastern Europe in transition: crisis in mortality, health and nutrition*, United Nations Children's Fund, International Child Development Centre, Florence.

UNICEF (1993), *Central and Eastern Europe in transition: public policy and social conditions*, United Nations Children's Fund, International Child Development Centre, Florence.

UNICEF (1993), *Crisis in Mortality, Health and Nutrition*, Regional Monitoring Report No. 2, United Nations Children's Fund, International Child Development Centre, Florence.

UNICEF (1993), *Public policy and social conditions*, Regional Monitoring Report No. 1, United Nations Children's Fund, International Child Development Centre Florence.

Zejda, J. E., Grabecki, J., Jarkowski, M., Panasiuk, Skiba, M. Sokat, A., Z., (1995), "Blood lead concentrations in school children of upper Silesian industrial zone, Poland", *Central European Journal of Public Health,* 3(2): 92-96.

Zejda, J. E., Grabecki, J., Krol, B., Panasiuk, Z., Jedrzejczak, A., Jarkowski, M. (1997), "Blood lead levels in urban children of Katowice voivodship, Poland: results of the population-based biomonitoring and surveillance program", *Central European Journal of Public Health,* 5(2): 60-64.

Zejda, J.E., Skiba, M., Mensink. I. (1996), "Lung function in children of upper Silesian industrial zone, Poland: results of the cross-sectional study in two towns of different ambient air pollution levels", *Central European Journal of Public Health,* 4(4):252-256.