SECOND INTERNATIONAL AUDIT

PLAN DE PREVENCION Y DESCONTAMINACIÓN ATMOSFÉRICA DE LA REGION METROPOLITANA DE SANTIAGO-CHILE(PPDA)

COMISION NACIONAL DEL MEDIO AMBIENTE
REGION METROPOLITANA

EXECUTIVE SUMMARY

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1. Introduction and General Information

Within the framework of the Prevention and Clean Air Plan of the Metropolitan Region (Plan de Prevención y Descontaminación Atmosférica de la Región Metropolitana, PPDA), a second audit is required during 2005 in order to verify progress of the PPDA and the feasibility of goals to be reached by year 2010. The required audit, to be completed during the four final months of 2005, is a key element for the 2006 update of the PPDA.

1.1 About this Study

The audit is intended to provide a review of air quality improvement progress, present an overview of the air quality management systems, and outline future steps to improve the air quality management system in the Santiago metropolitan region.

The final report should include comments on the present system and recommendations for improvement to the system.

Funding for this audit was substantially lower than the funding available for the first audit. Thus, review and analysis of actual data had to be limited. The audit team worked together for only one week holding interviews most of the time and sketching the main findings.

Interviews were held with 26 different groups that participate in the air quality management process for Santiago.

Audit was conducted by Humberto Fuenzalida, Gerhard Leutert, James Lents with support from Ximena Jara.

1.2 Air Quality in Santiago and its Present Status

Santiago recognized its air quality problems in the late 1980s and began the process to build an effective air quality management program. The program was improved throughout the 1990s and air pollution levels in Santiago began to decrease. An audit of the air quality management program was held in 1999. This audit noted that air quality progress was made between 1990 and 2000.

The most problematic pollutants for Santiago are PM10 (PM2.5), Ozone, and Carbon Monoxide. There may be some problems with toxics but present air quality monitoring data does not provide adequate information to make an evaluation.

As measured in Santiago in 2004 PM10 is 75% above the present Chilean air quality standard (24h), Ozone is more than twice the air quality standard (1h), and Carbon Monoxide is 80% above the air quality standard (8h). The particulate levels alone in Santiago could be contributing to more than 1.000 deaths per year according to one study (0stro et al., 1996). The World Health Organization (WHO) ranks Santiago among the world's worst polluted cities, which is mainly due to industrial and transport emissions, made worse by the unfavorable geographical and meteorological situation of the Santiago agglomeration. Even Los Angeles, which was considered one of the world's SMOG capitals, now has lower air pollution levels in most cases than those found in Santiago.

Even more alarming, air quality has not significantly improved since 2000. Considering the air quality data collected in Santiago from 2000 to 2004 (the 5 years since the last audit), at the worst Santiago measuring station Carbon Monoxide levels have increased an average of 4% per year and Ozone levels have increased an average of 1% per year. Only PM10 has shown any improvement, and it has only improved 2% per year compared to an improvement rate of 6% per year from 1997 to 2001. At this rate Santiago will never enjoy healthy air.

While Santiago has taken some progressive steps that will aid the air pollution control effort in the future, funding has been significantly reduced, as will be discussed later, to properly support

the understanding of the sources of emissions in Santiago and to define the most effective processes to make those reductions.

The economy of Santiago is improving and Chile is stepping forward to trade with and to operate as one of the more developed countries of the world. Chile will not be able to take the necessary steps forward and maintain trading agreements if it does not aggressively address its environmental problems as the developed world has.

1.3 Main Sources of Air Pollution Problem

The problem in Santiago is caused by the combined effect of a large number of sources of different classes with each class of sources making a significant contribution.

Due to the shortage of emissions analysis studies in Santiago, the exact sources, their diurnal emission rates, and the spatial distribution of the air pollution problems are not well understood. Thus any attribution of the air quality problems to sources must be understood to be approximate. The following table presents the approximate contribution of the various source classes to the Santiago air pollution problems and thus the sources that must be addressed

Source Class	*Particulate Matter*	*Ozone*	*Carbon Monoxide*
On-Road Heavy duty	49%	26%	5%
On-Road Light duty	30%	27%	88%
Off-Road	1%	1%	1%
Stationary Point	16%	7%	3%
Area	4%	39%	3%
Total	100.0%	100.0%	100.0%

For carbon monoxide, based on present data, light duty vehicles are the single source that must be addressed. There is a chance, however, that the contribution of carbon monoxide from residential burning in the area of highest carbon monoxide levels is underestimated.

For ozone, based on present data, heavy-duty vehicles, light duty vehicles, area sources, and to a lesser degree industry must be addressed.

For particulate matter, based on present data, heavy-duty vehicles, light duty vehicles, and industry must be the primary focus.

Although no Chilean standard has been defined for PM2.5, measurements of this finer fraction indicates that both annual and maximum 24 –hour averages are well over international standards taken as 15 and 65 $\mu g/m^3$, respectively.

It should be noted that, as a matter of policy around the world, air pollution reductions are typically sought from all sources even when their contribution is relatively small if it is cost effective to control those emissions. Thus, no source of emissions should be left out of the Santiago air pollution reduction program.

2. Review of Present Measures to Get and Distribute Information

2.1 MACAM Air Pollution Monitoring System

The present air monitoring system in Santiago is barely adequate for the analysis of criteria pollutants on a regional scale.. However there are locations near roads where levels of some pollutants will be higher. Such locations are not included in the MACAM monitoring network, neither are the results of (private) measurements at highways generally available. This gives rise to the public to argue that the real air pollution situation of Santiago is much worse than officially stated. Some consideration should also be given to special studies to understand the levels of toxic air contaminants that the residents of Santiago are breathing.

The validation of the air quality data from the Santiago air monitoring system is more than one year behind the date of collection in some cases. Data should be validated and made available to the public and researchers within 6 months of the date that it is collected.

It is advised that there should be interlaboratory tests carried out to certify the precise operation of the measuring instruments.

Studies to clarify the sources of the particulate matter in Santiago should be continued and improved based upon data already collected.

2.2 Air Quality Modeling

Air quality modeling in Santiago has improved from the last audit. Some useful conclusions can be drawn from the present modeling system. It is still not as good as it should be due to the poor quality of emissions and meteorological data that is available to modelers.

Some tracer studies using sulfur hexafluoride should be considered in order to better understand the movement of air pollution in Santiago in order to improve the accuracy of the present air quality modeling efforts.

While research to better understand the atmospheric processes is still needed, the importance of forecasting air pollution episodes has diminished due to the fact that acute air pollution episodes have decreased to a very low number. Thus a lower priority should be placed on episode prediction.

There is a debate as to the best control approach to address ozone. Industry argues that reduction of NOx can hurt the ozone attainment program. On the other hand NOx reductions are important to meeting particulate standards. Adequate modeling data evaluation approaches need to be developed to insure a better understanding of this issue. Likely, NOx will need to be further reduced in the future as well as all other pollutants to address the Santiago air pollution problem, not only in view of ozone formation, but also because NO_2 is an air contaminant that provokes negative health effects and also because NOx is a precursor for the formation of PAN and other photochemical oxidants and toxic contaminants.

2.3 Health Impacts

Some very good health data is presently being collected in Santiago. However, the relationship between this data and the air quality data is not being done, considering that the main purpose of PPDA is public health protection, this is an important omission.

More efforts should be made to help policy makers understand the extent of health damage that is being caused by air pollution. Health experts are capable of creating an annual analysis of the impact of air pollution on the health of Santiago citizens to improve the public's understanding of the need for aggressive air pollution control.

2.4 Information, Public Participation, Education

CONAMA has taken some efforts in the past to improve public understanding of the air pollution problems in Santiago. However, many of the experts at government agencies and non-governmental organizations that we interviewed for this audit had little information on important air quality issues outside of their own areas of responsibility. Sharing of information between agencies appears to be weak.

CONAMA and the Department of Health both operate useful air quality related web sites. These sites can be improved to make them more useful to the public, researchers, industry, and other government agencies. For example, air quality data should be available in a variety of formats both as tables and graphically. Industry and non-government groups should have easy access to emissions data and adopted and proposed regulations. Efforts should be taken to insure that the supplied information is easily accessible to non-expert users.

An Air Quality Advisory Group would is recommended in order to coordinate these information tasks.

3. Review of Present Measures to Reduce Emissions

3.1 Public Transport / Transantiago

Chile and Santiago should be congratulated on the development of the Transantiago concept including an improved bus system (1800 new EURO 3 buses, high efficiency Diesel particle filter on 3200 old buses) and an enhanced subway (expanded from 45 to 92 km).

The Transantiago system should reduce air pollution significantly and provide an efficient and fast system for citizens to move around Santiago. A reduction of 75% in PM10 and of 40% of NOx emissions of the previous public transport system is expected.

There is some danger that the improving economy in Chile and Santiago will lead to a higher rate of automobile ownership, which could undercut some of the long-term goals of Transantiago. Efforts should be taken to keep Transantiago as the fastest and cleanest option for public mobility.

Transantiago is about 18 months behind schedule, which is unfortunate, but it appears that it will be in almost fully operation in one more year.

In the medium term, all public buses should be equipped with high efficiency Diesel particle filters and in the long-term, provisions should be made to get new (or to retrofit old) buses to achieve lower NOx emissions.

3.2 Fuels

There is the possibility that there will be a short-term shortage of compressed natural gas. Natural gas has been relied upon as the primary emission reduction approach for industry and residential energy. Industry now wants to revert to fuel oil and temporarily delay new emission standards. There are relatively inexpensive approaches to reducing emissions from fuel oil such as low NOx burners and ammonia or urea injection. These technologies are well established and applied in Europe and in the United States as well as in many other parts of the world. They could be applied in Chile too.

Liquid natural gas (LNG) is seen as an alternative to the present problem with compressed natural gas (CNG). LNG standards have not been well established around the world. Thus, LNG tends to have a different makeup than CNG, which can increase emissions and can damage certain types of the equipment that it is used in. Efforts should be made to establish some LNG specifications to maintain lower emissions and usability.

The fuel standards adopted for Chile are excellent. In the metropolitan area since July 2004 gasoline has a sulfur content of max. 30 ppm, Diesel has max. 50 ppm. In the rest of the country

the sulfur content of Diesel will be lowered to max. 350 ppm by July 2006. For 2010 it is planned to reduce the sulfur in the RM Diesel to 10 ppm. These low sulfur contents enable the use of the full range of control options for motor vehicles and should be adopted.

Concerns over global warming and rising fuel prices may make diesel vehicles more popular in Chile than in the past. Diesel vehicles have the potential to offer a clean source of transportation if particulate and NOx controls are required. Thus, keeping diesel fuel standards tight will allow maximum flexibility for Chile in the future.

There is some possibility of high sulfur fuel being used in Santiago since it is available outside of Santiago. Efforts should be taken to ensure that the price of higher sulfur fuel is greater than that of low sulfur fuel. In the long-term, all of Chile should convert to the cleanest fuel options to allow the application of the next generation of super clean vehicles in cities outside of Santiago.

3.3 Vehicle Emissions

Chile should continue to require lower emissions vehicles. It is possible with today's technologies and Santiago's cleaner fuels to have almost emissions-free vehicles.

Once an improved technology is put into production by motor vehicle manufacturers, Chile should insist on receiving vehicles with that technology offered in Santiago at the same time the corresponding emission regulations come into force in the European Union or in the United States. Chile has taken the appropriate steps to provide clean burning fuels in Santiago. Modern vehicles of the highest levels of technology should be required to take advantage of modern improvements.

There is presently only one vehicle per five people in Santiago. This contrasts with the 1 vehicle per person in the United States and high vehicle ownership in Europe. Economic progress in Chile is going to make passenger vehicles very attractive in the future. Thus there is a tremendous potential for the growth of vehicle use in Santiago. The cleanest cars should be required and vehicles banned from parts of the city to keep Transantiago as the primary transportation option for Santiago.

The present vehicle certification system does not insure that vehicles meet requirements over the long term. As will be discussed in the enforcement section, efforts should be undertaken to correct this problem.

3.4 Residential Heating

Wood burning is a major problem in Santiago homes. Wood burning creates particulate matter, carbon monoxide, and human carcinogens.

Some emission requirements have been placed on wood burning stoves, but in a city the size of Santiago, these emission requirements will prove to be inadequate in the long run. In the long-term homes should be converted to natural gas and liquid petroleum gas for heating purposes and wood burning should be banned except for occasional recreational purposes on good dispersion days.

3.5 Industrial Processes

Emission reduction requirements for industry have been set through negotiations and in many cases modern control technologies can provide more emission reductions than are presently being required.

In general terms the team members are skeptical about compensation systems in the present state of air quality management in Chile and do not consider it recommendable to expand the present Chilean system in its various forms until the air pollution problem is better understood and emission inventories and enforcement programs are more reliable. This is particularly true for the case of inter-pollutant trading and for trading between mobile sources and stationary sources.

Chile is presently operating an emissions compensation system[1] that is similar to tradable permits for PM10. Consideration is being given to developing a system that includes NOx as well. Such

[1] The compensation system used in Chile is typically referred to as "a cap-and-trade" system in other locations.

compensation systems can lower industrial costs for achieving emissions reductions but can also be abused. If the executing institutions are weak (which is likely because of lack of personnel, knowledge and financial resources), the system can be counterproductive for the environment.

Chile could proceed to expand its cap-and-trade emission compensation system but should do so with great care by taking small steps and improving the enforcement infrastructure to be able to adequately manage such a system. There is interest in including mobile and area sources in the compensation program. In certain carefully controlled circumstances such systems can be made to work. However, there is great danger that emission reductions, that are needed to improve Santiago air quality, will be given away during such trades. We do not recommend trading between industry and mobile sources until management structures are improved. In Los Angles such trades are typically restricted to providing short-term regulatory relief rather than to provide permanent emission offsets. In the specific case of trading between industry and the transport sector, it is hard to understand why progress made in vehicle emission reduction should be compensated by more emissions from the industry.

Trading between pollutants should be avoided. The modeling needed to understand proper trades is too complex and inaccurate to support inter pollutant trading.

Trading between different contaminants is also hard to understand, because each air contaminant has its specific impacts.

3.6 Distributed Electrical Generation (Stationary Power Generators)

Uncertainty in electricity availability and electricity pricing has made the purchase and use of diesel fueled internal combustion engine powered generators popular in Santiago. Some estimates indicate that there are many thousands of these generators in operation and not included in the cities emissions inventory.

Present diesel fueled electricity generators can be big polluters. In much of the United States, they are restricted to only emergency use.

An investigation on the situation in Santiago has shown that on an annual basis, stationary Diesel power generators cause 4% of the PM and 18% of the NOx emissions of all stationary sources.

As these generators are not operating through out the whole year, on the daily basis the contribution of power generators is even higher and reaches 11% of the PM and 34% of the NOx emissions of all stationary sources.

Efforts are on the way to enact a regulation for stationary power generators in the metropolitan region aiming at reducing their emissions. This effort should be accelerated.

If owners want to have an auxiliary generator, they should be required to purchase low emission alternatives. Some natural gas generators can be relatively low emitters if properly configured. To maintain efficiency, efforts will need to be made to recover thermal energy from the generators as well.

Electricity pricing should be reviewed to insure that it is achieving the intended objectives and not arbitrarily driving business to seek out alternatives.

3.7 Volatile Organic Compounds

Santiago has regulations that require vapor recovery or emission reducing systems for large gasoline storage tanks (> 100 m3), for new and for part of the old pump stations as well as for the tanker trucks delivering the gasoline from the large storage tanks to theses pump stations. This program will contribute to reduce VOC emissions. Vapor recovery should be extended to all tank and tanker truck loading involving gasoline or fuel of similar volatility.

Vapor recovery should be considered for gasoline vehicle refueling in the Santiago metropolitan area as part of future PPDA plan improvements.

For industrial processes the are no limits for VOC emission. As many industrial processes emit large amounts of VOC, this is a severe lack that should be eliminated by setting specific emission limits for specific categories of industrial processes.

3.8 Enforcement

The enforcement of the measures laid down in the PPDA is not in the hands of one comprehensive air pollution control agency but is done by quite a number of different agencies

which moreover belong to different ministries, all having their own priorities and budgets. This makes it difficult to enforce the PPDA and to set overall priorities according to the urgency of a specific enforcement task. Some agencies might have ample resources for second priority projects while others have no means for very important enforcement actions.

At present about 30 inspectors are attempting to review 4,000 stationary sources. Sources are visited once per year unless complaints are received. The ratio of inspectors to sources is low at the present time.

A system of surprise visits should be organized to insure emission compliance, which will likely require a few more inspectors as indicated in the previous recommendation.

As will be discussed elsewhere, it may be more effective to integrate the fixed source enforcement, air monitoring, and planning into a single more comprehensive air pollution control agency.

In the case of mobile sources, it does not appear that motor vehicles are analyzed to insure that they meet emission standards over the long-term. Present tests are restricted to a few new vehicles. In-use testing of vehicles should be initiated on a large scale to ensure that vehicles comply with relevant regulations as they age. Such in-use data allowed enforcement officials in the United States to identify a program of cheating by truck manufacturers. Tests conducted by ISSRC in Sao Paulo and Mexico City suggest a high rate of deterioration of emission systems on light duty vehicles. This should be checked routinely in Chile.

4. Recommended Future Steps

4.1 Organization and Financial Resources

Beginning in 1990, Chile has taken great efforts to develop a first class air quality management system. In recent years, funding for this system has been severely reduced. It appears that the present air quality management system may be beginning to fail. As noted in the air monitoring section, ozone and carbon monoxide levels could be increasing after a decade of air quality

improvement. The air pollution in Santiago continues to be very bad. Appropriate funding for proper planning and enforcement must be maintained. Present levels of funding are simply inadequate.

Regarding the organizational structure, Chile will benefit from a stronger more integrated air quality management process. At a minimum, planning, enforcement, and air monitoring should be integrated into a single air pollution control agency. Adequate funding should be directed to this agency to insure its ability to function effectively.

Moreover it is recommended to have a reinforcement not only at the administrative and technical level but also at the political level. A Ministry of Environment would help to make better progress in air pollution control in the Santiago metropolitan region. It would raise the air pollution problem and its control - and the protection of the environment in general - politically to the same level as other important topics of the society.

Emission fees on industry and vehicle registration fees could be used to provide needed support for Chilean air quality management activities. In this sense, the polluter pays for the efforts required to address air quality problems. Such fees are common in the United States. They provide about 80% of the Los Angeles air pollution control agencies operating budget.

4.2 Air Pollution Control Strategy

Since Santiago began to fight against air pollution about 15 year ago, there have been big improvements in the air pollution situation. Today, *Emergencias* do not occur any longer, and the number of *Alertas* and *Pre Emergencias* has decreased to 4 and 2 respectively in the year 2005. However, the situation is still far from good, and a lot more has to be done to reduce air pollution down to values recommended by the World Health Organization (WHO) or even Chile's own standards.

A PM2.5 standard would also benefit the air quality management process in Chile. Smaller particulates are found to be the primary source of health and visibility impact. Thus, a PM2.5 standard will significantly benefit the citizens of Chile.

According to the disappearance of short episodes with very high air pollution, there should take place a change in the air pollution control strategy: avoidance of episodes is not the primary goal any longer, but the reduction of the still unacceptably high long time average of air pollution. The long-term goal must be to achieve at least the Chilean air quality standards.

The present air quality management plan for Santiago is being regularly updated. This is excellent since information and control technology are both constantly improving.

The air quality management plan for Santiago will impose a large cost on the citizens of Chile. While this cost is worthwhile, it is imperative that decisions be made to get the most air pollution reduction at the least cost. This requires effective air quality management planning. It can not be carried out with huge budget cuts and reductions of funds for needed air quality studies. If national tax revenues are inadequate to support such an effort, then emission fees and vehicle registration or gasoline fees should be considered so that the entities causing the pollution problem are the ones that pay the most to address the problem.

As noted in the modeling section, there is a debate concerning the need to control NOx emissions. Some argue that it can actually hurt ozone reduction progress. Others argue that NOx reductions are needed to meet particulate standards and to avoid health effects from NO2 and other aggressive substances evolving from NOx as a precursor. This issue needs to be addressed through an integrated and improved air quality management process that considers all pollutants and defines the most cost-effective strategy.

When discussing the cost of air pollution abatement, one should also indicate the benefit of such measures: air quality improvement will not only result in heath benefits for the population, but in most cases will also benefit the national economy. The benefits of air pollution control is greater than the cost.

4.3 Measures to Get and Distribute Information

Chile has adopted an integrated air quality management package of software developed in Sweden. A number of government agencies are using this software package. Efforts should be

taken to integrate as many air quality information developers and users into this process as possible.

As previously noted, the CONAMA and Department of Health web sites are good but can be improved to make them more informative and user friendly to the public as it becomes more computer literate.

Programs of environmental training that include an air quality element should be developed for use by elementary and high schools to provide training to children on the issues of developing a sustainable society with billions of people occupying the earth.

An effective Advisory Council is an important tool in developing supportable air quality management programs and the associated regulations. It is recommended that a meaningful Advisory Council process be developed for the Santiago metropolitan region.

4.4 Measures to Reduce Emissions

Chile and Santiago have done a reasonable job in identifying potential emission reduction measures. However, there is significant potential to reduce emissions beyond what has presently been adopted.

In the medium term, all Transantiago buses should be equipped with high efficiency Diesel particle filters. In the long-term, NOx emissions of buses should be reduced substantially by retrofitting or replacing them.

New Diesel passenger cars should also be equipped with Diesel particle filters, as is the case in Europe on an large basis, even without a legal obligation, i.e. only because of the awareness of the car buyers.

Tighter emission standards for both light-duty and heavy-duty vehicles should be set along with an enforcement system that insures that the vehicles meet emission requirements over the life of the vehicle and not just when they are new.

Once an improved technology is put into production by motor vehicle manufacturers, Chile should insist on receiving vehicles with that technology offered in Santiago at the same time the corresponding emission regulations come into force in the European Union or in the United States. Chile should enact the same emission regulations as the European Union or the United States and set these requirements into force on the same date as in the EU or the US. By admitting motor vehicles that correspond either to the actual European or to the actual US requirements alternatives are given to the trade and to the customers.

Cooperative aggressive vehicle emission regulatory programs with Brazil and maybe Argentina could help insure that manufacturers upgrade South American manufacturing facilities to produce the cleanest possible vehicles.

Random inspection of particle emissions from public buses in the streets is carried out with success. Similar inspections should also be carried out for trucks.

General emission standards should be enacted for industrial processes (i.e. for a range of industrial sources) and for toxic air pollutants. The well established German Technical Instructions on Air Quality Control (Technische Anleitung zur Reinhaltung der Luft, TA Luft) could be an example, as is has proven very successful in reducing air pollution in Germany.

Wood burning should be severely limited in Santiago.

Stage II vapor recovery (referring to fuelling of gasoline vehicles at the pump station) should be brought into use in Santiago.

Strict standards or an incentive tax should be set for the VOC content of paints used to repair vehicles, manufacture products, and to paint homes.

As the agglomeration of Santiago is rapidly growing and expanding it is important to avoid an undesirable increase of long distances commuting by private cars. Measures should be taken to build efficient mass transport systems (trains) from the outskirts into the center of Santiago. By this the use of private cars could be reduced to relatively short distances, i.e. from the home in the outskirts to the train station out there (park and ride).

5. Final Remarks

The air pollution in Santiago has a dim perspective at the present time unless drastic corrections are applied. The promising decrease in levels of the five criteria pollutants (PM, CO, NOx, SOx and O_3) during the 1997-2000 period has slowed considerably, come to a stop, or even reversed between 2000 and 2005. As a result, even the criteria pollutant PM10 has a 24 hour average exceeding the Chilean air quality standard (150 μg/m3) by 75%, whereas this standard in turn is three times higher than the European standard (50 μg/m3). Although additional reductions are expected to progressively become more expensive and difficult to obtain, the present status is far from satisfactory, particularly in view of the goals to be reached at the end of the present decade. Moreover, air quality measurements have been established to understand the regional impacts of air pollution in Santiago and higher local concentrations must be occurring in specific local situations.

During the last five years very poor or virtually no improvement has been achieved in air quality improvement or in reduction of industrial emissions. The two key factors in the emission reduction plan, the introducction of natural gas in the industry and the TRANSANTIAGO plan for mobile sources, have suffered important delays. A regular gas supply will take at least three years to become fully operative. On the other hand, TRANSANTIAGO has a 18 months delay undermining the favorable impact of better fuels introduced by ENAP in the market.

There are substantial structural and financial impediments in standard setting and in enforcement, together with rapid growth of traffic, industry, population and city expansion. In this context, reductions of 40% in personnel and 50% in funding for CONAMA RM, the group dealing directly with the PPDA, are major drawbacks.

The main obstacle under most of the identified problems, is the lack of a unique agency with enough power to manage the numerous aspects involved in urban pollution. Tasks and responsabilities in monitoring and enforcement are spread over about ten offices under at least five ministries, an extremely unsatisfactory arrangement.

Creating an Enviromental Office with rank of a ministry can solve most of present difficulties by rising environmental priorities at the same level of other sectorial interests. If additionally, an adequate budget or a financing mechanism is provided, a safe operation can be asured for monitoring and enforcing tasks as well as conducting specific studies to progressively upgrade the air quality in Santiago.