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CETESB Toxic Substance Use Reduction Program Development – Technical Assistance Final Report

Client: Companhia de Tecnologia de Saneamento Ambiental (CETESB)

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Executive Summary

The Companhia de Tecnologia de Saneamento Ambiental (CETESB) goal is to develop an approach to reduce the use of toxic substances by industries in the State of São Paulo, Brazil by using proven existing program elements in a way that minimizes the regulatory burden and motivates industry to implement the needed measures. The general steps that were taken to establish toxic chemical reduction program alternatives were as follows, and are detailed further below:

1. Identification of Toxic Chemical Reduction Program Goals
2. Identification of Toxic Chemicals and Toxic Chemical Reduction Program Target List
3. Review of Other Federal- and State-specific Government Programs
4. Development of Toxic Chemical Reduction Program Options
5. Development of Toxic Chemical Reduction Program Alternatives
6. Evaluation of Toxic Chemical Reduction Program Alternatives and Program Selection
7. Identification of US Sources of Supply

Identification of Toxic Chemical Reduction Program Goals

The objectives of a toxic chemical reduction program are to gather data on toxic chemical use, targeted to those chemicals with the highest toxicity and use volume, and to encourage industries to reduce the usage of those target chemicals to reduce impacts on human health (workers and consumers) and the environment due to chemical releases.

Identification of Toxic Chemicals and Toxic Chemical Reduction Program Target List

In order to develop toxic chemical reduction program alternatives that meet the program objective, the relative volumes of toxic chemicals released by industries to the air, water, and land of São Paulo were estimated and subsequently ranked using various risk and chemical properties.

The objective of the toxic chemical reduction program is to track and reduce specific toxic chemicals or compounds (such as lead, mercury, or trichloroethylene), and not a product (such as paint, solvent). Specific chemicals are targeted for a toxic chemical reduction program based on toxicity criteria, persistence in the environment, and usage, as follows:

- Toxicity Criteria
  - Cancer potency
  - Worker exposure limits

  - Drinking water standards
  - Land impact standards
- Persistence in the Environment – Target:
  - Chemicals/compounds that stay in the environment
  - Chemicals/compounds that are not readily degradable
- Usage – Target:
  - High toxicity coupled with High use
  - High toxicity coupled with Medium use
  - Medium toxicity coupled with High use

Data on chemical usage and release is not available for São Paulo, therefore usage and release estimates were based on the US Toxics Release Inventory (TRI). Data from the TRI were categorized by industrial categories, and the associated releases of toxic chemicals to air, water and the land were obtained. Once São Paulo industries were matched to the corresponding US industries, releases were ratioed based on relative economic output.

Subsequently, the toxic impact of each chemical was determined by applying toxicity criteria across media, a factor to reflect the persistence of the chemical in the environment, a factor to eliminate chemicals that are not used in a production process, and a factor to reflect the usage of the chemical as compared to the relative toxicity of the chemical.

Of the approximately 650 chemicals evaluated:

- 144 are used in Sao Paulo industries
- 122 are persistent
- 5 cause 80% of Toxic Impact
- 10 cause 90% of Toxic Impact
- 15 cause 97% of Toxic Impact

Based on this analysis, it is recommended to collect data for the top 15 toxic chemicals (based both on toxicity and volume of use, as noted above), and subsequently choose the top 5 toxic chemicals to target for reductions, because the top 5 chemicals represent 80 percent of the risks and the top 15 chemicals represent 97 percent of the risks. The list of targeted chemicals (reported and for reductions) can increase as the program progresses. Following the initial phase of the program, CETESB would need to re-evaluate the chemical usage inventory to determine if the initially selected chemicals should be continued to be reported, and whether other chemicals need to be added.

Recommendations for the associated de minimis (minimum) reporting thresholds are also detailed in the report, which includes two tiers, first by company profile and subsequently by chemical usage and product composition.

Review of Other Federal- and State-Specific Government Programs

Numerous pollution prevention programs that have been implemented in the US, as well as programs in other countries, were reviewed to evaluate the effectiveness of the programs and learn what could be adaptable to the CETESB program.

One of the first programs to be developed was the US TRI, which was developed in response to the 1984 methyl isocyanate release in Bhopal, India. The TRI is a database that contains detailed information on toxic chemical releases and other waste management activities reported annually by certain industry groups as well as by federal facilities. Facilities that manufacture, process, or use toxic chemicals above specified amounts must report annually on disposal or other releases and other waste management activities related to these chemicals. The program was initially set up to include 100 chemicals, and was expanded to include an additional 100 chemicals by Congress, including Na_2SO_4. The program now includes approximately 650 chemicals. Companies quantify their usage of toxic chemicals by taking the % chemical component in their product(s) and multiplying it by their annual usage of the product. Both de minimis values and usage thresholds have been established under the program. Releases to the air, water, and land are reported, and the database is publicly disclosed. The program has resulted in a significant reduction in use, both due to the incentives to industry to avoid the regulatory reporting cost and to reduce public pressure.

The 33/50 program, a US voluntary program, followed the TRI program, and established a set goal of reducing 17 chemicals by 50% in a period of five years, with a focus on the top 600 US companies. The 33/50 program achieved its goals in 1994, one year ahead of schedule. The program proved to be a successful way for the Environmental Protection Agency (EPA) to partner with industries to effectively reduce toxic chemicals through voluntary regulation. In addition, by focusing on the top 600 companies, with the largest releases and transfers, EPA was able to get 64% of these companies to participate in the program, compared to less than 14% of the smaller companies. However, the 33/50 program prioritized 17 chemicals on the TRI list for reduction, creating very little reduction in other TRI chemicals during the years the program was implemented. Reductions of the program's targeted chemicals continued at a higher rate than other TRI chemicals in the year after the 33/50 Program ended.

Subsequent to these programs, various US State-based toxic chemical reduction programs were developed, for example, in Massachusetts, Washington, New Jersey, and California. These programs require use reporting, reporting on product composition, reduction goal setting, and the development of pollution prevention plans. Based on input from companies regulated by State-specific programs, some of the following key points of State-specific toxic chemical reduction programs were noted:

- The focus of chemical reduction should be toxicity-based, not just based on mass, and the toxic chemicals used in production should be targeted (vs. the products themselves).
- Less emphasis should be placed on material accounting, as it can require a lot of resources that could be used to fund actual projects.

- Preparation of a pollution prevention plan helps companies to think through and detect toxic use reduction opportunities on a regular basis.
- Many toxic chemical use reduction ideas come from the operators of facilities, therefore their input should be obtained during development and implementation of reduction programs.
- Good environmental management, including toxic chemical use (and waste) reduction is viewed as a cost saving measure.
- Incentives for those firms that comply with pollution prevention regulations were attractive to industry.
- Public disclosure and associated pressure provides incentives for reduction. In addition, public disclosure can provide positive publicity for companies.
- Submittal of information in the program via the internet is preferred and system efficiency is important, especially during peak business hours. The reporting/submittal process should be streamlined by avoiding duplicative efforts (i.e. by not having multiple individuals from the same agency requesting data). In addition, there should be uniform application of requirements across differing industries.
- Larger companies have pollution prevention programs as part of their corporate culture. Smaller to mid-size facilities generally need more technical assistance developing pollution prevention programs. In general, it was determined that technical assistance is helpful, whether by a private institution or by a government agency, provided the government agency would not look for compliance issues during the on-site assessment activities.
- Regulations that are too prescriptive and inflexible for manufacturing facilities should be avoided, which can stifle a facility's manufacturing and economic growth.

The European Union's (EU's) Registration, Evaluation and Authorisation of Chemicals (REACH) program requires product composition reporting. The program also requires associated toxicity reporting, and regulates the use of prohibited chemicals in the manufacturing process of products for sale in the EU. The latter would apply even if, for example, the use of the prohibited chemicals used in the manufacturing process of the product is in Brazil and does not actually end up in the product itself that is being sold to the EU.

Development of Toxic Chemical Reduction Program Options

The information developed and gathered in support of the toxic chemical reduction program, including the identification of program goals and the toxic chemicals target list, as well as the review of other government toxic reduction programs was used to develop toxic chemical reduction program options, and subsequently program alternatives, for evaluation for the State of São Paulo.

Toxic chemical program options developed include the following:

- **Chemical Usage Reporting**– Determination of the target chemical list, de minimis (minimum) reporting values, reporting mechanics, and reporting frequencies.
- **Technical Assistance**– Assistance in inventory preparation, toxic use reduction planning, and industry sector-specific toxic chemical reduction by CETESB and/or universities/non-profit organizations.
- **Chemical Usage Reduction Planning**– Planning for toxic chemical reduction opportunities, cost-effective projects, goal setting.
- **Public Disclosure**– Publishing successes (positive public publicity), and chemical use inventory disclosure (via the internet) to incentivize toxic chemical use reduction.
- **Toxic Chemical Usage Fee**– Fee based on toxic chemical usage multiplied by a toxicity factor, to provide an economic incentive for reduction. The fee is proportionate to the level of toxicity. Factors also include determination of how the fee will be used and potentially reduced over time as a further incentive for reduction.
- **Usage Reduction Targets**– Consists of the establishment of either voluntary or mandatory reduction targets (absolute % reduction or reductions based on technically feasible projects that can be implemented), set by either individual companies or by CETESB.
- **Incentives**– Economic/regulatory incentives for toxic chemical reduction could include loans to fund reduction projects, direct reduced costs and healthcare costs for industries, reduced regulatory burden for both industry and CETESB, and expedited permit processing.

In this report, the program options were further detailed with respect to institutional/legal considerations.

Development of Toxic Chemical Reduction Program Alternatives

Among these program options, three different, proven program alternatives and associated implementation plans that could be used by CETESB to institute an effective operational toxic chemical reduction program were developed. Table ES-1 presents the program options that comprise each of the three developed program alternatives, followed by a more detailed description of the features of the three alternatives.

Table ES-1: Developed Toxic Chemical Reduction Program Alternatives and Associated Program Options

Program	1	2	3
Chemical Usage Reporting	X	X	X
Technical Assistance	X	X	X
Chemical Usage Reduction Planning		X	X
Public Disclosure		X	X
Toxic Chemical Usage Fee		X	X
Usage Reduction Targets		X	X
Mandatory Chemical Use Reduction			X
Incentives	X	X	X

Program 1

- Mandatory chemical usage reporting to CETESB
- No usage reduction goal setting
- Voluntary toxics chemical usage reduction planning
- Voluntary reduction of targeted chemicals
- Public disclosure highlighting company successes with permission
- Continued technical assistance (i.e., annual training classes to complete forms, general and industry sector toxics chemical usage reduction classes)
- Incentives for reduction in toxics (i.e., assistance in preparing winning loan applications, reduced regulatory burden, reduced permitting fees for reductions)
- Enforcement based on failure to report chemical usage inventories to CETESB
- Program Phasing:
  - In Phase 1, CETESB would set up the program, and industry would submit its chemical usage inventory to CETESB.
  - In Phase 2, CETESB would re-evaluate the chemical usage inventory and its effect on the environment to determine if the initially selected chemicals should continue to be reported, and whether other chemicals need to be added. In addition, CETESB would publicly disclose company successes.

- In Phase 3, CETESB would evaluate program effectiveness and determine if a more comprehensive mandatory plan needs to be implemented.

Program 2

- Mandatory chemical usage reporting to CETESB
- Mandatory establishment of individual goals for toxics chemical use reduction by each company
- Mandatory preparation of a detailed Chemical Usage Reduction Plan
  - The detailed plan would be kept onsite and available to a CETESB inspector on demand.
  - A Summary of the Plan would be submitted to CETESB.
  - Both the detailed Plan and the associated Summary will document progress in meeting goals from the previous reporting period, and set goals for the next reporting period.
- Establishment of a toxic chemical usage fee
  - CETESB would assign a unit price per kilogram (kg) usage for each chemical based on the toxicity factor for that chemical. Fees would thus be proportional to toxicity multiplied by the usage.
  - The usage fee to CETESB for each company would consist of the sum of the usage fees for each chemical used during the reporting period.
- Public Disclosure
  - Public disclosure highlighting company successes with permission
  - Mandatory public disclosure of chemical usage inventories and Chemical Usage Reduction Plan Summaries
- Technical assistance (i.e., non-regulatory public institution and/or university that would provide innovative and creative solutions to industries seeking assistance with toxics chemical usage reductions at their facilities)
- Incentives for reduction in toxics (i.e., assistance in preparing winning loan applications, reduced regulatory burden, and reduced permitting and emissions fees for reductions)
- Enforcement would be based on failure to report chemical usage inventories to CETESB, failure to submit Summary reduction plans that meet established requirements to CETESB, and failure to have the detailed Plan onsite
- Program Phasing:
  - In Phase 1, CETESB would set up the program, and industry would submit its chemical usage inventory to CETESB.
  - In Phase 2, industry would perform chemical usage reduction planning and set goals.

- In Phase 2, CETESB would establish the toxics chemical usage fee program and publicly disclose the chemical usage inventories and Chemical Usage Reduction Plan Summaries.
- In Phase 3, industry would evaluate the success of its previous plan and make adjustments if needed.
- In Phase 3, CETESB would publicly disclose company successes, collect fees based on the previous inventory, and re-evaluate the chemical usage inventory and targeted chemicals.
- In Phase 4 CETESB would evaluate program effectiveness and determine if a more comprehensive mandatory plan needed to be implemented.

Program 3

- Mandatory chemical usage reporting to CETESB
- Establishment of company-by-company goals for toxics chemical use reduction by CETESB
- Preparation of a detailed Chemical Usage Reduction Plan by each company
  - The detailed plan would be kept onsite and available to a CETESB inspector on demand.
  - A Summary of the Plan would be submitted to CETESB.
  - Both the detailed Plan and the associated Summary would document progress in meeting goals from the previous reporting period, and set goals for the next reporting period.
- Establishment of a toxic chemical usage fee
  - CETESB would assign a unit price per kilogram (kg) usage for each chemical based on the toxicity factor for that chemical. Fees would thus be proportional to toxicity multiplied by the usage.
  - The usage fee to CETESB for each company would consist of the sum of the usage fees for each chemical used during the reporting period.
- Public Disclosure
  - Public disclosure highlighting company successes with permission
  - Public disclosure of chemical usage inventories and Chemical Usage Reduction Plan Summaries
- Technical assistance (i.e., non-regulatory public institution and/or university that would provide innovative and creative solutions to industries seeking assistance with toxics chemical usage reductions at their facilities)
- Support for reduction in toxics (i.e., assistance in preparing winning loan applications, access to loans, reduced regulatory burden, and reduced permitting and emissions fees for reductions)

- Enforcement based on failure to report chemical usage inventories to CETESB, failure to submit Summary reduction plans that meet established requirements to CETESB, failure to have the detailed Plan onsite, and failure to meet CETESB-established usage reduction goals
- Program Phasing:
  - In Phase 1, CETESB would set up the program, and industry would submit its chemical usage inventory to CETESB.
  - In Phase 2, CETESB would set company-by-company reduction goals.
  - In Phase 2, industry would perform chemical usage reduction planning based on the goals established by CETESB.
  - In Phase 2, CETESB would also publicly disclose chemical usage inventories and Chemical Usage Reduction Plan Summaries.
  - In Phase 3, CETESB would re-evaluate the chemical usage inventory and targeted chemicals list.
  - In Phase 3, industry would evaluate the success of their previous plan and determine if adjustments are needed.
  - In Phase 4, CETESB would publicly disclose company successes and evaluate the effectiveness of the program.

Further elaboration of the details on the implementation plans are also provided as part of the program alternative descriptions in the report.

Evaluation of Toxic Chemical Reduction Program Alternatives and Program Selection

Evaluation of the program alternatives was based on technical/operational issues, financial aspects (including potential funding sources to both CETESB and industry), and potential direct environmental and development impacts with respect to toxic chemical reduction.

The ultimate goal of a toxic chemical reduction program is to have a positive impact on human health and the environment. Toxic chemical reduction programs in the US and elsewhere have achieved these goals and have had positive impacts on the environment. Additionally, other environmental impacts can be realized. For example, secondary environmental benefits could include reduced water/energy usage (associated with process modifications) and reduced greenhouse gas emissions. Toxic chemical reduction programs can, however, have unintended negative environmental impacts. If a reduction program causes an industry to replace one toxic chemical that is regulated or reported with another one that is not regulated and the replacement chemical is more toxic, then the program can have a negative impact. Due to this, a holistic approach must be taken when determining the environmental impact of the reduction of a given chemical, including the environmental impacts of any new chemicals or processes implemented.

Although the primary goal of a toxic chemical reduction program is the reduction in adverse impacts to human health and the environment, a secondary goal can be economic

stimulus. Development impacts from a toxic chemical reduction program could include upgrades to infrastructure/industry (and associated development of equipment manufacturers, who would need to cater to these process modifications), and market-oriented reforms such as regulations, laws, and institutional changes, ideally that are stringent in meeting goals, but are flexible in their means of achieving those goals, stimulate innovation, and favor upstream (vs. downstream) pollution prevention. Also included are human capacity building, technology transfer and productivity enhancement, and the establishment of beneficial spin-off or demonstration projects.

The ease in implementation of any of the proposed program alternatives needs to be weighed against the relative level of toxic chemical usage reduction expected. All three identified programs will likely have some level of success as far as reduction in toxic chemical usage; however, Program 1 will be limited in expected reduction given that it only has a mandatory reporting component, with no public disclosure and no mandatory toxic chemical usage reduction planning/goal setting. Because Program 1 does not have the element of public disclosure and mandatory usage reduction planning, it is estimated that the level of toxics chemical usage reductions would be approximately one-third of the reductions associated with Program 2, which does include these additional elements. Program 2 will be more effective in reducing toxic chemical usage, given the added component of mandatory goal setting (and associated usage fees) coupled with mandatory public disclosure. The US 33/50 Industrial Toxics Reduction Program was also a voluntary reduction program that included the element of public disclosure, although it was a program associated with emissions reductions (versus usage reductions). Based on a March 1999 EPA report (*33/50 Program, The Final Record*), over the 5 years that the 33/50 Program operated, releases and transfers of the 17 targeted chemicals reported to the US Toxic Release Inventory (TRI) decreased by 47 percent. This resulted in an average percent decrease of just over 9 percent per year during the program duration from 1990 to 1995, compared to less than 8 percent per year for the two previous years (1988 to 1990) and nearly 11 percent for the year after (1995 to 1996). Lastly, Program 3 would yield the greatest toxic chemical use reductions. Specifically, the reductions under Program 3 would be based on the company-by-company reduction goals established by CETESB, coupled with the further incentive to reduce the use of toxic chemicals due to the toxic chemicals usage fee. The resources required to implement this Program (specifically the company-by-company goal-setting aspect), however, would be extensive relative to Programs 1 and 2.

Selected Approach

The three proposed program options were presented to industry and CETESB at a workshop held at CETESB headquarters in São Paulo on May 15, 2009. The general conclusion from the workshop was that additional discussions between industry and CETESB were needed before a program could be fully developed. However, based on initial comments from industry and CETESB, and the practical aspects of developing a toxic chemical reduction program, the recommended first step is to prepare a toxic chemical inventory through mandatory chemical usage reporting by industry.

As previously mentioned, the data indicates that the top 5 chemicals contribute 80% of the toxic risk in São Paulo, the top 10 contribute 90%, and the top 20 contribute 98%. Based on this analysis, it is recommended to collect data for the top 20 toxic chemicals (based both on

toxicity and volume of use, as noted above), and subsequently, after a toxic impact analysis is performed based on data from the inventory, choose the top 5 toxic chemicals to target for reductions. The list of targeted chemicals (reported and for reductions) can increase as the program progresses. Following the initial phase of the program, CETESB would need to re-evaluate the chemical usage inventory to determine if the initially selected chemicals should be continued to be reported, and whether other chemicals need to be added.

A mandatory inventory may lead to some reductions in toxic chemical use due to an increased focus by industry on the targeted chemicals and their associated cost and risk. Furthermore, some reductions could be implemented by companies in order to get below the reporting thresholds, thereby avoiding cost, effort, and potential regulatory scrutiny that results from conducting the inventory. In any case, the toxic chemical inventory would allow CETESB to develop a toxic chemical reduction program based on actual data collected in São Paulo instead of data that is extrapolated from other countries.

After data has been collected from an inventory, a targeted list of chemicals can be compiled and a program can be developed using a number of the program options which include:

- **Technical Assistance**
- **Chemical Usage Reduction Planning**
- **Public Disclosure**
- **Toxic Chemical Usage Fee**
- **Usage Reduction Targets**
- **Incentives**

While three program alternatives were presented in this report, a successful program can be developed by using a "cafeteria-style" approach of selecting the elements of the above program options that are most likely to yield positive results. Based on the discussions following the workshop, a more staged approach that progressively introduces additional toxic chemical reduction measures may be the most successful approach. For example, once the inventory is completed, technical assistance programs can be introduced that focus on measures that will reduce targeted chemicals. Depending on the success of the technical assistance programs, voluntary or mandatory toxic chemical reduction planning could then be introduced. As the program progresses, the need for more stringent measures such as mandatory public disclosure and toxic chemical usage fees can be assessed.

The development of this program has just begun. The success of a program based on a partnership between CETESB and industry will depend on selecting carefully considered program options that result in the maximum possible toxic chemical use reduction with the least possible regulatory burden.

Identification of US Sources of Supply

This section identifies prospective U.S. Sources of Supply of services and equipment that may be required by industries in São Paulo as a result of the implementation of the toxic chemical reduction program described in this report. At this point, the program is expected to evolve over time, starting with a requirement that industry provide an inventory of usage

of toxic chemicals. As the program evolves, different options will be added to produce a result of reduced usage of toxic chemicals.

Methods of reduction are likely to include CETESB providing technical assistance to industries to reduce their usage. Due to the difficulties with CETESB providing technical assistance directly to specific companies facilities, this will provide a market for a separate entity to contract with CETESB to provide pollution prevention consulting services. This would be similar to the relationship between New Jersey and the Rutgers TAP program, discussed in Section 3 of this report. Such programs can range from several hundreds of thousands of dollars per year to millions in essentially engineering consulting services.

The Toxic Chemical Use Reduction program is also likely to include either voluntary or mandatory pollution prevention planning by industries. A typical pollution prevention opportunity assessment, when performed by a consultant is in the $50,000 to $200,000 range. If only 500 companies participate in the program, this could result in $50 million in consulting. These assessments have been performed by consultants in the US for over 25 years. US companies therefore have a technical edge in performing these studies and preparing pollution prevention plans.

A larger expenditure from implementation of a toxic chemicals reduction program would be in retooling manufacturing facilities to reduce or eliminate the usage of the chemicals. For instance, mercury is a world-wide toxic chemical issue, with current emphasis on eliminating its use in all manufacturing processes. The single largest user of mercury is in the chlor-alkali industry, where literally tons of mercury are sitting in brine cells acting as electrodes for the electrolytic conversion of simple salt (sodium chloride) into gaseous chlorine and sodium hydroxide. These chemicals end up containing trace quantities of mercury, which then introduce mercury to the products produced with these chemicals. There is a market for mercury-free chlorine and sodium hydroxide, and a membrane process was developed to eliminate mercury from the process. The Brazil chlor-alkali industry uses mercury cells. Conversion of a chlor-alkali plant from mercury cells to membrane process can cost in excess of a $ billion, with much of this going to companies that manufacture membrane equipment. The US is a leader in membrane technology, and would be a good candidate for providing equipment for this conversion.

Residential and industrial lighting is another example. Much lighting is currently accomplished using incandescent bulbs. These bulbs have low efficiency, turning most of the electricity used into heat, with a small fraction producing useful light. Due to their high heat, they typically last less than 1,000 hours before burning out. Due to their low efficiency, this type of bulb is slated to be phased out in the US and Brazil. These are being replaced by fluorescent bulbs, which use less than a third of the electricity of incandescent bulbs and are somewhat cooler, and last some 6 times longer than incandescent bulbs. Due to their energy efficiency , fluorescents have been used by commercial buildings for years. One problem with fluorescent bulbs is that they contain mercury, and their widespread use and disposal can result in unacceptable releases to the environment. One technology that is just in its infancy is light emitting diode (LED) lamps. These are more expensive than fluorescents, but last 5 times as long as them, and consume approximately half to a third of the electricity. Over their lifetime, even at the current high price, they save money in reduced bulb purchase and electricity They also do not use any mercury. A mercury use

reduction program would provide a market for LED bulbs as well as manufacturing equipment.

A number of the chemicals targeted for reduction are organic solvents used for products such as solvent cleaners and paints. Conversion to water or citrus based cleansers would result in a market for cleaning products and the equipment that uses them for cleaning operations.

These are just a few examples of the potential markets that would become available for consulting and manufacturing equipment sales if the toxic chemical use reduction program is implemented in Sao Paulo. Each chemical that is replaced will require that substitute "green" chemicals and the equipment to use them.

SECTION 1

1.0 Introduction

The Companhia de Tecnologia de Saneamento Ambiental (CETESB's) goal is to develop an approach to reduce the use of toxic substances by industries in the State of São Paulo, Brazil in a way that minimizes the regulatory burden and motivates industry to implement the needed measures. The overall goal of a toxic chemical reduction program is to reduce the use of toxic chemicals in the workplace, the home, and the environment. This goal could be accomplished by targeting the reduction of toxic chemicals used by industries. If use is reduced, release to the environment would be reduced, and exposure to the public and workers would be reduced due to less use of toxic chemicals in products and in the workplace. Various aspects of a toxic chemical reduction program were evaluated as part of this project, in order to ultimately develop a toxic chemical reduction program for implementation in São Paulo.

Specifically, CETESB obtained US Trade and Development Agency (USTDA) funding for this project and selected CH2M HILL to provide technical assistance (to CETESB) with the development of a toxic reduction program for implementation São Paulo. The development of the program was based on programs that have been implemented in other countries, including the US.

As part of this project, CH2M HILL was contracted by CETESB to complete the following tasks:

- **Task 1** of the project involved estimating the relative volumes of toxic chemicals released by industry to the air, water, and land of São Paulo.
- Under **Task 2**, the estimated volumes of toxic chemical releases were combined with recognized risk criteria for cancer potency, relative degradability of chemicals, and other known properties to rank each chemical by its relative impacts on human health and the environment.
- **Task 3** of the project involved assessing various pollution prevention programs that have been implemented in the US, as well as programs in other countries, for applicability in São Paulo.
- Under **Task 4**, CETESB and CH2M HILL project staff visited regulatory agencies responsible for administering toxic chemical reduction programs and the companies regulated by these programs in Washington and New Jersey to evaluate the effectiveness of the programs and learn what would be adaptable to the CETESB program.
- The information collected from these first four tasks was presented to Federation of Industries of the State of São Paulo (FIESP) and the regulated community of São Paulo in a workshop held in November 2006 under **Task 9**. Feedback from the workshop was used to develop a list of toxic chemical reduction options and associated program alternatives.

- The institutional and legal aspects of toxic reduction program options were reviewed under **Task 5**.
- Under **Task 6**, the possible sources of economic incentives to industries to adopt the toxic chemical reduction program were investigated.
- The environmental and development impacts of a toxic chemical reduction program were assessed under **Task 7**.
- Under **Task 8**, the general framework of the toxic chemical reduction program that was developed under Tasks 1 through 7 was used to develop toxic chemical reduction program options and associated alternatives for evaluation for São Paulo.
- The information collected from Tasks 1 through 8 was then presented to CETESB in a workshop held in May 2009 under **Task 9**. Feedback from the workshop was used to choose the toxic chemical reduction program for implementation in São Paulo.
- **Task 10** included the preparation of this Final Report, which is a substantive and comprehensive report of all of the work performed under Tasks 1 through 9, including identification of the chosen toxic chemical reduction program and identification of the prospective US Sources of Supply of services and equipment that may be required by industries in São Paulo as a result of the implementation of the selected program.

1.1 Report Organization

In order to develop toxic chemical reduction program options and associated alternatives, the relative volumes of toxic chemicals released by industry to the air, water, and land of São Paulo were estimated and subsequently ranked using various risk and chemical properties, as detailed in **Section 2** of this report. In **Section 3**, various pollution prevention programs that have been implemented, including the US, were reviewed for applicability in São Paulo to evaluate the effectiveness of the programs and learn what would be adaptable to the CETESB program.

Under **Section 4**, the information developed and gathered in support of the toxic chemical reduction program, as documented under Sections 2 and 3 of this report, was used to develop toxic chemical reduction program options. Institutional/legal aspects of the program options were also identified in this Section. Among these program options, three different, proven program alternatives and associated implementation plans that could be used by CETESB to institute an effective and operational toxic chemical reduction program were developed, as documented in **Section 5**. Evaluation of the program alternatives, based on technical/operational issues, financial aspects, economic incentives, and the expected environmental and development impacts from implementation of the toxic chemical reduction program alternatives is also detailed in Section 5, along with identification of the selected program.

Under **Section 6**, prospective US Sources of Supply of services and equipment that may be required by industries in São Paulo as a result of the implementation of a toxic chemical reduction program were identified.

SECTION 2

2.0 Development of Toxic Chemicals Target List

One key aspect of implementing a toxic chemical reduction program is the establishment of the list of toxic chemicals that will be targeted for reporting and reduction under the program, as well as establishment of the de minimis (minimum) reporting thresholds under the program.

Toxic chemical usage or release data is not available for São Paulo, Brazil industries. Therefore, the release and (indirectly) the use of toxic chemicals by industries in São Paulo was estimated, and subsequently ranked, based on estimates of releases to the environment and associated risks. Once the list of toxic chemicals was ranked by relative releases/risk, the targeted chemicals list and establishment of de minimis levels were established.

This section describes the steps and associated methodologies that were used to develop the toxic chemical target list and de minimis levels.

2.1 Estimation of São Paulo Toxic Chemical Releases

The following presents an estimate of release (and indirectly) the use of toxic chemicals by industries in São Paulo, Brazil. US companies are required to estimate the usage of a large group of toxic chemicals under the Emergency Planning and Community Right to Know Act (EPCRA). If the use is more than a threshold amount, then they must report releases to land, air and water. Usage is not reported, but the release data is available to the public in the Toxics Release Inventory (TRI). Toxic chemical usage or release data is not available for São Paulo industries. However, TRI release data is available for US industries similar to the major industry sectors operating in São Paulo. Therefore, toxic chemical releases from US industries were used as a surrogate to estimate releases from, and indirectly usage of toxic chemicals by industries in São Paulo.

2.1.1 Assumptions

In order to calculate releases from São Paulo industries based on US industry releases, two main assumptions were made. First, it was assumed that releases from São Paulo industry today are comparable to TRI Releases by US industries in 1989 when scaled for production rate. TRI reporting has resulted in significant reductions in TRI releases by industry. Therefore, after 18 years of the program, today's TRI releases are expected to be lower per unit production rate than releases from industries in São Paulo, who have not been subject to such reporting. In order to establish comparable emissions, TRI release data from early in the program was considered to be more representative of São Paulo industrial releases. The earliest TRI data available on the internet is from 1988 – the first year of the TRI program. In order to reduce the risk of encountering data abnormalities that may have been encountered during the first year of the program, the 1989 TRI data was used. Because production rates of industries in the US differ from those in São Paulo, a production scaling factor was used.

In addition, it was assumed that economic output can be used as a surrogate for production rate. Although production data is not readily available in the US or Brazil across the major industrial categories, economic output data is well documented. Therefore, economic

output was used as a surrogate for production rate. Historical US economic data was readily available for the calendar years 1992 and 1997. 1992 data was selected as most comparable to 1989. The most recent economic data available from industries in São Paulo was from 2003.

2.1.2 Methodology

TRI data initially considers the amount of each chemical used at a site. Once a threshold amount of the chemical is used, releases are calculated and reported. TRI data is available for the each of the major manufacturing industries. It therefore can be used not only as an indicator of chemical releases, but also of chemical use.

Economic Output Ratio

Industries in the US TRI are categorized by Standard Industrial Classification (SIC) codes. SIC codes classify a business or facility according to its primary type of activity, such as food, lumber, or electrical. Brazil also has an industrial coding system, the Classificação Nacional de Atividades Econômicas (CNAE). Although these two codes are not identical, they are similar. Each code has an official associated description that defines the processes related to the code. Descriptions for each CNAE code used in São Paulo were matched to the SIC code with the same or similar industrial processes (see Table 2-1 in Attachment).

Once São Paulo industries were matched to the corresponding US industries, releases were ratioed based on relative economic output. Using the economic data described above, the ratio of São Paulo industrial output to US industrial output was calculated. A currency conversion factor of 2 BRL = 1 USD was used. The determination of the economic output ratio is shown in Table 2-1 in Attachment.

Refinement of TRI Release Data

Chemicals included in the USEPA TRI database that have similar chemical and toxic properties were combined into a single toxic chemical category (i.e. mercury and mercury compounds). The chemicals that were combined are listed in Table 2-2 in Attachment.

It should be noted that chromium and chromium compounds were combined and assumed to be hexavalent chromium. Although this approach will overestimate overall emissions of hexavalent chromium, this approach takes into account the fact that some forms of chromium can be oxidized to the hexavalent after they have been released. This approach was used as a conservative estimate of toxic emissions.

In some instances, an elemental metal and its associated compounds had varying rates of toxicity. If an elemental metal had a relatively low toxicity and the metal salt toxicity was considered to be higher (i.e. elemental nickel is not considered highly toxic, and some nickel salts are), the emissions from the elemental metal were disregarded and only the emissions from the metal salts were considered in the toxic emissions inventory. The metals that were disregarded are listed in Table 2-3 in Attachment.

Releases to Air, Water, and Land

The TRI data is available on many different ways in which toxic chemicals are released from facilities. To simplify analysis, release data was combined into releases to air, water, or land using conversions shown in Table 2-4 in Attachment.

São Paulo Industry Emissions

As explained above, 1989 TRI data provides US emissions of each chemical for each SIC code. Once Brazilian industry categories were matched to the corresponding US industrial categories, the US emission rates were scaled to production levels in São Paulo by using the economic output ratio. Emissions from São Paulo industries for each CNAE code were calculated using the following equation:

[São Paulo Releases (lbs)] = [US Emissions (lbs)] [Industrial Output Ratio)]

The estimated releases from each industry (by CNAE code) in São Paulo are presented in Table 2-5 in Attachment and the total estimated releases from São Paulo industries are presented in Table 2-6 in Attachment.

The chemical emissions data in Tables 2-5 and 2-6 are sorted by chemical name alphabetically. Because chemicals are often listed under different synonyms, Table 2-7 in Attachment provides a cross reference that shows the chemicals sorted by Chemical Abstract Service (CAS) number.

2.1.3 Data Sources

The following data sources were used in order to calculate releases from São Paulo industries:

- US Toxic Emissions: US Toxics Release Inventory – 1989 (www.epa.gov/tri/)
- Brazilian Economic Output – Brazilian Statistical Report *Pesquisa Industrial 2003 (IBGE)* – "Valor da produção industrial"
- US Economic Output – US Census (www.census.gov) – 1992 "Value of Shipments"

2.2 Development of São Paulo Priority Toxic Chemicals List

The following presents a ranking of toxic chemicals based on the estimates of their releases to the environment by industries in São Paulo, Brazil (Section 2.1) in conjunction with their associated relative risk.. The relative environmental impact of the chemicals was based on recognized risk criteria for discharges to land, air and water as well as cancer, the degradability of each chemical, and other known properties of each chemical, as detailed further below.

2.2.1 Analysis

The following documents the methodology for ranking the impact of emissions from São Paulo industries.

Releases and Risks

The annual releases of each chemical for each industry sector were combined (as detailed in Section 2.1) to obtain total estimated releases to soil, water, and air, as shown previously in Table 2-6.

Chemical toxicity is based on human or animal data that relates exposure to a given dose of the chemical per mass of the subject per day (typically reported as mg/kg-day) that would result in an unacceptable number of deaths per million. This toxicity is combined with likely exposure route (such as drinking one liter of water per day) to come up with an unacceptable level of contamination in that environmental media. The following health and environmental standards and risk values were used to rank the overall toxicity of the released chemicals:

1. Occupational Exposure: US Occupational Safety & Health Administration Permissible Exposure Limits (OSHA PEL) listed as an 8-hr time weighted average (29 CFR 1910, Subpart Z, 7/1/05 Edition). This is an indicator of the risk to worker exposure to the contaminant in the air. This value is listed as a maximum concentration in air.
2. Soil Standard: Brazilian Prevention Value (mg/kg), Companhia De Tecnologia De Saneamento Ambiental (CETESB) Decisão De Diretoria N° 195-2005- E, de 23 de novembro de 2005. Brazilian soil prevention standards based on concentration of chemicals in soil.
3. Water Quality Standard: Brazilian CONAMA Class I Standards (ug/l), Conselho Nacional Do Meio Ambiente (CONAMA) Resolução No 357, De 17 De Março De 2005.
4. Cancer: California Office of Environmental Health Hazard Assessment (OEHHA) cancer risk values, measured in $(mg/kg\text{-}day)^{-1}$ from Toxic Chemical Database output provided by OEHHA 11/20/06.
   a. Inhalation pathway
   b. Oral pathway

Each of these four criteria were given equal weighting in this analysis; 25% occupational exposure, 25% soil standard, 25% water quality standard, and 25% cancer (12.5% inhalation and 12.5% oral).

The standards used in this analysis are shown in Table 2-8 in Attachment. The occupational exposure, soil, and water quality values are standards that list the exposure limit at which the chemical will cause harm. A lower value indicates a more toxic chemical. The OEHHA cancer potency factor is actually the inverse of a dosage risk factor, the higher the number, the higher the risk.

Risks Normalized

Each risk factor also has a different set of units. In order to maintain consistency within the calculations, the risk factors were normalized.

Prior to normalizing, the risk values that are listed as standards (OSHA PEL, Brazilian Soil Prevention Standards, and CONAMA) were converted to potency factors by inverting them (i.e. 1/x) so that all criteria are consistently shown as potency factors with higher value for higher risk.

The potency factors were then normalized, so that the highest risk value of each criterion was assigned a value of 1 and the lowest was assigned a value close to 0. This was done by dividing each potency factor by the maximum value of each standard. After the risk prioritization procedure was completed as described below, the risk values were normalized again so that each risk value was normalized based on a risk value that had one of the 10 highest prioritization scores. This was done so that each of the risk values had a relatively equal impact on the prioritization of chemicals.

After the potency factors were normalized, the criteria were combined to create an overall "Toxic Impact Factor". A "Toxic Impact Factor" is the relative impact of each chemical based on its potency factor multiplied by total estimated annual release to the appropriate pathway: air; soil; or water, as follows:

- The worker exposure toxic impact was calculated by multiplying estimated releases to air by the normalized OSHA PEL potency factor.
- The land release toxic impact factor was calculated by multiplying the estimated Soil releases by the normalized Soil Prevention potency factor.
- The water quality toxic impact factor was calculated by multiplying estimated water releases by the normalized CONAMA potency factor.
- The inhalation cancer toxic impact factor was calculated by multiplying the estimated air releases by the inhalation cancer potency factor
- The oral cancer toxic impact factor was calculated by combining the estimated soil and water releases and multiplying by the oral cancer potency factor.

The contribution of each factor to the overall toxic impact factor is shown in Table 2-9 in Attachment. Once this toxic impact factor was calculated, three additional adjustment factors were applied:

1. Persistence - adjusts for chemicals that degrade when released:
    a. Readily Degradable = 0.0
    b. Moderately Degradable = 0.1,
    c. Slightly Degradable = 0.5,
    d. Non-degradable = 1.0
2. Used/Produced – eliminates chemicals that are not used in a production process:
    a. If the chemical was emitted by processes but not used as a raw material, a factor of 0 was applied.
    b. If the chemical was used as a raw material, a factor of 1 was applied.
    c. A factor of 0 was also applied to asbestos and PCBs, due to the fact that these materials are regulated separately from other chemicals under Brazilian legislation.
3. High Use / Low Toxicity Factor - eliminates chemicals that have a high use but relatively low environmental impact:
    a. High Use/Low Toxicity - 0.0
    b. Otherwise – 1.0

The total toxic impact factor was multiplied by the adjustment factors to account for the likelihood of the chemical accumulating in the environment (persistence), to account for no production usage, and/or to account for those chemicals that had relatively low toxicity. This adjusted toxic impact factor was used to prioritize compounds for a toxic use reduction program in São Paulo, as noted in Section 2.3 below. The overall toxic impact factor, adjustment factors and adjusted toxic impact factor are shown in Table 2-10 in Attachment.

2.3 Targeted Toxic Chemicals List

The estimated release data and toxicity rankings (Sections 2.1 and 2.2, respectively) were used to provide an analysis in the selection of chemicals to use as "targets" in the program. Ranking toxic chemicals by cumulative risk is a method that can be used to choose how many chemicals to include in the mandatory reporting program, and to identify those to target for use reduction.

Table 2-11 presents a list of the chemicals identified under Sections 2.1 and 2.2, ranked by adjusted toxicity impact of the estimated releases by industries in São Paulo. Toxicity impact is based on multiplying the estimated releases (Section 2.1) by a toxicity factor that is weighted by the medium (air, water, or land) to which the chemicals are released by the type of industry in São Paulo, times the appropriate toxicity factors based on impacts to human health and the environment (Section 2.3).

TABLE 2-11
Ranking of Toxic Chemicals By Estimated Toxicity Effect

CAS Number	Chemical	Releases (Kg/Year)	Toxic Impact Factor	% of Total Toxic Impact Factor	Cumulative Risk (%)	Toxicity Factor (1/mg)
7440-38-2	Arsenic	256,982	278,577	49%	49%	223,437
18540-29-9	Chromium VI	2,371,081	79,175	14%	63%	6,883
118-74-1	Hexachlorobenzene	46,136	55,354	10%	73%	247,297
79-06-1	Acrylamide	208,872	19,798	4%	77%	19,537
7439-92-1	Lead	1,532,695	19,703	3%	80%	2,650
107-13-1	Acrylonitrile	481,345	16,071	3%	83%	6,882
7440-43-9	Cadmium	34,804	12,123	2%	85%	71,792
79-01-6	Trichloroethylene	1,279,083	11,879	2%	87%	1,914
108-88-3	Toluene	8,938,161	11,268	2%	89%	260
108-95-2	Phenol	587,742	9,204	2%	91%	3,228
75-09-2	Dichloromethane	4,611,923	8,830	1.6%	92%	395
N106	Cyanide Compounds	460,513	8,244	1.5%	94%	3,690
N084	Chlorophenols	6,475	6,911	1.2%	95%	219,990
1330-20-7	Xylene (Mixed Isomers)	5,191,278	4,729	0.8%	96%	188
71-43-2	Benzene	1,113,980	4,248	0.8%	97%	786
127-18-4	Tetrachloroethylene	805,299	2,536	0.4%	97%	649

TABLE 2-11
Ranking of Toxic Chemicals By Estimated Toxicity Effect

CAS Number	Chemical	Releases (Kg/Year)	Toxic Impact Factor	% of Total Toxic Impact Factor	Cumulative Risk (%)	Toxicity Factor (1/mg)
50-00-0	Formaldehyde	816,556	2,257	0.4%	97%	570
120-82-1	1,2,4-Trichlorobenzene	57,991	2,093	0.4%	97.8%	7,438
7439-97-6	Mercury	8,043	1,404	0.2%	98.0%	35,969
91-20-3	Naphthalene	172,572	1,200	0.2%	98.2%	1,433
101-77-9	4,4'-Methylenedianiline	12,716	1,135	0.2%	98.4%	18,396
107-06-2	1,2-Dichloroethane	239,129	955	0.2%	98.6%	823
7440-36-0	Antimony	116,632	809	0.1%	98.8%	1,429
1319-77-3	Cresol (Mixed Isomers)	175,582	744	0.1%	98.9%	874
71-55-6	1,1,1-Trichloroethane	5,050,397	603	0.1%	99.0%	25
56-23-5	Carbon Tetrachloride	163,867	478	0.1%	99.1%	601
75-21-8	Ethylene Oxide	110,717	433	0.1%	99.2%	806
7440-22-4	Silver	1,361	421	0.1%	99.2%	63,687
7440-41-7	Beryllium	2,199	405	0.1%	99.3%	37,995
63-25-2	Carbaryl	2,392	378	0.1%	99.4%	32,589

Subsequently, the relative risk of each chemical (percent of total risk, or percent of Total Toxic Impact Factor) was calculated by dividing the individual Toxic Impact Factor by the total sum of all of the individual chemical Toxic Impact Factors. In Table 2-11, these are presented as individual risks for each chemical, as well as cumulative risks associated with the chemical and those above it in the list.

Ranking chemicals by cumulative risk can be used to choose how many chemicals to include in the inventory, and to target for use reduction. The top five chemicals represent 80 percent of the risks associated with the full list of chemicals. The top 10 chemicals represent 90 percent of the risks. The top 15 chemicals represent 97 percent of the risks. The top 20 chemicals represent 98 percent. The top 25 chemicals represent 99 percent. The top 30 chemicals increase the percent of risks to 99.4 percent.

This analysis also was used to create a media-weighted factor (toxicity per milligram [mg]), or Toxicity Factor, by dividing the Toxic Impact Factor by the mass of the estimated release. The toxicity factors are included to show that some of the high-risk chemicals are driven by high-volume emissions of a relatively lower toxicity chemical. The list includes benzene, toluene, and xylene, which are principal components of gasoline. It is not the intent of this program to reduce gasoline consumption, but rather to reduce industrial usage of toxic chemicals. One alternative is to not include fuel usage in the inventory. Another approach would be to eliminate chemicals that are below a selected toxicity factor.

Table 2-12 shows the revised list for the top 30 chemicals if chemicals with a toxicity factor less than 1,000/mg were eliminated. This methodology eliminates benzene, tetrachloroethylene, formaldehyde, 1,2-dichloroethane, cresol, carbon tetrachloride, ethylene oxide, and biphenyl. The chemicals 2,4-dinitrotoluene, 2,4-D, hydrazine sulfate, 2,4-dichlorophenol, lindane, methyl isocyanate, 3,3'-dichlorobenzidine, and parathion would be added.

TABLE 2-12
Ranking of Toxic Chemicals By Estimated Toxicity Effect Excluding Toxicity Factor <1,000

CAS Number	Chemical	Releases (Kg/Year)	Toxic Impact Factor	Cumulative Risk (%)	Toxicity Factor (1/mg)
7440-38-2	Arsenic	256,982	278,577	40%	223,437
18540-29-9	Chromium VI	2,371,081	79,175	63%	6,883
118-74-1	Hexachlorobenzene	46,136	55,354	73%	247,297
79-06-1	Acrylamide	208,872	19,798	77%	19,537
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107-13-1	Acrylonitrile	481,345	16,071	83%	6,882
7440-43-9	Cadmium	34,804	12,123	85%	71,792
79-01-6	Trichloroethylene	1,279,083	11,879	87%	1,914
108-95-2	Phenol	587,742	9,204	89%	3,228
N106	Cyanide Compounds	460,513	8,244	90%	3,690
N084	Chlorophenols	6,475	6,911	91.4%	219,990
120-82-1	1,2,4-Trichlorobenzene	57,991	2,093	91.8%	7,438
7439-97-6	Mercury	8,043	1,404	92.0%	35,969
91-20-3	Naphthalene	172,572	1,200	92.3%	1,433
101-77-9	4,4'-Methylenedianiline	12,716	1,135	92.5%	18,396
7440-36-0	Antimony	116,632	809	93%	1,429
7440-22-4	Silver	1,361	421	93%	63,687
7440-41-7	Beryllium	2,199	405	93%	37,995
63-25-2	Carbaryl	2,392	378	93%	32,589
101-68-8	Methylene Bisphenyl Isocyanate	55,665	275	93%	1,020
584-84-9	Toluene-2,4-Diisocyanate	8,475	244	92.9%	5,928
7782-49-2	Selenium	8,797	195	92.9%	4,571
121-14-2	2,4-Dinitrotoluene	9,994	171	93.0%	3,517
94-75-7	2,4-D	5,312	131	93.0%	5,098
10034-93-2	Hydrazine Sulfate	3,503	122	93.0%	7,206
120-83-2	2,4-Dichlorophenol	373	111	93.0%	61,627
58-89-9	Lindane	61	87	93.0%	291,276
624-83-9	Methyl Isocyanate	1,130	73	93.1%	13,393
91-94-1	3,3'-Dichlorobenzidine	356	67	93.1%	38,941
56-38-2	Parathion	163	44	93.1%	55,416

The effect of eliminating chemicals that are below the toxicity factor of 1,000/mg in reducing the total risk from the total list of chemicals evaluated in this study is illustrated in Table 2-13. Table 2-13 analyzes the effect of choosing various numbers of chemicals to include in the program with the percent of the total risks associated with all chemicals evaluated. This compares the case where less toxic chemicals were eliminated (from Table 2-12) to the base case (from Table 2-11), where all chemicals are included and evaluated based on Toxicity Impact Factor.

TABLE 2-13
Comparison of Total Risk Reduction Potential by Strategy

Number of Chemicals	Base Case	Eliminate Toxicity Factors < 1,000
5	80%	80%
10	91%	90%
15	97%	93%
20	98%	93%
25	99%	93%
30	99.4%	93%

Based on this analysis, it is recommended to collect data for the top 15 toxic chemicals (based both on toxicity and volume of use), and subsequently choose the top 5 toxic chemicals to target reductions because the top 5 chemicals represent 80 percent of the risks and the top 15 chemicals represent 97 percent of the risks. As shown in Table 2-12, beyond the top 15 chemicals, there is an insignificant increase in the percentage of risk (i.e., the top 20 chemicals represent 98 percent of risk).

The list of targeted chemicals (reported and for reductions) can increase as the program progresses. Following the initial phase of the program, CETESB would need to re-evaluate the chemical usage inventory to determine if the initially selected chemicals should be continued to be reported, and whether other chemicals need to be added.

2.4 De Minimis Level Establishment for Reporting

Subsequent to developing the target toxic chemicals list for reporting/reduction, de minimis (minimum) reporting thresholds need to be established. The recommended de minimis evaluation includes two tiers, first by company profile and subsequently by chemical usage and product composition, as detailed below:

- Tier 1 – By number of employees or annual sales: If a company has fewer than X number of employees, or has annual sales of less than Y Reals, the company is considered a de minimis user and does not need to report chemical usage. As an example, the TRI program de minimis level is 10 full-time employees.
- Tier 2 – For those companies that do need to report chemical usage (not considered de minimis), when quantifying the usage of a targeted chemical in a given reporting period, any product whose composition of a targeted chemical is less than A percent of the compound does not need to be included as part of the quantification of the total

annual usage of that chemical. As an example, EPA's typical de minimis level is 1 percent for pollutants and 0.1 percent for "Extremely Hazardous Substances."

- In addition, when quantifying usage data, any targeted chemical whose usage amounts to less than Z kg annually is considered de minimis and does not need to be reported.
- As a joint effort, CETESB and the industry should determine specifically what these specific de minimis thresholds should be. The thresholds would need to be re-evaluated by CETESB in subsequent reporting years, as well.
- As far as determining how the usage data are to be calculated and reported, the recommendation is when preparing the inventory, engineering judgment needs to be used; the inventory should not be carried out using strict accounting standards or to requiring usage to be measured such as by weighing. Also, if a company reports a usage of a listed toxic chemical by volume, it should be required to also supply the density or specific gravity of the substance.
- It is recommended to require that all permitted companies report on their usage (after taking the de minimis considerations noted above into account), and that they have the responsibility to determine the composition information of the products they use. An option is for CETESB to use its discretion to start an initial pilot program with targeted industries.

Enforcement would take place to ensure continued reporting of the annual chemical usage inventories to CETESB.

SECTION 3

3.0 Government Toxic Chemical Reduction Programs

Various approaches have been used to implement toxic chemical use reductions. A review of various industrial Federal- and State-level toxic chemical reduction programs currently being implemented that contain approaches potentially applicable to Sao Paulo's toxic chemical reduction program was conducted. The purpose of the review was to provide additional information (including advantages and disadvantages) for each toxic chemical reduction program option and approach and to provide associated details on company-specific program implementation examples.

Below is the list of programs reviewed:

- United States Environmental Protection Agency's (USEPA) Toxics Release Inventory (TRI) Program
- USEPA 33/50 Program
- Massachusetts Toxics Use Reduction Act (TURA)
- Maine Toxics and Hazardous Waste Reduction Program
- Washington State Department of Ecology Pollution Prevention Program
- Technical Resources for Engineering Efficiency (TREE) Program
- Lean and the Environment Program (Washington State Program)
- Washington Department of Ecology Persistent, Bioaccumulative Toxins (PBT) Program
- Targeted Chemicals (Mercury) Program (Washington State Program)
- New Jersey Pollution Prevention (P2) Program
- New Jersey Technical Assistance Program
- California – Hazardous Waste Source Reduction and Management Review Act of 1989 (SB14)
- California – Proposition 65
- European Union's (EU) Registration, Evaluation Authorization and Restriction of Chemicals (REACH) Program

A matrix of general program options included in each toxic chemical reduction program reviewed is presented in Table 3-1. Following this table are detailed descriptions of the various programs that were reviewed.

Table 3-1. Summary of Toxic Chemical Reduction Programs and their Associated Program Options

Program	Toxic Chemical Reduction Program Options						
	Chemical Usage Reporting	Technical Assistance	Chemical Usage Reduction Planning	Public Disclosure	Toxic Chemical Usage Fee	Usage Reduction Targets	Incentives
USEPA - Toxic Release Inventory (TRI)	X			X			
USEPA – 33/50 Program				X		X	
Massachusetts Toxics Use Reduction Act (TURA)	X	X	X				
Maine Toxics and Hazardous Waste Reduction Program	X	X					
Washington State Department of Ecology Pollution Prevention Program	X	X	X				
Technical Resources for Engineering Efficiency (TREE) Program		X					
Lean and the Environment Program (Washington State Program)		X					
Washington Department of Ecology (DOE) Persistent, Bioaccumulative Toxins (PBT) Program						X	
Targeted Chemicals (Mercury) Program (Washington State Program)						X	
New Jersey Pollution Prevention (P2) Program	X	X	X				
New Jersey Technical Assistance Program		X					
California – Hazardous Waste Source Reduction and Management Review Act of 1989 (SB14)	X	X	X				
California – Proposition 65				X[1]			
European Union REACH Program				X[1]			

[1]Program entails public disclosure of product composition reporting (vs. reporting the use and/or release of specific chemicals).

3.1 United States Environmental Protection Agency's (USEPA) Toxics Release Inventory (TRI) Program

The Toxics Release Inventory (TRI) is a database available to the public that contains detailed information on toxic chemical releases and other waste management activities reported annually by certain industry groups as well as by federal facilities. It was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990 and is administered by the Environmental Protection Agency (EPA).

Facilities that manufacture, process, or use toxic chemicals above specified amounts must report annually on disposal or other releases and other waste management activities related to these chemicals. This report is filed with a specified format. Reports must be filed with both the EPA and with the applicable State Agency. Most states allow reporters to submit both reports at once, through programs provided on the EPA website.

3.1.1 Basis for Program

EPCRA was enacted to facilitate emergency planning, to minimize the effects of potential toxic chemical accidents, and to provide the public with information on releases of toxic chemicals in their communities. It was inspired by an incident in 1984 during which a deadly cloud of methyl isocyanate killed thousands of people in Bhopal, India. Shortly thereafter, there was a serious chemical release at a sister plant in West Virginia. These events underscored demands by industrial workers and communities in several states for information on hazardous materials. Public interest and environmental organizations around the country accelerated demands for information on toxic chemicals being released outside of the facility

A facility must report to TRI if it:

- Operates within any of the following industry sectors:
  - Manufacturing (Standard Industrial Classification (SIC) codes 20-39),
  - Metal mining (SIC code 10, except 1011, 1081, and 1094),
  - Coal mining (SIC code 12, except 1241),
  - Electrical utilities that combust coal and/or oil for the purpose of generating power for distribution in commerce (SIC codes 4911, 4931, and 4939),
  - Resource Conservation and Recovery Act (RCRA) Subtitle C hazardous waste treatment and disposal facilities (in SIC code 4953),
  - Chemical wholesalers (SIC code 5169),
  - Petroleum terminals and bulk stations (SIC code 5171),
  - Solvent recovery services (SIC code 7389),
  - A federal facility in any SIC code; and
- Employs 10 or more full-time-equivalent employees; and
- Manufactures or processes more than 25,000 pounds or otherwise uses more than 10,000 pounds of any listed chemical during the calendar year, except for PBT chemicals where the thresholds are 0.1 gram for dioxin and dioxin-like compounds, and 10 or 100 pounds for other PBT chemicals.

The Pollution Prevention Act (PPA) of 1990 mandates collection of data on toxic chemicals that are treated on-site, recycled, and combusted for energy recovery. Together, these laws require facilities in certain industries, which manufacture, process, or use toxic chemicals above specified amounts, to report annually on disposal or other releases and other waste management activities related to these chemicals. Each year, the EPA makes TRI data available to the public on two Internet sites: TRI Explorer (www.epa.gov/triexplore) and Envirofacts (www.epa.gov/enviro).

The list of toxic chemicals subject to reporting under section 313 of EPCRA is not static. The list can be modified by Agency-initiated reviews of chemicals or by public petition. Petitions can be filed by individuals or groups In general, previous petitions have been submitted for single chemicals, however, there has been a recent increase in petitions for groups of chemicals.

3.1.2 Program Requirements

Information reported annually by facilities includes:

- Basic information identifying the facility (including name, location, type of business, and name of parent company)
- Name and telephone number of a contact person
- Environmental permits held
- Amounts of each listed chemical disposed of or released to the environment at the facility
- Amounts of each chemical sent from the facility to other locations for recycling, energy recovery, treatment, or disposal or other release
- Amounts of each chemical recycled, burned for energy recovery, or treated at the facility
- Maximum amount of chemical present on-site at the facility during year
- Types of activities conducted at the facility involving the toxic chemical
- Source reduction activities.
- general information about the manufacture, process, and otherwise use of the listed chemical at the facility
- information about methods used to treat waste streams containing the toxic chemicals at the site, and the efficiencies of those treatment methods
- information regarding the amount of toxic chemicals sent off-site for further waste management, facilities, and the destination of these transfers

There are two different reporting forms, Form R and Form A. Form A can be used if the chemicals in question are not Persistent, Bioaccumulative, and Toxic (PBTs), and when the amount manufactured, processed, or otherwise used is less than or equal to 1,000,000 pounds and the reportable amount is less than or equal to 500 lbs/yr.

3.1.3 Role of Stakeholders

Facilities are responsible for completing the reports and filing them with the EPA and the applicable state agency within the published deadlines. This can be a time-consuming process, even with the free software that EPA provides for this purpose. Facilities are allowed to estimate releases; however this involves recordkeeping and calculation time. Once the report is filed, facilities must maintain copies of all documents for at least 3 years.

After the deadline, EPA and state personnel must review the reports to ensure accuracy.

Once all the reporting is complete, EPA posts the results online, within easy access of the public. The data can be searched by area, chemical type, amount, and other variables.

3.1.4 Financial Impacts

Violators of the requirements of this regulation are liable for a civil penalty of up to $25,000 each day for each violation. Facilities are financially responsible for their own reporting requirements.

The cost to the EPA to process the Form A Certification Statements can be broken down into fixed costs and variable costs. Fixed costs include Full Time Employees (FTEs) and other recurring EPA costs. The variable component depends on the number of forms. It reflects total data processing costs divided by the total number of paper reports processed in the 2002 reporting year. EPA expends $26 in variable costs for each form processed. A total of 1,800 Form A Certification Statements were filed in the 2002 reporting year. Thus, the total annual burden to EPA is estimated to be $46,800 in variable costs for the Form A Certification Statement. The cost to facilities is outlined in Table 3-2.

To estimate EPA burden and cost to process the Form R Certification Statements, costs are separated into a fixed component and a variable component. Activities and expenses that are not greatly affected by marginal changes in numbers of reports are treated as fixed. These include rent for the EPCRA reporting center, development costs for data access tools, compliance assistance measures, and other activities and expenses. The variable component is the amount that varies depending on the number of forms. The variable component reflects total extramural data processing costs divided by the total number of reports processed in the 2003 reporting year. $0.8 million in fixed costs and 26.3 FTEs are required to conduct the EPA activities described above plus an additional $35 in variable costs for each form processed. The cost to facilities in both time and money is outlined in Tables 3-3 and 3-4.

Table 3-2:

Annual Burden and Cost per Facility (Assuming 1, 2, or 3 Chemicals)

Activity	Number of Chemicals Reported on Each Form A					
	1 Chemical		2 Chemicals		3 Chemicals	
	hours	cost	hours	cost	hours	cost
First-year filers						
Rule Familiarization - first-time filers	34.5	$1,644	34.5	$1,644	34.5	$1,644
Calculations/ Certification - first-time filers	44.5	$2,081	89	$4,162	133.5	$6,243
Form A Completion - first-time filers	1.6	$70	1.6	$70	1.6	$70
Recordkeeping/Submission	3	$122	6	$244	9	$366
Total per Facility	83.6	$3,917	131.1	$6,120	178.6	$8,323
Average per Chemical	83.6	$3,917	65.5	$3,060	59.5	$2,774
Subsequent year filers						
Calculations/ Certification - subsequent year filers	16.2	$759	32.4	$1,518	48.6	$2,277
Form A Completion - subsequent year filers	1.3	$58	1.3	$58	1.3	$58
Recordkeeping/Submission	3	$122	6	$244	9	$366
Total per Facility	20.5	$939	39.7	$1,820	58.9	$2,701
Average per Chemical	20.5	$939	19.8	$910	19.7	$900

Table 3-3:

Average Annual Burden Hour Estimate by Activity

Category	Activity	Management	Technical	Clerical	Total Hours
Facility Level	Compliance Determination - all facilities	1	3	0	4
	Rule Familiarization - first-time filers	12	22.5	0	34.5
	Supplier Notification	0	7	17	24
Per Form R	Calculations and Report Completion - first-time filers - PBTs	20.3	43.9	2.7	66.8
	Calculations and Report Completion - first-time filers - Non-PBTs	20.5	44.4	2.8	67.6
	Calculations and Report Completion - subsequent year filers - PBTs	14.1	30.4	1.9	46.3
	Calculations and Report Completion - subsequent year filers - Non-PBTs	7.5	16.1	1.0	24.6
	Recordkeeping/Submission -all filers	0	4	1	5

Table 3-4

Average Annual Cost Estimate by Activity

Category	Activity	Management	Technical	Clerical	Total Cost
Facility Level	Compliance Determination - all facilities	$53	$134	$0	$187
	Rule Familiarization - first-time filers	$637	$1,008	$0	$1,644
	Supplier Notification	$0	$314	$402	$715
Per Form R	Calculations and Report Completion - first-time filers - PBTs	$1,076	$1,965	$63	$3,104
	Calculations and Report Completion - first-time filers- Non-PBTs	$1,088	$1,986	$66	$3,140
	Calculations and Report Completion - subsequent year filers - PBTs	$748	$1,360	$44	$2,152
	Calculations and Report Completion - subsequent year filers - Non-PBTs	$400	$720	$24	$1,144
	Recordkeeping/Submission - all filers	$0	$179	$24	$203

Effectiveness of Program

TRI reporting has limitations; however the program has been successful in reducing releases of the targeted chemicals. The following chart (Figure 3-1) shows the reduction in TRI reporting over the years for the original compounds, demonstrating its effectiveness in reducing releases.

Figure 3-1*:

Total Releases of TRI Core Chemicals in the US

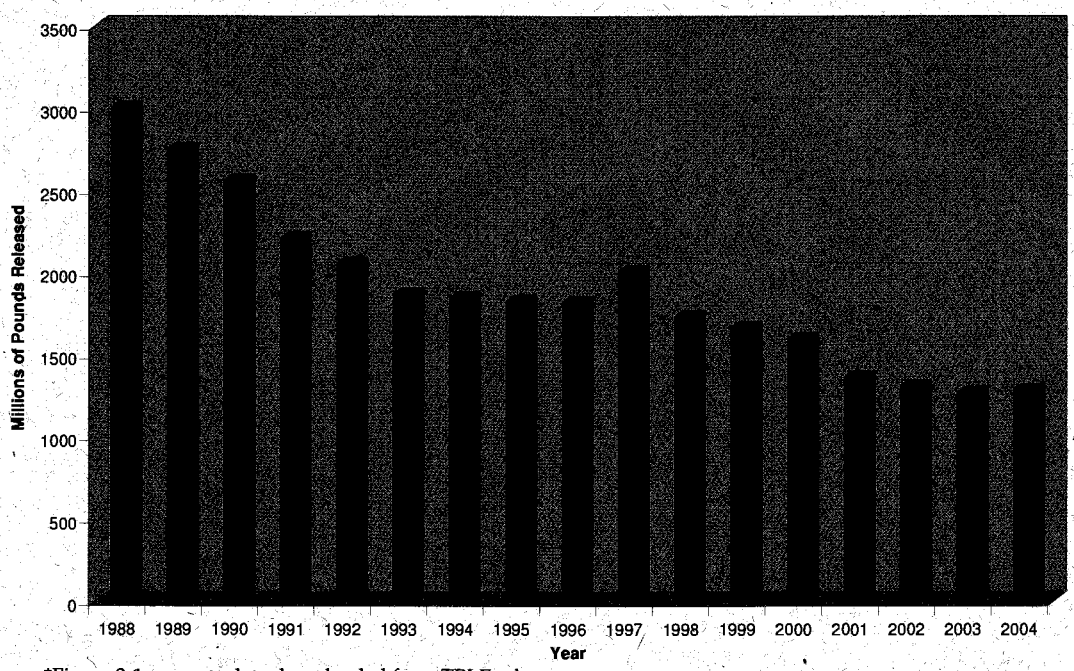

*Figure 3-1 presents data downloaded from TRI Explorer

The TRI Program showed a reduction of over 50 percent in the release of a set of toxic chemicals between 1988 and 2001. A number of factors contributed to this reduction. One key factor was the desire by facilities to reduce their reporting burden. By reducing the use of a chemical targeted by the program, the facility was able to reduce or eliminate reporting requirements for this chemical. Furthermore, the requirement for an inventory and public disclosure of toxic chemical releases was an integral part of the reduction in emissions achieved under the TRI Program. Toxic release information for each company reporting to the program is required, and this information is available on the Internet. The publishing of these data increased public awareness, and therefore public and stockholder pressure, to reduce the release of toxic chemicals. Therefore, it is likely that the reductions for a voluntary program without the mandatory disclosure of inventories would be less than those experienced in response to the TRI program.

Limitations of TRI data:

- TRI chemicals vary widely in toxicity, or their potential to produce toxic effects. Some high-volume releases of less toxic chemicals may appear to be more serious than lower-volume releases of highly toxic chemicals, when just the opposite may be true.

- The potential for exposure may be greater the longer the chemical remains unchanged in the environment. Sunlight, heat, or microorganisms may or may not decompose the chemical. Smaller releases of a persistent, highly toxic chemical may create a more serious problem than larger releases of a chemical that is rapidly converted to a less toxic form.

TRI data can be used as a Public Relation Tool. Environmental progress has become a selling point for industries, and many company web sites now include an environmental report.

3.1.5 TRI Success Stories

TRI success stories include:

- The Haartz Corporation, located in Acton, Massachusetts, makes coated fabrics used in automobiles. The firm once used 800,000 pounds per year of methyl ethyl ketone (MEK), a solvent that can cause dizziness, nausea, or unconsciousness when inhaled. In 1987, when Haartz was preparing its first TRI report, the company installed a new emissions control system to capture and recycle MEK. TRI data enabled Haartz Corp. to track the association between reduced toxic chemical releases and reduced costs. According to the Haartz environmental manager, the company's "emissions have stayed pretty flat" despite its "double-digit sales growth" between 1993 and 1998. In addition, reducing its MEK releases saved Haartz an estimated $200,000 annually.

- Marathon Oil installed a thermal desorption unit to process oily waste and recovered over 120,000 barrels of oil; Georgia Gulf Corporation relocated a methanol stripper

purge line that resulted in the recovery of 9,300 gallons of methanol that previously underwent biological waste treatment.

- Attendees of the 1997 EPA Region III TRI workshop provided reasons for undertaking waste reduction activities. Their most frequent reason given was cost reduction (98% of respondents).

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3.2 USEPA 33/50 Program

The 33/50 Program takes its name from its goal, which was to reduce the releases and off-site transfers of 17 targeted chemicals (Table 3-5) by 50% in 1995 (with an interim goal of 33% by 1992), using 1988 Toxics Release Inventory (TRI) reporting data as a baseline.

Table 3-5. 17 Targeted Chemicals		
Benzene	Tetrachloroethylene	Cadmium and cadmium compounds
Carbon tetrachloride	Toluene	Chromium and chromium compounds
Chloroform	1,1,1-Trichloroethane	Cyanide Compounds
Dichloromethane	Trichloroethylene	Lead and lead compounds
Methyl ethyl ketone	Xylenes	Mercury and mercury compounds
Methyl isobutyl ketone		Nickel and nickel compounds

The program was a voluntary pollution prevention initiative implemented voluntarily in 1991 by a number of large chemical companies in cooperation with the US EPA.

Because the 33/50 Program was voluntary, the EPA sent invitations to companies to solicit their participation. In the spring and summer of 1991, EPA sent invitations to 5,000 companies to participate in the program, focusing on facilities reporting to TRI on any of the targeted chemicals from 1988 to 1994. Another 2,500 more invites were sent over the next three years. EPA concentrated the majority of their outreach on the top 600 companies with the largest releases and transfers. A total of 1,294 facilities (16% of those invited) accepted the invitation to participate in the program.

Participants in the program examined production processes and identified cost-effective pollution prevention practices. The companies were then to write a simple letter to EPA stating their reduction goals and plans. EPA asked that companies focus their reduction/release strategies on their waste management hierarchy, evaluating source reduction first and then looking for opportunities to recycle, treat or dispose of wastes. Any steps taken to reduce the targeted chemicals were not enforceable, unless the activities are otherwise required by law or regulation. The success of the 33/50 Program was measured according to whether reductions have been achieved nationwide, with reductions being looked at as an aggregate of total releases of all 17 targeted chemicals.

3.2.1 Basis for Program

The public release of TRI data in 1988 is the basis for the 33/50 Program. Soon after the first release of TRI data to the public in 1989, public citizen groups placed full page ads in the *New York Times* newspaper highlighting the top ten corporate air, water and land polluters. Some of these companies approached EPA and pledged their commitment to improve their environmental performance, which in effect started the 33/50 Program. (Arora, Cason, 1996)

EPA then conducted high-level meetings with chief executives of major corporations, industry trade associations, and environmental groups, looking for ways to use the TRI data to reduce chemical releases. These meetings led to the 33/50 Program.

The purpose of the 33/50 Program was to demonstrate whether voluntary regulation by the industries could supplement the EPA's traditional command-and-control approach by bringing about targeted reductions more quickly than would regulations alone. This program is an example of voluntary environmental regulation that was national in scope,

involved multi-media (integrating an all media to reduce releases to air, water and land), and was prevention-oriented. The program also sought to foster P2 ethic, encouraging companies to consider and apply P2 approaches to reduce their environmental releases rather than traditional end-of-the-pipe methods for treating and disposing of chemicals in waste.

3.2.2 Program Requirements

There were no specific mandatory guidelines developed by EPA for the 33/50 Program. The companies could set their own reduction commitments that were truly voluntary and not enforceable by law. A company's participation in the program did not preclude it from its responsibilities for complying with all other laws.

The majority of the companies (1,066) set measurable goals/pledges to reduce their releases and transfers of the 17 targeted chemicals, with the companies choosing which of the 17 chemicals they would reduce. Other participants developed goals tied to changes in their production levels, chose alternative baseline years (when the 1988 baseline year was not a representative year for their facility), or set a reduction target for all their TRI reporting without specifying goals for the 33/50 chemicals.

The EPA did not monitor the companies to ensure that their reported figures were accurate. The simple letters sent to EPA stating their reduction pledges or plans was required to be signed by the companies' chief financial officers (CFOs). It was in the CFOs interest to reduce costs for their company; therefore they were interested in the amount of waste reduced or chemicals released from a cost-savings opportunity perspective.

3.2.3 Role of Stakeholders

The EPA, major corporations, industry trade associations and environmental groups all played a part in developing the 33/50 Program. The stakeholders, not the sponsoring agency (EPA), were directly involved in the implementation and program design to meet self-determined reduction targets for one or more of the targeted chemicals. The 33/50 Program was free from government regulations, paperwork, penalties, punishments, and lawsuits. Companies participating in the program voluntarily developed their own goals and plans and provided their reduction commitments to EPA in a simple letter.

3.2.4 Financial Impacts

EPA funded the administrative costs of the 33/50 Program through Pollution Prevention Incentives for States (PPIS) Grants (now referred to as P2 Grants Program) to the states. The 33/50 Program administrative and technical assistance activities were added to the list of other state P2 Programs already funded by the grants.

The voluntary approach of the 33/50 Program avoided the costly process of legislation and the substantial costs of monitoring and enforcement by the regulatory agency. It was also cost effective for those making pollution reductions because it allowed firms to make the most cost-effective emission reductions.

In addition to costs-savings, program participation also included possible public recognition by EPA and special awards for innovators and firms with outstanding P2 achievements. The incentives for a company to participate are the benefits a company derived from a clean

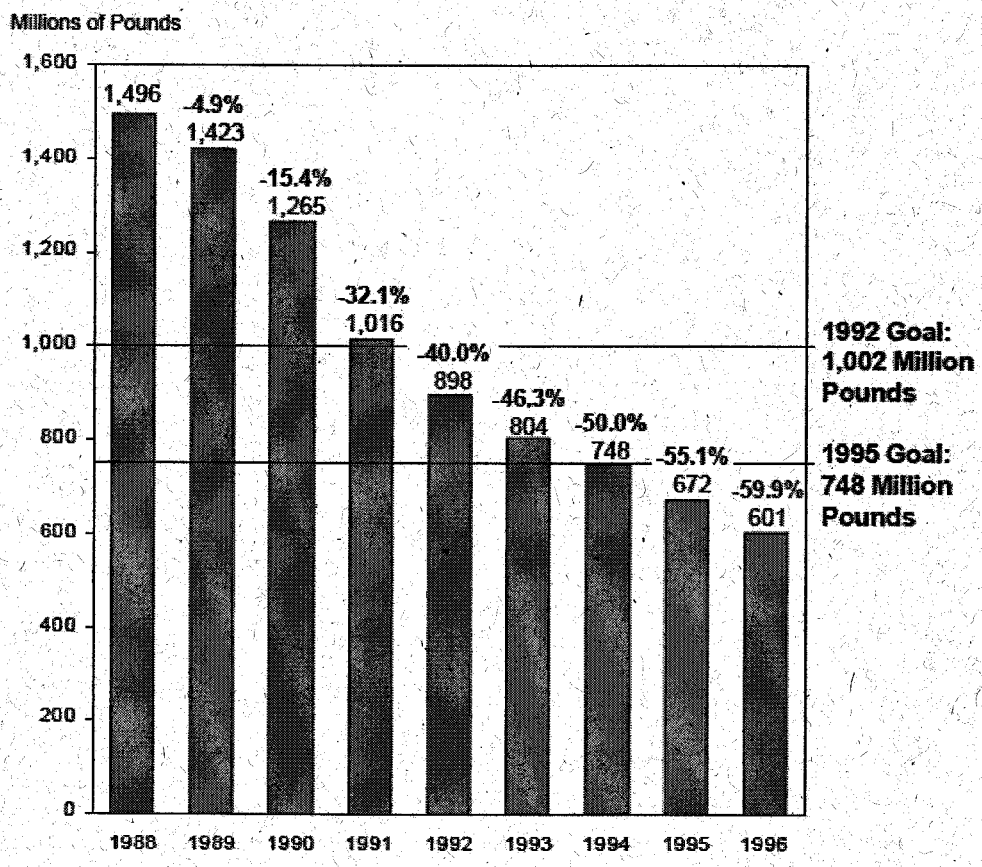
environmental record and was one way for a company to indicate that it was environmentally conscientious.

3.2.5 Effectiveness of Program

The 33/50 Program achieved its goals in 1994, one year ahead of schedule. The program proved to be a successful way for the EPA to partner with industries (instead of their usual command-and-control approach) to effectively reduce toxic chemicals through voluntary regulation. In addition, by focusing on the top 600 companies, with the largest releases and transfers, EPA was able to get 64% of these companies to participate in the program, compared to less than 14% of the smaller companies (EPA, 1999).

The program measured its progress in reducing releases and transfers to treatment, publicly owned treatment works (POTWs), and disposal, based on the original TRI reporting categories. To control for changes in the TRI chemical list over time, year-to-year comparisons are based on a consistent list of chemicals reported in all years 1988 to 1996. Figure 3-2 shows the average percent decrease in releases and transfers between 1988 and 1996.

Figure 3-2. Releases and Transfers of 33/50 Program Chemicals (1988-1996) (Source – 33/50 Final Record)



Note: Does not include amounts for transfers to recycling and energy recovery reported for 1991-1996.

The 17 targeted chemicals in the program outpaced all other TRI chemicals for reductions in releases and transfers (See Figure 3-3 and Table 3-6 below). In a way, the 33/50 Program prioritized the 17 chemicals on the TRI list for reduction, creating very little reduction in other TRI chemicals during the years the program was implemented. Reductions of program's targeted chemicals continued at a higher rate than other TRI chemicals in the year after the 33/50 Program ended.

Figure 3-3. Total Releases of TRI Core Chemicals in the US

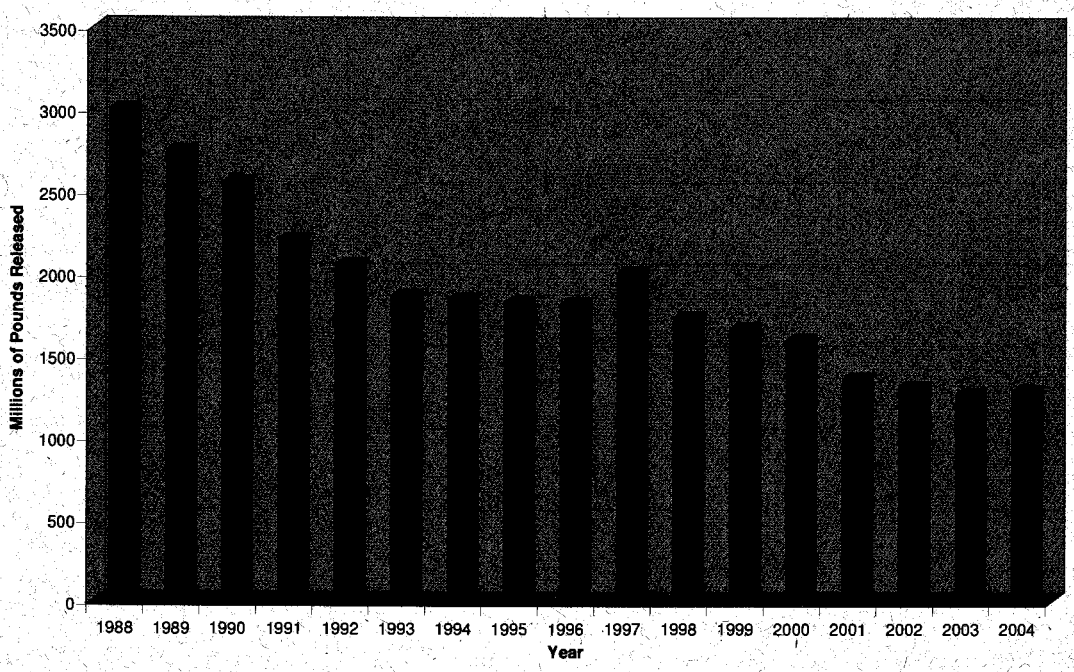


Table 3-6. Releases and Transfers of 33/50 Program Chemicals vs. Other TRI Chemicals, 1988-1996

Year	All TRI Chemicals (Excluding Additions/ Deletions) Pounds	TRI Chemicals Less 33/50 Chemicals Pounds	33/50 Chemicals Only Pounds
1988	4,020,250,532	2,524,122,352	1,496,128,180
1990	3,428,644,482	2,163,382,571	1,265,261,911
1995	2,289,147,796	1,616,832,014	672,315,782
1996	2,216,858,876	1,616,250,453	600,608,423
	Percent Change	**Percent Change**	**Percent Change**
1988-1990	-14.7	-14.3	-15.4
1990-1995	-33.2	-25.3	-46.9
1995-1996	-3.2	-0.04	-10.7

Note: Does not include delisted chemicals, chemicals added in 1990, 1991, 1994 and 1995, ammonia, aluminum oxide, hydrochloric acid, and sulfuric acid. Does not include amounts for transfers to recycling and energy recovery reported for 1991-1996.

During the implementation of the 33/50 Program, an international agreement, the Montreal Protocol, was also in effect to phase-out ozone-depleting chemicals. The chemicals in the 33/50 Program that would have also been affected by the Protocol are carbon tetrachloride and 1,1,1-trichloroethane. Although these chemicals reflected the largest reduction, facilities also reduced releases and transfers of the other 33/50 chemicals by 50% from 1988 to 1995.

Some environmentalists criticized the program as not reducing pollution at the source, but instead at the point of departure from a facility, arguing that any chemical is a potential hazard to workers. They also worried that self-reporting by the companies would not provide accurate figures on chemical releases since companies would have an interest in making their numbers look good (USFDA, 2000).

In a paper published in the *Journal of Environmental Economics and Management*, researchers from the University of Pittsburgh found that the United States Environmental Protection Agency (EPA) voluntary 33/50 industrial toxics reduction program, which uses the TRI to measure progress, only reduced toxics emissions in politically active communities (*Did EPA's Voluntary Industrial Toxics Program Reduce Emissions? A GIS analysis of Distributional Impacts and By-Media Analysis of Substitution*, Vol. 52, Issue 1).

3.2.6 Bibliography

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5. US Food and Drug Administration (USFDA), Center for Devices and Radiological Health, "Outside Leveraging: Creating Relationships Through Partnerships with Stakeholders - Mini Case Study - EPA's 33/50 Program: From Confrontation to Collaboration". http://www.fda.gov/cdrh/leveraging/2.html. Updated May 10, 2000.
6. *Did EPA's Voluntary Industrial Toxics Program Reduce Emissions? A GIS analysis of Distributional Impacts and By-Media Analysis of Substitution*, Vol. 52, Issue 1.

3.3 Massachusetts Toxics Use Reduction Act (TURA)

Massachusetts TURA (1989) requires that large-quantity users of toxic materials submit an annual Toxics Use Report to the Massachusetts Department of Environmental Protection (MADEP) and participate in a planning process designed to reduce their wastes and usage of toxic chemicals. There are four separate organizations in Massachusetts that are responsible for ensuring that the environmental and economic goals of TURA are met:

- Massachusetts Department of Environmental Protection, Bureau of Waste Prevention is responsible for implementing TURA, through review of toxics use reports, enforcement actions, managing toxics use data, and evaluating the state's overall progress.
- Office of Technical Assistance (OTA) is a non-regulatory agency that provides free, confidential, on-site technical and compliance consultation to manufacturers, businesses and institutions. They also develop TUR technologies and sponsor workshops and conferences focusing on TUR for specific industries.
- Toxics Use Reduction Institute, through the University of Massachusetts Lowell campus, provides TUR education and training for professionals and the general public.
- Administrative Council on Toxics Use Reduction is made of seven members representing state agencies and are responsible for environmental protection, public health, occupational safety and economic development.

3.3.1 Reporting Requirements

Regulated facilities in Massachusetts are required to file a toxics use report if they meet all three of the following criteria:

- The facility employs at least 10 full-time employees;
- Conducted business practices activities described by certain SIC codes; and
- The facility is a large quantity toxics user – processed or used a TUR-regulated chemical in excess of reporting thresholds. A facility is considered a large quantity toxics user if:
    - 25,000 pounds of toxic substances was manufactured or processed during the reporting year; or
    - 10,000 pounds of a toxic substance was used during the reporting year; or
    - 100 lbs, 10 lbs, or 0.1 lbs of PBT chemicals [depending on the specific Persistent, Bioaccumulative, and Toxic (PBT) chemical] was manufactured, processed, or used during the reporting year.

3.3.2 P2 Planning

Participating facilities engage in systematic P2 planning by reviewing source reduction opportunities, evaluating feasibility and cost issues, and setting goals for future reductions. Massachusetts TUR reporting supplements the federal Form R Reporting. Facilities submitting a state toxics use report must first obtain federal TRI reporting forms and instructions in order to complete the state toxics use report.

Facility-level materials accounting data and production unit information is reported annually, with the state protecting confidential business information by combining

conventional trade secret protections with the use of data collection and reporting strategies. This approach is designed to allow tracking without the need for public release of sensitive business data.

3.3.3 Technical Assistance

Toxic use reduction technical assistance is provided to industries through the Massachusetts TURI and the OTA. The TURI is a multi-disciplinary research, education, and policy center established by the Massachusetts TURA and is considered to be the education and research component of the TURA program. The Institute sponsors and conducts research, organizes education and training programs, and provides technical support to governments to promote the reduction in the use of toxic chemicals or the generation of toxic chemical byproducts in industry and commerce. (TURI, 2003)

The OTA is a non-regulatory agency with the Executive Office of Environmental Affairs providing assistance to manufacturers and other toxic chemical users to help reduce or eliminate their use or generation of hazardous byproducts. Their services are free and are offered to all businesses that are toxic chemical users in Massachusetts.

3.3.4 Company Examples

Some examples of where manufacturers installed upgrades to their manufacturing processes to achieve a reduction in their use of toxic chemicals under the Massachusetts TURA program are presented in Table 3-7 below. The table also shows cost reductions that have been realized by companies participating in the program.

Table 3-7 Massachusetts Toxic Use Reduction Program	
Company Name	Coyne Textile Services
Company Description	Industrial Laundry Service
Project Description	Discontinued acceptance of saturated laundry that was dripping, installed extractor to remove liquids from laundry prior to washing
Capital/Installation Cost	$60.000
Annual Cost Savings	Over $25,000
Pay Back Period	Less than 3 years
Annual Reduction in Chemical Use	3,500 lb sulfuric acid; 1,200 lb ferric chloride; 15,000 lb potassium hydroxide
Reduction in Air Emissions	Reduced solvent emissions
Additional Benefits	Reduced water use by 2,000,000 gallons per year; increased productivity

Company Name	Cranston Print Works
Company Description	Prints on cotton and blended fabrics
Project Description	Installed liquid carbon dioxide system for wastewater neutralization to reduce the use of sulfuric acid
Capital/Installation Cost	$115.000
Annual Cost Savings	$80.000
Pay Back Period	1.5 years
Annual Reduction in Chemical Use	2.66 million pounds of sulfuric acid
Additional Benefits	Reduced risk of employee exposure, reduced training requirements, improved operational control

Company Name	Poly-Plating
Company Description	Production of nickel plated parts
Project Description	Installed filtration, recycling, and concentration system for waste reclamation
Capital/Installation Cost	$225.000
Annual Cost Savings	$107.000
Pay Back Period	25 months
Annual Reduction in Waste	Reduced disposal costs by 91%
Annual Reduction in Chemical Use	Reduced acid purchased by 96%
Additional Benefits	Reduced water use and sewage fees by 98%; new company was formed to manufacture and sell waste purification equipment

Company Name	V.H. Blackinton
Company Description	Manufactures metallic uniform insignia (badges)
Project Description	Eliminated the use of freon from drying system, replaced brazing furnaces that used ammonia with ones that used hydrogen and nitrogen, and various modifications to plating and wastewater treatment systems
Pay Back Period	3 years
Annual Reduction in Chemical Use	5,000 lb sulfuric acid; 9,000 lb sodium hydroxide; 1,500 lb sodium hypochlorite; 1,900 lb cyanide; 30,000 lb trichloroethane; 20,000 lb ammonia
Additional Benefits	Improved employee safety, reduced water use, reduced reporting burden

3.3.5 Bibliography

1. General Laws of Massachusetts, "*Chapter 21I. Massachusetts Toxics Use Reduction Act*". http://www.mass.gov/legis/laws/mgl/21i-1.htm, Accessed July 31, 2006.

2. Geiser, Ken and Mark Rossi, University of Massachusetts Lowell, "*Toxics Chemical Management in Massachusetts: The Second Report on Further Chemical Restriction Policies*". January 1995.

3. Massachusetts Department of Environmental Protection, Bureau of Waste Prevention, "*2005 Toxics Use Reporting Instructions*".

4. Toxics Use Reduction Institute, University of Massachusetts Lowell, "*TURI Overview, Working to Make Massachusetts Safer for Everyone.*"2003.

3.4 Maine Toxics and Hazardous Waste Reduction Program

The State of Maine Department of Environmental Protection (DEP) encourages an integrated approach to toxics use reduction, toxics release reduction, and hazardous waste reduction based on P2 management strategies as outlined in the State of Main Toxics Use and Hazardous Waste Reduction Law (Toxics Law). (State of Maine, 1989)

- **Toxic Use Reduction** - The state promotes reducing the use of toxic substances through changes in production or other processes or operations, in products or in raw materials that reduce, avoid or eliminate the use or production of toxic substances without creating substantial new or increased risk to public health.
- **Toxic Release Reduction** – The state encourages reducing the release of toxics during manufacturing and other processes.
- **Hazardous Waste Reduction** – The state promotes reducing the generation of hazardous waste through use and release reduction techniques employed by the facility.

3.4.1 Reporting Requirements

Facilities in Maine must meet one or more of the three reporting categories listed below before they are required to report and submit a P2 Plan:

- Hazardous Waste – a facility reports shipping 2,640 lbs of hazardous waste in a calendar year;
- Toxic Use – a facility reports their use of Extremely Hazardous Substances to Maine's Emergency Management Agency (EMA); or
- Toxic Release – a facility reports release of toxic chemicals to EPA's TRI database.

Facilities that ship between 661 and 2,639 lbs of hazardous waste are only required to pay a $100 fee, but not report or develop a P2 Plan.

3.4.2 P2 Planning

P2 planning in Maine is driven by and is encouraged to be in line with the facilities reduction goals. P2 planning development by the facility must also include the facility's employees, management and technical staff that will carry out the plan's recommendations.

The Toxics Law requires regulated facilities to (State of Maine, 2006):

- Develop a P2 Plan;
- Solicit employee input during P2 Plan development;
- Set specified reduction goals;
- Report biannually to Maine's Department of Environment Toxics Program and local municipal officials on the progress made towards meeting reduction goals; and
- Pay an annual fee to Maine's DEP Toxics Program.

3.4.3 Technical Assistance

The Office of Innovation and Assistance offers free compliance, technical and P2 assistance through three main programs P2 Program, Small Business Technical Assistance Program, and the Toxics and Hazardous Waste Reduction Program. OIA provides on-site technical P2 and small business assistance, manages innovative P2 programs, conducts literature searches and financial analysis of P2 projects, and assists in identifying cleaner technologies.

3.4.4 Bibliography

1. State of Main Department of Environmental Protection, "*Toxics and Hazardous Waste Reduction Pollution Prevention (P2) Planning Guidebook*". May 2006.
2. State of Main, Title 38, Chapter 26, "*Toxics Use and Hazardous Waste Reduction Act.*" 1989.

3.5 Washington State Department of Ecology Pollution Prevention Program

The Washington State P2 program applies to all hazardous substance users and to hazardous waste generators who generate more than 2,640 pounds of hazardous waste per year, except for those facilities that are primarily treatment, storage, and disposal facilities or recycling facilities. Applicable facilities must prepare a Pollution Prevention Plan, which is then updated at least every five years.

If a facility has an Environmental Management System (EMS), it can be used instead of submitting pollution prevention planning forms. Information on the development of an EMS can be found at: http://www.ecy.wa.gov/biblio/97401.html

3.5.1 Basis for Program

Under Chapter 173-307 WAC of the Washington Administrative Code, facilities that report under Section 313 of the Emergency Planning & Community Right-To-Know Act (EPCRA), or that generate more than 2,640 pounds of hazardous waste per year, must prepare a Pollution Prevention Plan. These plans are generated on a schedule based on hazardous waste generation levels at the facility.

P2 encourages voluntary efforts to redesign industrial, commercial, production, and other processes to result in the reduction or elimination of hazardous waste by-products and to

maximize the in-process reuse or reclamation of spent material. The act establishes a legislative policy to encourage reduction in the use of hazardous substances and reduction in the generation of hazardous waste whenever economically and technically practicable. The Washington department of ecology provides technical assistance, to the greatest extent possible, to those required to prepare facility plans.

3.5.2 Program Requirements

The purpose of a P2 plan is to consider ways in which processes and procedures may be modified to reduce dependence upon hazardous substances and/or the generation of hazardous wastes. All plans must consider opportunities based on the following priorities: Hazardous substance use reduction and hazardous waste reduction, recycling, and treatment. The plans shall consist of the following four parts:

- **Part 1:** This section includes a statement expressing the facility's commitment to the plan and its goals, and includes the scope and objectives of the plan. It describes the type of facility and products made or services provided at the facility, including the current production/activity level. It provides the total pounds of extremely hazardous waste and total pounds of dangerous waste reported on Form 4, Dangerous Waste Annual Report for the last calendar year, and, if applicable, the total pounds of toxic releases reported on Form R under SARA Title III, Section 313 for the same time period. It also includes a description of current reduction, recycling, and treatment activities and compares these with documentation of any reduction efforts that were took place before the first plan was submitted

- **Part 2:** This section includes an identification of hazardous substances used and hazardous wastes generated by the facility; a description of the facility processes; an identification of reduction, recycling, and treatment opportunities; an evaluation of those opportunities; a selection of proposed options; a policy to prevent shifting of risks; performance goals; and an implementation schedule.

- **Part 3:** This section shall provide a financial description of the plan, which shall identify costs and benefits realized from implementing selected opportunities to the extent reasonably possible. Part three shall also include a description of accounting systems that will be used to identify hazardous substance use and hazardous waste management costs. Liability, compliance, and oversight costs must be components of these accounting systems.

- **Part 4:** Part four of the plan shall include a description of personnel training and employee involvement programs. Each facility required to write a plan is encouraged to advise its employees of the planning process and solicit comments or suggestions from its employees on hazardous substance use and waste reduction opportunities.

The date of submittal of the initial plan at any facility is based on the amount of waste generated by the facility, so that large generators receive priority. Once the initial plan is submitted, it must be updated every five years. If there are any significant changes to the facility or its operations before the five year period is over, the plan must be amended to reflect these changes.

Progress reports must be submitted to the department annually on September 1 after the due date of the plan. The purpose of the progress report is to provide information on quantities of hazardous waste and hazardous substances or products containing hazardous substances in the prior twelve-month period. These progress reports consist of:

- Progress towards any numeric performance goals and a description of reduction, recycling, and treatment opportunities that were implemented.
- A description of the process or processes impacted by each opportunity.
- A description of the quantities, by weight, of hazardous substances or products containing hazardous substances reduced and hazardous waste reduced by each option.
- Discussion of any changes in measurement or estimation techniques
- Problems encountered in the implementation process.

3.5.3 Role of Stakeholders

The Washington State P2 program was developed as a collaborative effort by state Advisory committees, which included representatives from state government, business sectors, and environmental interests. These groups provided feedback to the different phases of the act.

In 1988, the Washington State Legislature passed ESHB 1340, which was codified Chapter 70.95C RCW, and set up a waste reduction technical assistance program. Under this legislation, facilities were required to develop reduction plans, and the agency (Ecology) was required to provide technical assistance for that planning.

In 1990, the state passed ESHB 2390, which revised Chapter 70.95C RCW. This established P2 planning requirements and established a goal to reduce the generation of hazardous waste by 50 percent by 1995. This eventually led to Chapter 173-307 WAC, which outlines the current P2 plan requirements.

Hazardous waste generators must develop their plans to fit their individual situations. Once a draft of the plan is complete, the department may review a plan, executive summary, or an annual progress report to determine whether the document is adequate. If a hazardous substance user or hazardous waste generator fails to complete an adequate plan, executive summary, or annual progress report, the department shall notify the user or generator of the inadequacy, identifying specific deficiencies. The generator then has at least 90 days to complete a modified plan, executive summary, or annual progress report addressing the specified deficiencies. If this modified document is still considered to be inadequate, the department will assign penalty fees.

Once the plan is approved by the department, it is the responsibility of the facility to maintain compliance with the plan. Progress reports are submitted to the department annually. If the department reviews the progress report and feels that the report or the P2 efforts are inadequate, they will give the facility a chance to regenerate the report. If the report is still inadequate, the department will assign penalty fees.

3.5.4 Financial Impacts

Adopting pollution prevention practices and techniques often benefits industry by lowering a company's operational and environmental compliance costs. By preventing the generation of waste, P2 can also reduce or eliminate long-term liabilities and clean-up costs. Furthermore, disposal costs are reduced when the volume of waste is decreased. This leads to a reduction in workplace exposures to hazardous materials which can affect workers' health and productivity. If less waste is produced, there will also be a diminished need for on-site storage space.

Because the costs of the P2 efforts are provided by the facility itself, it is important to evaluate the economic costs and benefits of any potential action. Washington Department of Ecology Publication 95-400, titled "Cost Analysis for Pollution Prevention", outlines tools, methods, and resources for this type of analysis.

The amounts reported for hazardous waste generation and toxic chemical releases are used to calculate an annual fee assessed to planning facilities. WAC 173-307-015(1) provides that hazardous waste recycled on-site or recycled off-site for beneficial use shall not be counted toward the planning threshold amount. A similar provision in the fee regulation, WAC 173-305, excludes recycled waste from the fee calculation. This allows facilities to benefit financially from hazardous waste reductions.

Each year, the state collects a approximately a total of $1.5 million dollars per year, divided among the facilities that generate over 2,640 pounds of hazardous waste annually. The largest hazardous waste generators pay the majority of these fees. However, approximately 400 facilities paid some fees. This includes private and public facilities, including all public 4 year colleges and universities, some private ones, as well as some 2 year colleges.

The Washington Department of Ecology has 15 employees who commit part of their time to P2. Employees at regional offices focus on assisting facilities with their P2 plan updates. These employees dedicate much of their time from April to September working with these facilities. Once the plans and progress reports are submitted, employees in the headquarters office spend most of September through December reviewing these plans.

The P2 Program expenditures are approximately $4,000,000 per year. These expenses are funded primarily from two sources; an education fee of $46/year per facility, and an additional fee charged to large hazardous waste generators.

3.5.5 Effectiveness of Program

Different facilities have varying success with P2, depending on their processes. Some facilities have been able to bring themselves below the planning thresholds, based on changes implemented through the P2 program. Other facilities with older or more specialized processes have not found cost effective methods or materials to modify their processes.

An analysis performed by the Washington Department of Ecology indicates that between 1990 and 2003, the goal of an overall decrease of 50% in the amount of recurrent hazardous waste generated in the state of Washington was met. Per capita waste generation has also decreased from 52 pounds/year in 1990 to 17 pounds/year in 2003. These decreases are due to a variety of reasons. Some companies and industries have closed, due to economic

factors. This inherently decreases hazardous waste generation. However, most industries continue to experience economic growth while decreasing their hazardous waste output.

Statistics between 1990 and 2003 show a steady decrease in waste generation. The current state of the program indicates that these numbers will continue to decrease in the future.

3.5.6 Bibliography

1. Washington State Department of Ecology, "EPA Pollution Prevention Guide", http://www.ecy.wa.gov/programs/hwtr/P2/p3additional.html. Accessed November 6, 2006.
2. Washington State Legislature, "Chapter 173-307 WAC, Pollution Prevention Plans", http://apps.leg.wa.gov/WAC/default.aspx?cite=173-307. Accessed October 31, 2006.
3. Washington State Hazardous Waste and Toxics Reduction Program, Ecology Information Document. "*Cost Analysis for Pollution Prevention*". Publication Number 95-400. Revised, April 2005
4. Washington State Department of Ecology, "Pollution Prevention in Washington State", http://www.ecy.wa.gov/programs/hwtr/p2/whatisp2.html. Accessed October 31, 2006.
5. Washington State Department of Ecology, "Pollution Prevention Planning in Washington State", http://www.ecy.wa.gov/programs/hwtr/p2/p3.html. Accessed October 31, 2006.

3.5.7 Company Example 1

The following subsection summarizes a discussion with Marine Industries Northwest, Inc. (Tacoma, Washington), which is required to comply with the Washington State Department of Ecology Pollution Prevention Program regulations. The goal of the discussion was to gain a better understanding of the background of the state program and its associated advantages and disadvantages.

Marine Industries Northwest, Inc.

http://www.mininw.com

Tacoma, Washington

Point of Contact

Richard G. Webster
Safety and Environmental Director
313 East F Street
Tacoma, WA 98401
(253) 627-9136
finance@mininw.com

Participants in the Visit

CETESB Participants

Lineu José Bassoi, Director of Environmental Engineering, Technology and Quality
Angela de Campos Machado – Mngr, Dep. of Env. Development, Technology and Risks
Meron Petro Zajac - Manager of the Division of Clean Technologies and Laboratory Quality

CH2M HILL

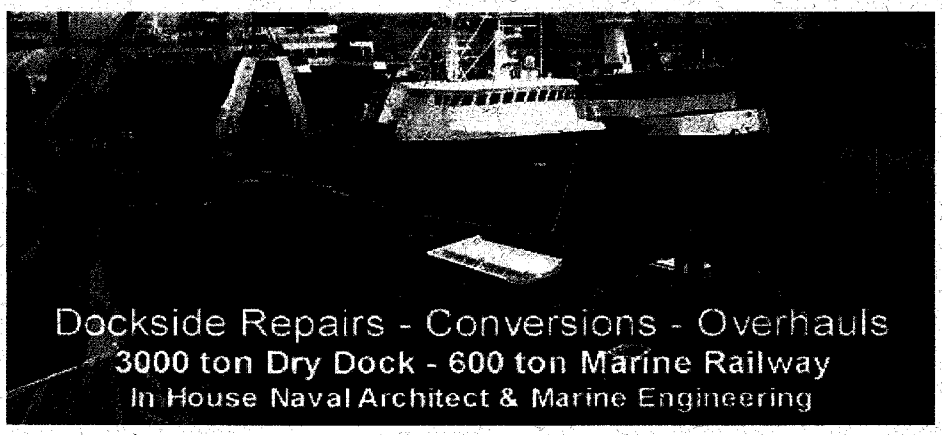
Tom Higgins, Project Manager
Steve Engleman, Project Engineer
Lucilla Telles, Local Project Coordinator

Marine Industries Northwest, Inc.

Richard G. Webster, Safety and Environmental Director

Facility Background

On September 12, 2006, the staff from CETESB visited Marine Industries Northwest, Inc. (MINNW). MININW operates a ship repair facility in Tacoma, Washington.



The facility conducts dockside repairs, conversions, overhauls, and voyage repairs. Site activities include hull repair, pipe fitting, electrical work, wood joiner work, machining, and surface coating.

At the time of the visit, the site had been notified that it triggered the requirement to prepare a pollution prevention plan due to the amount of hazardous waste it generated (over 2600 pounds per year). The primary waste streams include paint and solvents.

Site Visit Activities

Mr. Webster provided an overview of facility operations and led a tour of the facility. The facility tour was followed by a discussion of the Washington P2 Program and how the state program affects the MININW facility.

Key Points

Below are the key points that were discussed during the site visit. These key points are specifically related to toxics use reduction approaches and strategies.

WA Toxics Use Reduction Program –

- Site personnel were in the early stages of understanding the requirements of the program.
- The facility views good environmental management as a cost saving measure. The facility looks for waste products that have a market to reduce the overall cost to the facility.
- Mr. Webster stressed the importance of having the application of a pollution prevention regulation be applied uniformly. This would allow for the fair application of requirements across industries and geographical boundaries.

3.5.8 Company Example 2

The following subsection summarizes a discussion with Kenworth Truck Company (Renton, Washington), which is required to comply with the Washington State Department of Ecology Pollution Prevention program regulations. The goal of the discussion was to gain a better understanding of the background of the state program and its associated advantages and disadvantages.

Kenworth Truck Company, a Division of Paccar Inc.

www.kenworth.com

Renton, Washington

Point of Contact

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Senior Facilities Engineer
1601 N 8th Street
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Renton, WA 98057-9001

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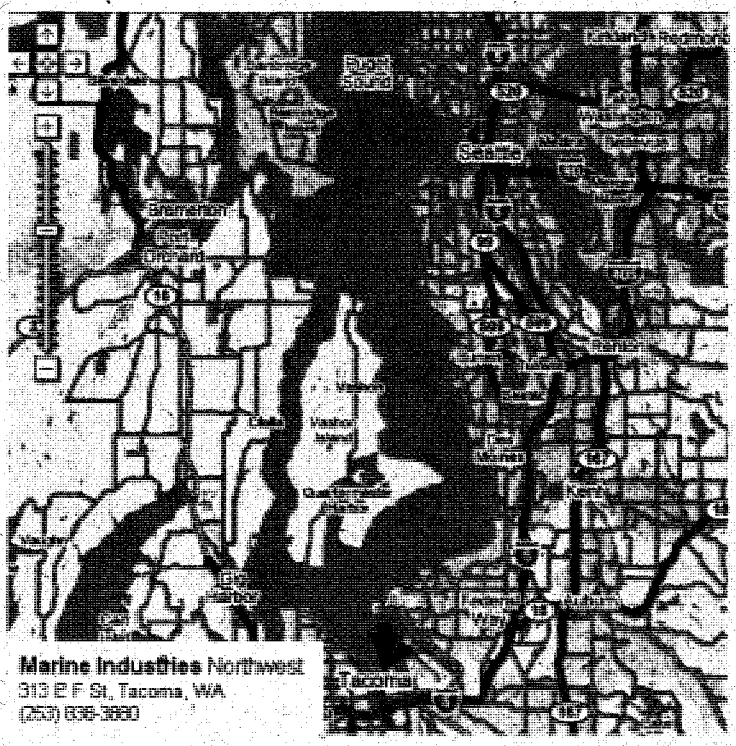
Rich.Sklar@Paccar.com



Participants in the Visit

CETESB Participants

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Meron Petro Zajac - Manager of the Division of Clean Technologies and Laboratory Quality

CH2M HILL

Tom Higgins, Project Manager
Steve Engleman, Project Engineer
Lucilla Telles, Local Project Coordinator

Kenworth

Richard A. Sklar, Senior Facilities Engineer

Facility Background

On September 13, 2006, the staff from CETESB visited Kenworth Truck Company (Kenworth). Kenworth operates an

assembly plant in Renton, WA for medium and heavy duty trucks.

Each truck is assembled according to custom specifications provided by the customer. Parts are not fabricated by Kenworth, but are delivered by other suppliers for assembly by Kenworth , usually on a moving production line. The facility conducts some surface coating activities that are conducted both manually and by robotic systems.

Kenworth is a proponent of the Toyota Lean Manufacturing approach. The parts requirement for each truck is maintained in a computer system that tracks the parts demand at each stage in the production line process. Parts inventory in the facility is kept low and "just in time" for assembly. According to Mr. Sklar, the parts inventory is turned over approximately 35 times per year which means that parts are generally present at the facility for approximately 10 days before use.

Hazardous material inventory is kept low using the same principles. Hazardous materials at the facility consist mainly of coatings and solvents. In addition, the inventory of hazardous materials at each work station is limited to a 1 day supply. The remaining inventory of hazardous materials is stored in a secured area. According to Mr. Sklar, this practice results in the more controlled use (i.e. limits over-application and use) and also reduces the amount of hazardous waste generated. Hazardous material purchasing is further reduced by the use of a solvent recycling system that allows the reuse of waste solvent after distillation at the facility.

Hazardous material use is strictly controlled by Kenworth's hazardous material procurement process. Before a new material can be purchased, detailed information must be provided that indicates the chemical composition, how the product will be dispensed and used, as well as the disposal method. The material must then be approved by the environmental department (for compliance and disposal concerns), facilities (for material storage concerns), and by the safety department (for employee exposure issues). The process of evaluating the need for a new material therefore restricts the introduction of new hazardous materials unless there is sufficient justification and no alternative material or manufacturing method.

It should be noted that the facility has restricted the use of toxic materials to avoid being subject to requirements that apply when certain regulatory thresholds are exceeded. By reducing the regulatory burden of the facility, the costs associated with hazardous material management, regulatory reporting, and control equipment is significantly reduced.

- **TRI Data Summary**

Environmental Releases, Transfers, and Production-Related Waste (Pounds from TRI sources)

Year	Air Releases	Water Releases	Land Releases	Underground Injection	Total Environmental Releases	Total Off-Site Transfers	Total Production-Related Waste
1993	28,037	0	0	0	28,037	8,100	72,407
1994	72,474	0	0	0	72,474	21,000	176,914
1995	117,882	0	0	0	117,882	41,881	260,267
1996	104,321	0	0	0	104,321	48,500	237,061
1997	121,231	0	0	0	121,231	115,000	284,581
1998	136,276	0	0	0	136,276	127,800	427,886
1999	116,822	0	0	0	116,822	87,000	329,882
2000	38,549	0	0	0	38,549	59,701	152,050
2001	13	0	0	0	13	12,000	12,013
2002	24	0	0	0	24	14,000	14,024

"NA" means that no data are available because "Total-Production Related Waste" was not reported until 1991.

Source – Scorecard The Pollution Information Site (http://www.scorecard.org)

Site Visit Activities

Mr. Sklar provided an overview of facility operations and led a tour of the facility. The facility tour was followed by a discussion of the Washington P2 Program and how the state program affects the Kenworth facility.

Key Points

Below are the key points that were discussed during the site visit. These key points are specifically related to toxics use reduction approaches and strategies.

WA Toxics Use Reduction Program –

- Richard pointed out that by strictly controlling the use of hazardous materials through a hazardous materials procurement process, the facility reduced the costs associated with the use of hazardous materials.
- The state of Washington is currently switching to an electronic reporting system for its P2 program. It was noted that this system had many programming bugs and it was recommended that these bugs be worked out prior to implementing a new system.
- Richard noted that the P2 program requires that toxic discharge goals be set based on absolute emissions. Because emissions are dependent on production levels, he recommended that the emission goals should be tied to a unit production value.
- In closing, Richard pointed out that the facility operates under a profit motive and that toxics use/waste reduction is viewed as a cost saving measure.

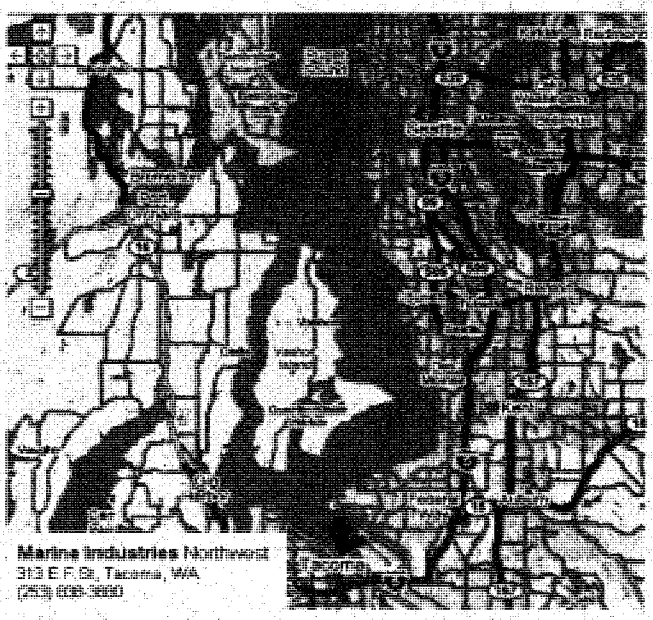
3.5.9 Company Example 3

The following subsection summarizes a discussion with Genie Industries, Inc. (Redmond, Washington), which is required to comply with the Washington State Department of Ecology Pollution Prevention program regulations. The goal of the discussion was to gain a better understanding of the background of the state program and its associated advantages and disadvantages.

Genie Industries, Inc, a TEREX Company

www.genieindustries.com

Redmond, Washington



Point of Contact

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Director, Environmental Services and Community Affairs
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CH2M HILL

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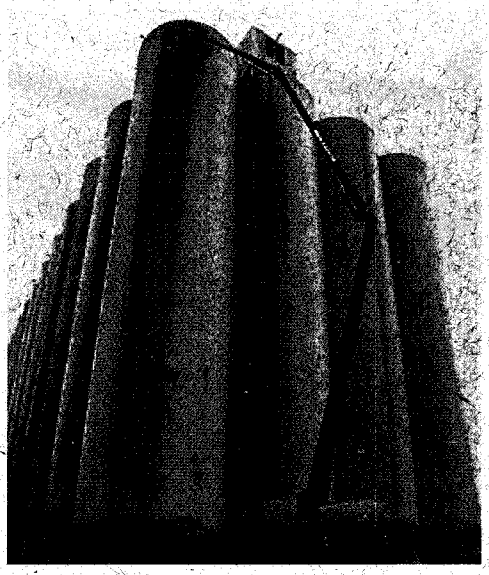
Genie Industries

Michael Johnson
James Hanley, Environmental Compliance Manager
Sarah Hanson, Chemical Engineer



Facility Background

On September 14, 2006, the staff from CETESB visited Genie Industries. Genie Industries manufactures aerial work platforms, scissor and material lifts, and stick, articulated, and trailer mounted booms. Sizes vary from small scissors lift platforms that are moved around a facility by hand to large motorized boom type lifts capable to lifting several people and equipment to more than 130 foot elevation.

The processing facility takes raw sheet metal and small parts, and through machining, welding and assembly and final finishing produces complete units in a number of assembly lines, each dedicated to a given size and type of unit.

Genie is a proponent of the Toyota Lean Manufacturing approach, although they implement it by relying on visual cues for ensuring that the right materials are available to the assembly line in just in time delivery, rather than using computers on the shop floor. They use a number of rolling masked boards with visual space for each of the parts required for a given piece of equipment. These are kept filled by "water Striders" who spot an empty board and goes to the bins to replenish the board for the next unit and return it to the assembly line in the right position. Visual cues trigger reorder of parts.

They use extensive system of keeping track of productivity, level of waste, and make it continuously available to the work force.

- **TRI Data Summary**

Environmental Releases, Transfers, and Production-Related Waste (Pounds from TRI sources)

Year	Air Releases	Water Releases	Land Releases	Underground Injection	Total Environmental Releases	Total Off-Site Transfers	Total Production-Related Waste
1998	17,016	0	0	0	17,016	0	33,271
1999	18,889	0	0	0	18,889	0	18,889
2000	14,622	0	0	0	14,622	0	14,622
2002	96	0	52	0	148	22,235	22,383

"NA" means that no data are available because "Total-Production Related Waste" was not reported until 1991.

Source – Scorecard The Pollution Information Site (http://www.scorecard.org)

Site Visit Activities

Mr. Johnson introduced the group to the product line and roles and responsibilities he has as the environmental services director. He pointed out that he and his staff wears dual-hats, responsible for environmental compliance, but also for plant process engineering. He implements any process changes based on environmental as well as economic and technical bases.

Key Points

Below are the key points that were discussed during the site visit. These key points are specifically related to toxics use reduction approaches and strategies.

WA Toxics Use Reduction Program –

- Michael recommended that any Toxics Use Reduction program should be kept simple, and that the Washington system was complex, with too many different individuals requiring reports from the facility.
- He preferred the Washington approach for reporting on toxics chemicals use reporting over NJ, in that WA only requires reporting on reductions, not use of all chemicals, which is "good news", as opposed to keeping track of all uses and needing to justify.
- He liked the WA P2 requirements in that they "make you think" of means to reduce waste, something that is his company's goal, whether the state program existed or not. He supported the Washington approach to reporting as well.

3.6 Technical Resources for Engineering Efficiency (TREE) Program

The TREE program began in 1998, when it was recognized that a system was needed to work with companies in a proactive manner, to keep them from falling out of environmental compliance and to assist in reducing resource use. It is a voluntary program offered by the Washington Department of Ecology, designed to look at the overall operations of a facility and identify specific areas that can be altered to improve both environmental performance and industrial efficiency. This involves site visits, interviews, research, and report-writing. Once potential improvements are identified, it is up to the company to implement the changes. The suggested changes are targeted at inefficiencies and waste minimization at the facility. Examples of suggested changes include reuse of water, chemicals or other materials; chemical substitutions; multiple processes that can be combined into one process; changing the order of processes in an operation; improving housekeeping and maintenance; working with outside organizations; and other systematic and organizational changes.

3.6.1 Basis for Program

The TREE program is a voluntary process designed to benefit individual companies. Assistance is targeted to industrial facilities who do not have their own engineering staff available. TREE has worked with facilities having 4 to 500 employees. If a company feels that their organization could profit from an analysis, it is their responsibility to contact the TREE team. Once a company contacts the Washington Department of Ecology, they meet for an initial evaluation. During this meeting they discuss site specifics and the expectations of both the company and the TREE team. Based on this meeting and any other information provided by the company, the team decides whether their resources match the needs of the company, and if they will be able to increase the efficiency of operations at the company. The company decides if they are interested in pursuing the project.

3.6.2 Program Requirements

Once a company is selected to work with the program, they are assigned a team of three to five members. The composition of the team varies depending of the specific issues at the company.

The TREE team has personnel with expertise in chemical engineering, water and wastewater treatment, solid waste minimization, water resources, air emission treatment and spill

prevention. The company that is undergoing assessment provides man-hours and any necessary material analyses for the assessment, along with any costs associated with the eventual improvements. The Washington Department of Ecology provides the man-hours of their staff. This assessment is not an environmental audit. If the TREE team identifies an environmental violation while onsite, that information cannot be used in enforcement. TREE will inform the company of violation and suggest ways to solve the issue. The TREE team will generally spend 300-350 hours working on each project. This includes time in the facility (generally 3-7 days), travel, research, and report-writing. The assessment consists of both onsite and offsite analysis. The team inventories what the company is doing, and collects any necessary information on the specific process units contained in the facility. They look at chemicals that are the most toxic, and the most used. Some of the industries are common, some are unique. The team also identifies possible changes through interviews. One of the most valuable sources of information is interviews with facility staff. Workers at the facility are intricately familiar with its processes. This does not just include management personnel.

At the end of the analysis, the team compiles a report for the facility. It is the facility's decision as to whether or not they will implement the changes. Not all changes are implemented. This can be due to organizational or management changes within the company, budget constraints of the company, or other decision-making factors within the company.

After the analysis is complete, an estimate is developed comparing the one-time investment costs to the annual saving incurred by implementing all the changes. Although the specific numbers vary, the initial investments are generally recouped within a year. The one-time investment cost does not include man-hours spent on the analysis. The company specifies the return on investment that they would prefer and TREE provides only those suggestions which will meet that payback period. Payback period that the companies specify is typically 18 to 24 months.

One year and two years after the analysis, follow-up interviews are conducted. These provide qualitative information. No follow-up quantitative analysis is performed.

3.6.3 Role of Stakeholders

The TREE program was developed by the Washington Department as an offshoot of its technical assistance program based on the needs and feedback of industry.

The program is an effective networking tool between the Washington Department of Ecology and individual industries. It affects both groups in a positive way, by building relationships and increasing environmental awareness. It also positively affects the population of the state of Washington, by reducing the pollution in their environment.

Some companies that might wish to take part in this program will not be able to. The needs of the company have to match the resources of the team in order for an analysis to be effective.

3.6.4 Financial Impacts

The TREE program does not have its own source of funding. Participants from the Washington Department of Ecology come from various departments within the agency.

Each department essentially "donates" the labor and expenses (which include local travel and some minimal equipment) from its existing budgets. The cost to participating industries is limited to the labor hours required to interact with TREE staff. The facility is not required to implement the recommendations from the program. However, the recommendations typically involve a capital investment that provides a payback within a few years. Recommended improvements, if implemented, have estimated potential savings of over $1 million per year for Washington businesses since 1998.

During the analysis phase, the team evaluates methods to combine processes and reduce the use of toxic and prolific chemicals. In order to receive buy-in from the company, they have to demonstrate that the changes are not only environmentally beneficial, but also economically beneficial. The estimated savings of past analyses have shown up to a sevenfold return of investment within the first year. Because it is up to the companies to implement their own changes, the suggestions have to be realistic in scope.

3.6.5 Effectiveness of Program

The environmental and occupational health impacts based on historical recommendations would stem from the reduction in the use of water and the generation of hazardous waste.

The TREE team aims for 10-15% design level in their evaluations. Because this is a free program, they do not have the resources to analyze all the systems and potential systems in the facility, along with all the potential side affects of any change. If the company feels that they need this service, they can hire an outside engineering firm or vendor.

The use of an outside organization leads to a fresh look for the facilities in the program. In addition, because the program is voluntary, the assessors offer an unbiased viewpoint to the process. The analysis of each company's needs that is performed before the project begins focuses this program on those companies that will benefit the most. However, as the program develops, it will be helpful to expand the expertise and the marketing of the program. Smaller businesses, which are the ones which are most likely to need a program like this, are the ones that are the least likely to hear about it.

The TREE program initially consisted of two part-time staff. Today, there is the equivalent of one to one and a half full time employees dedicated to this program. It is also expanding its scope. The Washington Department of Ecology recently added an air quality expert to their staff, who will help them expand to help companies with air quality issues. They also feel that it would benefit from an energy expert. The fact that the program continues to grow is a testament to its success.

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3.6.7 Company Examples

Some examples of where manufacturers installed upgrades to their manufacturing processes to achieve a reduction in their use.of toxic chemicals under the TREE program are presented in Table 3-8 below. The table also shows cost reductions that have been realized by companies participating in the program.

Table 3-8 - Washington Department of Ecology Technical Resources for Engineering Efficiency Program

Company Name	Encompass
Company Description	Reclaim services for silicon wafers
Project Description	Reduce HF use in baths and recycle water
Annual Cost Savings	$30,000 - $80,000
Pay Back Period	0 - 15 months
Reduction in Hazardous Waste Generation	38,700 lb/yr
Additional Benefits	Savings of up to 6.5 million gallons per year of water

Company Name	Prototron
Company Description	Printed circuit board manufacturer
Project Description	Water saving measures and wastewater treatment system improvements
Annual Cost Savings	$56.600
Pay Back Period	6-9 months
Reduction in Hazardous Waste Generation	11,000 pounds
Additional Benefits	Water savings

Company Name	Skills, Inc.
Company Description	Metal Finishing
Project Description	Process improvements in chemical finishing and painting lines
Annual Cost Savings	$52.900
Pay Back Period	Less than one year
Reduction in Hazardous Waste Generation	3,700 gal/yr
Additional Benefits	Water savings of 1.6 million gallons per year

3.7 Lean and the Environment Program (Washington State Program)

Lean Manufacturing is the reduction of waste and the increase of efficiency in a production operation. These changes are based on economic benefits to a company, and minimize any activity that does not directly contribute to the product or service that is being manufactured or provided. That covers more than just materials; it could be down or wait time, rent and utilities for unnecessary facility space, or dealing with defects. Once a production operation is streamlined, environmental benefits occur indirectly. Because Lean Manufacturing does not have a specific environmental focus, it can miss opportunities for environmental source reduction. In 2006 the EPA funded a Lean and the Environment pilot project to develop a non-regulatory approach for managing pollution prevention and waste management at manufacturing companies, in order to improve and sustain their competitiveness and profitability, and reduce the need for regulatory compliance. The Washington Department of Ecology worked with the EPA and Washington Manufacturing Services (WMS) to provide Lean Environmental assistance and training to facilities in Washington State. WMS, the Washington State center for the Federal Manufacturing Extension Partnership program under the National Institute of Standards and Technology (NIST MEP) is a not-for-profit organization with the goal of increasing the competitiveness of Washington manufacturers.

This pilot program has three participating companies. These companies manufacture cabinets, fiberglass tubs, and paint. This program is designed to take the principals of lean manufacturing and apply them to these companies in a way that also improves environmental management. Work has been completed with the cabinet manufacturing company. The second project has commenced, and the third project has just started.

The goals of the pilot program are to:

- Develop a collaborative partnership between the State Dept of Ecology and WMS
- Integrate environmental tools with lean practices.
- Identify and reduce material and resource wastes and risks at 3 pilot companies

3.7.1 Basis for Program

Companies were chosen for the program based on several criteria. They had to agree to the publicity associated with the pilot program. The names of the companies and an analysis of the process at each facility will be included in both Department of Ecology and WMS documentation. The companies will also be expected to testify to the state legislature in regards to the effectiveness of the program. Each company chosen had to have processes and products in their operating systems that would benefit significantly from both lean and environmental improvements. If the company could only make changes in one of these areas, then it would not be considered for the program. Size and industrial classification were not directly considered, but instead factored into the potential changes. The Department of Ecology and WMS contacted likely candidates within Washington and encouraged them to apply, then chose the top three applicants based on the criteria listed above.

3.7.2 Program Requirements

Lean Manufacturing is based on the idea of Kaizen – or continual improvement. This refers to the continuous, incremental improvement of production activities. Kaizen is broken down into three phases.

Phase 1: Planning and Preparation
Phase 2: Implementation
Phase 3: Follow-up

Value Stream Mapping is used during the implementation phase of the Kaizen process. Value Stream Mapping is a Lean process-mapping method for understanding the sequence of activities and information flows used to produce a product or deliver a service. It involves site visits to the facility and interviews of facility personnel. Lean practitioners use Value Stream Mapping to:

- Identify major sources of non-value added time in a value stream;
- Envision a less wasteful future state; and
- Develop an implementation plan for future Lean activities.

Lean and the Environment work at the cabinet manufacturing facility included a week-long value stream mapping (VSM) workshop and three week-long kaizen events. Operations in the facility were broken down into two separate processes, with a team assigned to each process. All events were conducted between May and August 2006. During value stream mapping and kaizen events, WMS facilitated the events and conducted overall project management for the site. Ecology staff was on-site for every day of the lean events, and a minimum of one Ecology person participated on each team at all times. The team leaders and the rest of the team participants were facility staff.

The value stream mapping workshop at the cabinet manufacturing facility was conducted over five days and included four components: (1) training, (2) analysis and mapping of the "current state" of the finishing department and the production line, (3) development of "future state" value stream maps and associated implementation plans, and (4) report-out presentations from both teams and a debrief meeting. The workshop was extended by two days (Value Stream Mapping workshops are generally three days) to support additional process mapping and analysis of environmental wastes and costs. About 30 facility staff attended the training. Systems at the facility were broken into two specific processes, with a team for each one. Eight or nine facility staff participated in each of the two teams during the rest of the week.

The kaizen events occurred over three separate weeks, with several weeks in between each kaizen. The first kaizen began with a day of training on lean methods useful for kaizen events. From there, teams brainstormed, planned, and prioritized on actionable items for each week, and accomplished the changes using a set of lean and environmental tools. At the end of the project, the cabinet manufacturing facility had implemented many of the identified changes, and planned to implement more in the future.

It is assumed that the other two facilities will have similar timelines and participation requirements.

3.7.3 Role of Stakeholders

This program is a collaborative effort. It is a voluntary program which exists because of the potential benefit that it will provide to the state and to private facilities. It has developed through a partnership between the EPA, the Washington Department of the Environment, and WMS. There is a steering group consisting of Ecology and WMS staff, and an Advisory/Support group consisting of EPA staff. Each project has a project manager and a project supervisor.

The role of WMS is to provide training, and assist with assessment and improvement projects. The role of the Department of Ecology is to identify environmental wastes and risks and P2 opportunities, and provide regulatory assistance. These two groups, along with the EPA, provide some level of funding.

The role of facility staff is to attend and participate in all analysis, and implement the suggestions during and after the kaizen events.

3.7.4 Financial Impacts

This program is partially funded through an EPA demonstration grant. This provides funds to each of the ten EPA regions for regional EPA offices and state environmental organizations to develop new, groundbreaking environmental projects.

For work at the cabinet manufacturing company, the Department of Ecology and the EPA spent $58,000 on consulting time, personnel training, and overhead. Of this money, $21,700 came from the Department of Ecology, $31,600 came from the Pollution Prevention Grant, and $4,700 came from EPA Innovations Office funding. The Pollution Prevention Grant is comprised of 50% EPA funding, and 50% Department of Ecology Funding. The cabinet manufacturing company spent a total of $258,000. This was broken down into $42,000 spent on labor for the Lean events and $6,000 spent on WMS services, with the rest spent on capital investments.

Because of the streamlining process that is inherent to Lean Manufacturing, operating costs at a facility will decrease once the program is in place. This could be due to less staff, a shorter processing time, less undesired product, or many other reasons. It also results in a reduced waste stream, which lowers processing, regulatory, and disposal costs. As of September 2006, the cabinet manufacturing facility is expected to save $1,090,947 annually in cost, time, material, and environmental savings from actions implemented during the pilot project (May – August 2006), and is expected to save an additional $465,618 annually from actions pending implementation.

3.7.5 Effectiveness of Program

The Washington State Department of Ecology Toxics Reduction Advisory Committee recently published a Findings and Recommendations document in December 2008. Washington's pollution prevention (P2) program over the last 20 yrs has reduced hazardous waste and hazardous substance use by 200 million pounds, saving over $400 million, 11 times more than the total revenue generated from the P2 planning fee during the same time period. For every dollar businesses invested in P2, most observed a $6 return through cost savings and efficiencies.

However, there are still some limitations to this program. It is a workload intensive program that relies on an ongoing partnership. Additional funding sources may be required for the program to continue in the event that EPA funding is no longer available. It is dependant on facilities that have a potential for both lean and environmental improvement.

Because Lean Manufacturing does not specify that it will focus on environmental improvements, it sometimes does not take advantage of these opportunities. If environmental regulatory requirements are not considered in the Kaizen process, the changes may not satisfy these requirements. New environmental risks or hazardous waste streams may be generated, and P2 opportunities may be lost. This program ensures that these opportunities are utilized.

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3.7.7 Company Examples

Some examples of where manufacturers installed upgrades to their manufacturing processes to achieve a reduction in their use of toxic chemicals under the Lean and the Environment program are presented in Table 3-9 below. The table also shows cost reductions that have been realized by companies participating in the program.

Table 3-9 - Lean and the Environment Program	
Company Name	Canyon Creek Cabinet Company
Company Description	Wood cabinet manufacturer
Project Description	Through LEAN Kaizen events, employees identified production efficiency measures, and improved and upgraded staining operations to reduce toxic chemical use
Project Costs to Company	$258.000
Financial Incentive Provided	$58,000 in agency consulting costs
Annual Cost Savings	$1.2 Million
Reduction in Hazardous Substance Use	68,720 pounds
Reduction in Hazardous Waste Generation	84,400 pounds
Reduction in Air Emissions	55,130 pounds of solvent
Additional Benefits	Increased productivity, increased quality, reduced regulatory burden, reduced worker exposure, improved ergonomics, increased employee morale, reduced floor space needed for production, reduced solid (nonhazardous waste) production

Company Name	Columbia Paint and Coatings
Company Description	Paint and Coating Manufacturer
Project Description	Through LEAN Kaizen events, employees identified production efficiency measures
Project Costs to Company	$17.100
Financial Incentive Provided	$54,000 in agency consulting costs
Annual Cost Savings	$138.600
Reduction in Hazardous Substance Use	15,000 lb paint/yr
Reduction in Hazardous Waste Generation	2,820 pounds/yr
Additional Benefits	Increased productivity, increased quality, improved employee safety, improved staff morale, reduced wastewater generation

Company Name	Columbia Paint and Coatings
Company Description	Paint and Coating Manufacturer
Project Description	Through LEAN Kaizen events, employees identified production efficiency measures
Project Costs to Company	$17.100
Financial Incentive Provided	$54,000 in agency consulting costs
Annual Cost Savings	$138.600
Reduction in Hazardous Substance Use	15,000 lb paint/yr
Reduction in Hazardous Waste Generation	2,820 pounds/yr
Additional Benefits	Increased productivity, increased quality, improved employee safety, improved staff morale, reduced wastewater generation

3.8 Washington Department of Ecology (DOE) Persistent, Bioaccumulative Toxins (PBT) Program

Established by the Washington Department of Ecology (DOE) in 2000, the Ecology's Persistent, Bioaccumulative Toxins (PBT) program was implemented to phase out all sources of persistent toxic chemicals through specific state actions, focusing on one PBT at a time. The primary goals established by the Ecology's PBT program to reduce the use and prevent the pollution of PBTs are:

- Development of alternative materials used in products and industrial or manufacturing processes;
- Incremental and continuous improvements in pollution reduction through better science and processes, technical assistance and use of regulatory tools; and
- Additional guidance and direction to agencies by Washington Legislature.

The first persistent toxic chemical the program has focused on is mercury. Mercury was made the highest priority PBT chemical in Washington due to its widespread use and ease of release into the environment. A Mercury Chemical Action Plan was prepared (and implemented) outlining strategies to reduce the use and pollution of mercury. WA DOE is currently seeking to develop chemical action plans for three additional chemicals over the next three years. At the time of this tech memo, the Draft PBT Chemical Action Plan Schedule was under public review and comment.

WA DOE is also planning to adopt a new rule, Chapter 173-333 WAC Persistent Bioaccumulative Toxins Regulations, which will help establish Ecology's process and procedures to address the subject of PBTs.

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3.9 Targeted Chemicals (Mercury) Program (Washington State Program)

The State of Washington has a number of Toxic Chemical Reduction programs that target specific chemicals.

In August 1998, the Washington Department of Ecology released a Dioxin Source Assessment and announced plans to develop a long-term strategy to reduce and eliminate Persistent, Bioaccumulative Toxins (PBTs). These chemicals build up through the food chain and accumulate in human and animal tissues.

In December 2000, the Washington State Department of Ecology developed the *Proposed Strategy to Continually Reduce Persistent, Bioaccumulative Toxins (PBTs) in Washington State.* This document outlined strategies and actions to phase out PBTs. Under guidance provided by the State Legislature in 2002, the departments of Ecology and Health targeted mercury as the first priority pollutant in the State's PBT initiative. The Washington State Mercury Chemical Action Plan was published in January, 2003. This plan was followed by the 2003 Mercury Education Reduction Act (MERA), Chapter 70.95M RCW.
The Washington Department of Ecology also produced a plan to examine and reduce the use of polybrominated diphenyl ether (PBDE) flame retardants. A final PBDE action plan was published in January 2006. Chapter 173-333 WAC, the Persistent biocumulative toxic substances rule was finalized in February of 2006. The draft Multiyear PBT Chemical Action Plan Schedule was published September 2006, and will receive public comment until December 20, 2006. This plan proposes to develop chemical action plans for lead, PAHs and PFOS, in that order, from November 2006 to March 2010.

Lead and Cadmium have been designated metals of concern under WAC 173-333-315. The "metals of concern" category was established as an interim category pending completion of EPA's inorganic metals assessment framework process. The Washington Department of Ecology can prepare chemical action plans for one or more metals of concern.

The most mature of Washington's targeted toxic chemical reduction programs is the mercury reduction program. Therefore, this case study will focus on the mercury program.

3.9.1 Basis for Program

It is estimated that approximately 5,000 pounds of mercury were released in Washington State in 2001. By 2006, this number had been reduced to approximately 2,300 pounds of mercury released. The goal of the mercury program is to virtually eliminate anthropogenic releases by 2015.

Mercury emission levels are estimated by:

- Conducting ongoing fish tissue sampling across state
- Comparing historic and current soil and sediment monitoring
- Conducting studies of mercury levels in landfill gas to determine disposal of mercury-containing wastes
- Maintaining a list of products containing mercury and tracking their disposal and recycling rates.
- Measuring performance every six months

Most mercury releases come from small or medium businesses, schools, and households. The majority of this pollution could be prevented from entering Washington's environment through purchasing alternative products that contain no mercury, improvements in waste separation and disposal methods in dentistry, households, medical facilities, and others areas where mercury is used. As the amount of mercury released to the environment continues to decrease, incremental voluntary changes and small compliance activities will be needed to provide further reductions.

The *Mercury Chemical Action Plan* lists and describes the major sources of mercury in the state of Washington. These include: mercury release from fossil fuel combustion; mining and manufacturing; use of products containing mercury; and products containing mercury at end-of-life. Requirements are specified in MERA for labeling fluorescent lamps, mercury in schools, and prohibited sales of mercury. The state developed Memorandums of Understanding (MOUs) between Ecology and Industry for dental practices, hospitals, and automotive recyclers. They also focused attention on disposal of Auto Switches, Thermostats, and Fluorescent Lamps. Mercury emission standards were developed for Coal-fired power plants. The list of products containing mercury was not sufficiently comprehensive in 2001, so additional products are tracked as information is available. Utility switches and relays, for example, were never counted in 2001, yet they may increase mercury loading by as much as 800 pounds per year.

3.9.2 Program Requirements

Washington state requires by law that:

- Mercury lamps are appropriately labeled
- Washington State Government can only purchase low mercury or mercury-free products
- Sale of mercury containing novelties, thermometers, thermostats, manometers, and automobiles with mercury switches is prohibited
- Schools can not purchase, use, or possess elemental mercury

Washington state requires by policy that:

- Communities maintain voluntary collection and recycling programs for mercury containing products, elemental mercury, & mercury waste.
- Collected mercury goes to retort facilities.
- Funding is provided to local governments for mercury lamp recycling. Thermostat collection bins are funded by either the state or the county. King County provides a rebate for recycled thermostats.

The Washington Department of Ecology has three separate MOUs with industry groups. These MOUs target groups with an established mercury waste stream, and define best management practices (BMPs) to reduce or eliminate mercury waste.

- The Washington Department of Ecology had an MOU with the Washington State Dental Association (WSDA), outlining BMPs for the disposal of mercury and mercury containing products from dental practices. WSDA is a voluntary membership association of Washington dentists, covering 55% of Washington dentists. The MOU expired on December 2005 and it is now required through water quality and hazardous

waste regulations that dentists install amalgam separators or document that they are not exceeding regulatory discharge standards.

- The Washington Department of Ecology has an MOU with The Washington State Hospital Association (WSHA). WSHA is a voluntary membership association of hospitals in Washington, representing over 100 medical facilities in the state. This MOU focuses on mercury and other relevant PBTs in hospitals. The goal of this MOU is to reduce mercury waste generated from hospitals statewide. It also specifies that Ecology and WSHA will co-sponsor training and seminars on the topic.
- The Washington Department of Ecology has a MOU with the Automotive Recyclers of Washington (AROW), and the End-of-Life Vehicle Solutions Corporation (ELVS), which represents auto manufacturers. AROW is a trade association of licensed auto recyclers in Washington State, and the ELVS is a 501(c)(4) nonprofit social welfare corporation created by the automotive industry to promote the industry's environmental efforts. The purpose of this MOU is to establish a voluntary Motor Vehicle Mercury Switch Removal Program for end of life vehicles.
- Education and outreach are a large part of this program. The Washington State Department of Health provides these services as mandated by the 2003 legislature.

Washington State also regulates mercury releases from wastewater treatment, chlor-alkali plants, hazardous waste, and municipal solid waste incinerators.

3.9.3 Role of Stakeholders

The Washington State Departments of Health and Ecology worked together with an external Mercury Advisory Committee to develop the Washington State *Mercury Chemical Action Plan*, which was published in January, 2003. The external committee consisted of statewide agriculture, business, environmental, local government, and public health representatives. There has also been a push towards mercury-reduction at the local level, with many counties having mercury-reduction programs. The *Mercury Chemical Action Plan* lists the identified most sources of mercury, and evaluates potential methods of contamination from each of these sources. After the plan was published, the Washington State Legislature passed the Mercury Education Reduction Act (MERA), Chapter 70.95M RCW in 2003.

3.9.4 Financial Impacts

Any fiscal impact on the Departments of Health or Ecology that results from the implementation of MERA is paid for out of funds that are appropriated by the legislature from the state toxics control account for the implementation of the department's persistent bioaccumulative toxic chemical strategy.

If there is a violation of MERA, it is punishable by a civil penalty not to exceed one thousand dollars for each violation in the case of a first violation. Repeat violators are liable for a civil penalty of up to five thousand dollars for each repeat violation. Penalties collected must be deposited in the state toxics control account created in RCW 70.105D.070.

3.9.5 Effectiveness of Program

MERA has caused measurable improvements in the amount of mercury used and released since 2001. The goal of the program is to eliminate mercury use by 2015.

Banned under MERA	Goals	Results to 2005
Bulked Mercury (schools)	100% (2600 lbs)	90% (2300 lbs)*
Thermometers	100% (300 lbs)	99% (288 lbs)
Thermostats	100% (400 lbs)	10% (40 lbs)
Manometers	100% (300 lbs)	99% (295 lbs)
Novelties	No Data	No Data

*This is a non-recurring number. All the others are annual.

Other Items		
Button cell batteries	90% (88 lbs)	10% (8 lbs)
Fluorescent Lamps	90% (500 lbs)	26 % (130 lbs)
Amalgam	90% (400 lbs)	90% (360 lbs)
Switches & Relays	90% (800 lbs)	10% (80 lbs)
Auto Switches	90% (4000 lbs)	10% (55 lbs)

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3.10 New Jersey Pollution Prevention (P2) Program

The New Jersey Department of Environmental Protection Office of Pollution Prevention and Right to Know administers the pollution prevention (P2) program in New Jersey, which includes P2 planning focused on toxics use reduction. The preparation of P2 plans by industries is one of the primary tools used by New Jersey for toxic use and waste reductions. The New Jersey P2 program focuses on toxic substances produced or manufactured in quantities of greater than 10,000 pounds (lbs). The P2 planning is targeted at 90% use or non-product output or releases and also must target PBTs (Persistent, Bioaccumulative, Toxic substances) due to their low thresholds. P2 planning does not include waste minimization. Waste minimization is encouraged, but is not counted as part of the overall reduction for a facility.

Although the P2 planning is a mandatory component in the NJ P2 program for regulated facilities, the plans prepared by the facilities are voluntarily implemented. Between 500 and 600 facilities are currently subjected to the P2 planning requirements and are all on a 5-year planning cycle. The plans are approved by an administrative checklist to encourage self-direction. The plans are not reviewed for technical content by the engineers at NJ DEP, but the engineers do review the plans to make sure the material accounting calculations make sense.

The New Jersey Pollution Prevention (P2) program set goals of "significant reduction" in the use of toxic (TRI-listed) chemicals and a state-wide 50 percent reduction in toxic waste generation. Materials accounting is used in the New Jersey program as a regulatory tool to measure use of toxic substances and to facilitate preparation of mandated P2 plans. Materials accounting data provides a complete view of hazardous substances as they flow through communities and facilities' manufacturing operations.

The P2 planning program is structured so that the technical assistance component is separate from the data collection and enforcement components. The technical assistance component, the New Jersey Technical Assistance Program, is discussed in Section 3.11.

It took approximately 2 years to get the New Jersey P2 Program up and running. Most of the time was spent drafting the regulations to implement the program. A certain amount of money is appropriated each fiscal year to operate the program. Although the amount appropriated has been slightly higher, the cost to implement the program is approximately $900,000/year. Paying salaries constitutes the largest percentage of spending. Staffing is currently at 12 individuals, which includes managerial, technical (half of the staff), data management, and secretarial support. The state also contracts every year with Rutgers University to provide P2 technical assistance. This contract is typically around $200,000/year, which comes out of the annual appropriation. There is also a $140,000-per-year cost to the Department of Labor, which covers the cost for them to send out the P2 fee assessments. Lastly, approximately $10,000 to $15,000 per year is spent for a vendor to maintain, upgrade, and/or enhance the program tracking database and $30,000 per year for general office-type costs (i.e., printing, telephone, information systems).

3.10.1 Basis for Program

P2 planning in New Jersey is pursuant to the federal Toxic Release Inventory (TRI) reporting requirements and the New Jersey Pollution Prevention Act (P2 Act). New Jersey's Worker and Community Right-To-Know (WCRTK) Act established a regulation process for collecting data on the flow of toxic materials through individual facilities. Under the WCRTK Act, information on releases to the environment, transfers to off-site waste management facilities, non-product output (total production-related waste) and throughput (use) of over 600 toxic chemicals is reported annually.

The regulations established by the P2 Act were adopted by the state in 1993 and are readopted every 5 years. The basis behind the legislation were the findings by the legislators that thousands of tons of hazardous substances are discharged into the environment of the state each year and the regulatory approaches, at the time, was fragmented and allowed pollution to be shifted from one environmental medium to another. The legislators also declared that the inherent limitations of the traditional system of pollution prevention should be addressed by a new emphasis on pollution prevention that included the following:

- Reduction in the use of hazardous substances in industrial and manufacturing processes;
- Rigorous accounting of the use, generation and multi-media environmental releases of hazardous substances to identify points where pollution can be prevented;
- P2 can be achieved by a more efficient and rational use of hazardous substances through use of less hazardous substances, substitution of substances, or processes less prone to produce pollution; and
- Soundly planned P2 program can be implemented without adversely affecting the State's economic health and those employed by the industries that use and discharge hazardous substances.

The P2 Act specifies every requirement of the P2 program through statutes that were devised and written by New Jersey lawmakers, not NJ DEP. Also, because the program's regulations are written into law (see text below), they are difficult to change or amend.

Assembly Appropriations Committee Statement, Senate, No 2220-L.1991, c.235

"Senate Bill No. 2220 (SCS) (SCS), as amended, the "Pollution Prevention Act," establishes a regulatory program in the Department of Environmental Protection (DEP) designed to prevent pollution by reducing the use and discharge of hazardous substances at certain industrial facilities. The bill sets a Statewide goals of 50 percent reduction over five years [baseline 1987] in the use, discharge and generation of hazardous substances. Owners and operators of certain industrial facilities at which hazardous substances are used or manufactured will be required to prepare pollution prevention plans and pollution prevention plan summaries, which will be maintained at the facility for inspection by the department.

The bill establishes an Office of Pollution Prevention (OPP) in the DEP to administer this program; such an office currently exists in the department but does not perform some of the functions detailed in the bill."

3.10.2 Program Requirements

P2 Planning

Facilities that use, process or manufacture chemicals listed in the TRI in quantities greater than 10,000 pounds, have 10 or more full-time employees, and/or submit at least one federal toxic release inventory Form R or Form A to EPA are required to implement P2 planning and reporting at their facility. Facilities subject to P2 planning are required to develop P2 plans every five years, which remain at the facility. These plans are required to be certified to make sure they are true, accurate and complete.

P2 Planning documents include a P2 Plan (two parts), a P2 Plan Summary, and a P2 Plan Progress Report.

The P2 Plan Part 1 includes the following:

- Companies are required to provide personnel information for those responsible for the P2 plan and at least one non-manager employee.
- The plan has to be certified to make sure they are true, accurate and complete.
- Hazardous substances information for substances manufactured, stored, and/or used at the facility and should include the chemical abstract services (CAS) number.
- Annual amount of TRI substances – generated, stored, treated, disposed, reductions/increases.
    - Stored on the 1st day of the year, brought into the facility, manufactured, and recycled and reused.
    - Stored on the last day of the year, consumed, shipped off-site as/or in product or co-product, generated as non-product output
    - Recycled or released into the air, water, and waste.
- Process identification – unique identification numbers are assigned to each process and the processes may be combined.
- In-depth financial analysis is performed to evaluate costs for storage/handling; monitoring, tracking and reporting; treatment; transportation and disposal;

hazardous waste manifesting; permit fees; liability; raw materials; and safety and compliance.

- Reductions/increases (use, non-product output, and releases) of TRI substances are evaluated and compared to the base year and the progress of the goals are recorded.
- Processes that are targeted by the facility are evaluated and the reductions/increases per unit of product are reported and compared to the base year.

P2 Plan Part 2 contains the following:

- The facility is required to identify/investigate P2 options that target certain processes and sources the contain TRI substances.
- A feasibility analysis is performed to calculate the financial and technical feasibility for implementing the P2 options.
- Five-year reduction goals are established for non-product output and use of TRI substances.

The P2 Plan Summary is required to be revised and submitted electronically to NJ DEP every 5 years and includes a summary of the P2 plan elements, such as the reduction goals set by the facility. The inputs/outputs reported by a facility are required to be within 5% of each other.

The P2 Plan Progress Report is required to be submitted electronically to NJ DEP annually. The report includes the actual P2 reductions/increases and is integrated with the Release and Pollution Prevention Report (RPPR), which is an annual report submitted to NJ DEP that contains facility-level materials accounting numbers and throughput of TRI substances.

Some other aspects of the program to note:

- A facility is not penalized if they try a failed TUR process;
- Releases are available for public review, but use or storage of toxic substances are not;
- A reading room was created by NJ DEP for the public to review facility information.

TUR Requirements

Facilities can report up to 20 different data elements that make up a complete accounting of their hazardous substances. This data is reported annually in pounds to the New Jersey Department of Environmental Protection Office of Pollution Prevention and Right to Know (NJDEP P2RTK) on a form know as the "Release and Pollution Prevention Report" (RPPR). Three different total quantities are reported on this form, use [*total throughput of substances and includes quantities of TRI chemicals both brought on site and produced on site*], non-product output [*total production-related waste measured before treatment or other type of management*], and on-site releases. Although the facilities are required to develop pollution prevention plans, wherein goals are established for toxic use reduction, reductions in the use of toxic chemicals are not mandatory.

3.10.3 Role of Stakeholders

Pollution Prevention planning regulations in New Jersey was established by the New Jersey lawmakers. However, there was, and will continue to be, a great deal of stakeholder involvement in the promulgation and readoption of the P2 Planning and WCRTK rules. While the NJDEP's main role is to implement the program and enforce compliance with the program requirements, it does try to provide compliance assistance to facilities having difficulties in preparing their P2 Plans. The NJDEP provides a grace period for companies to comply with its regulations; however, it does penalize recalcitrant facilities.

3.10.4 Financial Impacts

Funding for the NJ DEP P2RTK to implement the P2 planning program is from revenues from fees charged to employers pursuant to the Worker and Community Right to Know Act[1](CRTK). Every facility subject to the NJ CRTK reporting requirements are assessed a fee. The fee schedule is $4.00/employee, with a minimum of $75.00 for CRTK and $2.00/employee with no minimum for P2 Planning. Even though there are approximately 550 to 600 facilities that are required to perform P2 Planning, the larger CRTK universe is assessed a fee. A portion of the revenue from these fees is deposited into a "Pollution Prevention Fund", which is used to carry out the provisions outlined in the P2 Act.

At the time of the creation of the P2 Act, it was estimated that $2.5 million would be generated from the increased fees from the Worker Community Right to Know Act. The NJ DEP P2RTK budget included funding for the salaries of 31 employees and operation costs (research and consultant services).

3.10.5 Effectiveness of Program

The data collected by the NJ DEP P2RTK is used to create trend analysis, determine enforcement targets and to help set priorities. The trend analysis helps NJ DEP P2RTK to set meaningful metrics through the evaluation of multi-media releases, use, non-product output, production and shipped in/as product. The trend analysis also helps determine the top ten lists of substances (carcinogens, PBTs, extraordinary hazardous substances) and facilities (largest increases/decreases of use, NPO and releases).

A trend analysis of materials accounting data from 1994 through 2001 was completed in New Jersey in 2004. The overview findings of the analysis are listed below.

- Decrease statewide in non-product output and releases of hazardous substances.
- Hazardous substance use increased due higher statewide industrial production. However, the amount of releases when adjusted for industrial production decreased. In other words, facilities are using hazardous substances more efficiently.
- Hazardous substance use increases as reported in New Jersey are primarily the result of hazardous substances contained in products shipped as or in a product.
- Statewide trends driven by changes at a few large facilities.
- Although the trend shows an overall increased efficiency of hazardous substance use and a reduction in the release of hazardous substances, certain industries and chemicals do not follow this trend.

[1] The New Jersey Workers Right to Know Act is a law that was established in 1983 and requires public and private employers to provide information about hazardous substances at their work place. The NJ P2 Act increased the per-employee fee charged to employers by the state for administering the Workers Right to Know Program.

Enforcement targeting is determined through a relative risk analysis of the data and evaluating permit exceedances. This helps to prioritize P2 inspections.

The data also helps the agency with priority setting through health tracking (cancer, child blood lead, and birth defects), multi-media release reports, and through the discovery of hot spots and chemicals of concern.

On the other hand, the requirements for the New Jersey P2 plans were laid out in the P2 Act legislation, and resulted in some outcomes that do not necessarily lead to P2. For example, some companies produce products that contain non-toxic forms of chemicals listed on the TRI lists, such as nickel, chromium or cobalt in their alloy form. Targeting is an option for facilities to streamline their planning requirements. A facility could choose to target the metal component; however, it is possible that other more toxic substances also contributed to 90% of use, NPO or releases and would also be targeted. Targeting does not prevent a facility from looking at all substances.

In addition, in 1996, the New Jersey Department of Environmental Protection (NJDEP) commissioned a report by Hampshire Research Associates (HRA) entitled *Evaluation of the Effectiveness of Pollution Prevention Planning in NJ*. HRA and NJDEP visited 115 facilities to evaluate pollution prevention planning, including planning costs and cost savings. The report showed the following findings:

- Of the 28 facilities able to calculate their annual cost savings, the annual average cost savings was approximately $254,000, for a total of $7.1 million. Most facilities calculated only the direct savings in raw material costs for their reduction projects.
- Eight of the facilities calculated the costs/amounts of both capital investment and annual cost savings, yielding a total (for all eight facilities) capital investment of $7.2 million and a total annual return of $1.7 million, for an average payback period of 4.2 years.
- Potential capital investment to complete all of the projects in the plans of the facilities ranged from zero to $19.0 million for the 48 facilities visited by HRA.
- The 49 of 115 facilities that could place a dollar figure on the cost of their planning spent an average of $35,000 each.
- The 95 of 115 facilities that could quantify the amount of time necessary to prepare their plans spent, on average, 6.5 weeks of one person's time to develop the plan. Taking an average salary of $50 per hour yields an average planning cost of $13,000 per facility.
- Overall, the average cost of planning was less than the average annual savings per facility found through planning.

3.10.6 Bibliography

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3.10.7 Company Example 1

The following subsection summarizes a discussion with Howmet Castings (Dover, New Jersey), which is required to comply with the New Jersey P2 program regulations. The goal of the discussion was to gain a better understanding of the background of the state program and its associated advantages and disadvantages.

Howmet Castings an Alcoa Business

http://www.alcoa.com/howmet/en/home.asp

Dover, New Jersey

Point of Contact:

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Engineer
Safety and Environment
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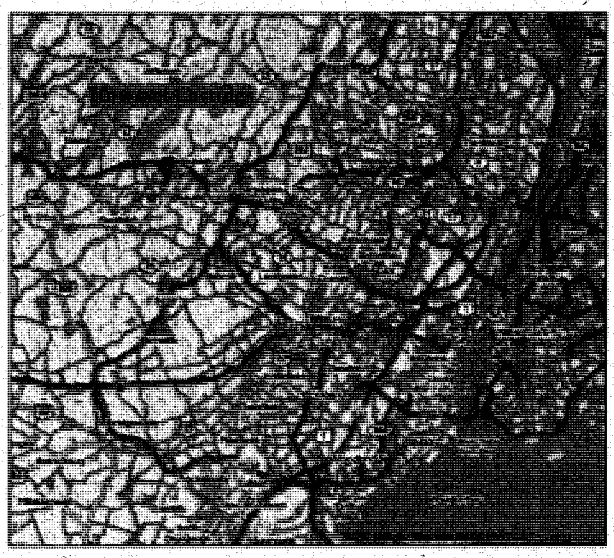

Attendees:

Alcoa Howmet Castings:
Bruce E. Tiger, Safety and Environmental

CETESB:
Flavio de Miranda Ribeiro, Cleaner Production Technology Sector
Ives Alcazar Gomes, Systems Development Division
Marcelo de Souza Minelli,

CH2M HILL:
Thomas Higgins, Vice President, Energy and Industrial Systems
Lucila Cavalari D'Alkmin Telles,
Keisha Wilson, Associate Scientist

Facility Background

On September 20, 2006, the staff from CETESB visited Howmet Castings Division of Alcoa Aluminum Company, located in Dover, New Jersey. Howmet Castings primarily manufacture turbine blades of various sizes for jet engines and power plant gas turbines.

There are two major facilities located on the Howmet Castings site, an alloy facility and a processing facility. The alloy facility produces a variety of super alloys of chromium, nickel and cobalt, to withstand the high temperatures of gas turbine engines. Alloys are melted in inert gas and vacuum furnaces. Alloy scrap is recycled on-site.

The processing facility uses a lost wax process to cast a wide variety of complex turbine blades and other critical parts. All materials for the turbine blades and parts are processed by Howmet Castings or another Howmet/Alcoa facility. Using best management practices, the processing facility tracks wasted parts and minimize waste as much as possible, with the wax and sludge generated during processing being sent to a recycling facility in Pennsylvania.

In addition, a wastewater pre-treatment facility is located on-site and is used to remove dissolved metals from wastewater prior to release.

- **TRI Data Summary**

Environmental Releases, Transfers, and Production-Related Waste (Pounds from TRI sources)

Year	Air Releases	Water Releases	Land Releases	Underground Injection	Total Environmental Releases	Total Off-Site Transfers	Total Production-Related Waste
1988	113,530	0	0	0	113,530	1,342,496	NA
1989	89,880	0	0	0	89,880	48,499	NA
1990	52,740	0	0	0	52,740	39,443	NA
1991	59,800	0	0	0	59,800	132,497	303,795
1992	0	0	0	0	0	68,652	131,210
1993	0	0	0	0	0	56,227	131,487
1994	3,161	0	0	0	3,161	58,503	131,380
1995	6,063	0	0	0	6,063	58,568	189,833
1996	7,518	0	0	0	7,518	11,299	152,354
1997	7,246	0	0	0	7,246	17,345	92,880
1998	792	0	0	0	792	3,198	806,281
1999	11,963	0	0	0	11,963	20,261	135,385
2000	3,765	0	0	0	3,765	2,880	996,119
2001	7,572	0	0	0	7,572	682,117	1,566,778
2002	5,300	0	0	0	5,300	331,107	784,764

"NA" means that no data are available because "Total-Production Related Waste" was not reported until 1991.

Source – Scorecard The Pollution Information Site (http://www.scorecard.org)

Site Visit Activities

The staff from CETESB met with Bruce E. Tiger, the Safety and Environmental Engineer for the facility. Mr. Tiger discussed the NJDEP P2 Program and how the state program affects the Howmet Castings facility and provided insight on how the P2 Program could be revised to be more flexible to industries that use chemicals that are listed on the TRI lists for their primary production. The group also toured both the alloy and processing facilities.

Key Points

Below are the key points that were discussed during the site visit. These key points are specifically related to toxics use reduction approaches and strategies.

NJ P2 Program –

- Advantages
  - Preparing a P2 plan helps to detect toxic use reduction opportunities.

- The public can request to review the facility's toxic release information.
- Hazardous waste that is recycled is credited back to the facility when hazardous waste disposal is reported in Form Rs.
- The 2006 P2 Plan, and other NJ P2 documents for the facility will be submitted electronically to NJDEP through the internet.

- Disadvantages
  - Because the NJ P2 Program is specifically outlined in the NJ law, it is hard to modify and is therefore not flexible for all industries.
  - The preparation of a P2 Plan requires many hours of labor to complete and there are also duplicate efforts to fill out duplicate mass balance reports for NJ in addition to Form Rs that contain similar information under the TRI program.
  - The New Jersey P2 program recommends that facilities target for reduction the TRI chemicals that constitute 90 percent of use. However, since chromium, cobalt and nickel are in the alloys that is the company's product, the plan would target these rather than materials used in production that are much more of a toxic product and should be targeted for reduction. The super alloy is inert and not an environmental or health threat. Lower volume materials like etching solutions should be targeted.
  - Therefore the law has the unintended consequence of targeting the product of the facility, not the toxic chemicals used in its production

New Jersey Technical Assistance Program - Rutgers University, New Jersey Program for Manufacturing Excellence (NJME)

- Bruce Tiger visited the Rutgers University, New Jersey Program for Manufacturing Excellence (NJME) for a class on filling out the new New Jersey P2 electronic application. When there, he heard the presentation on how Rutgers has assisted another company in finding a method for regenerating ferric chloride etching solutions. He invited Rutgers to evaluate Howmet Castings' etching line, take samples and come up with an analysis of the feasibility of regenerating the facility's ferric chloride etching solution. Rutgers is currently performing this study for him, and he is impressed by it. If the technology proposed by Rutgers works and is cost effective, he hopes to reduce the facility's waste and materials purchases. Hence the Rutgers program has been helpful.
- When asked whether he would prefer having a program like NJME either through a private institution or by a government agency, he responded that it would not matter either way, provided the government agency would not look for compliance issues during the on-site assessment activities.

3.10.8 Company Example 2

The following subsection summarizes a discussion with Air Products Polymers, L.P. (Dayton, New Jersey), which is required to comply with the New Jersey P2 program regulations. The goal of the discussion was to gain a better understanding of the background of the state program and its associated advantages and disadvantages.

Air Products Polymers, L.P.

www.airproducts.com

Dayton, New Jersey

Point of Contact:

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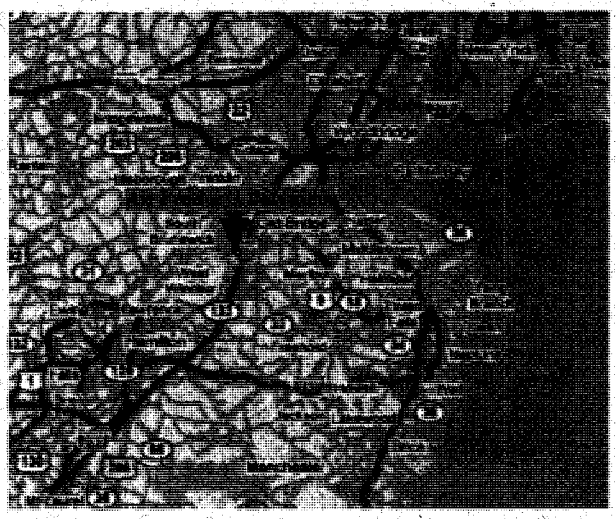


Attendees:

Air Products Polymers, L.P.:
Jerry Hartig, Manager, Global Environment
Rebecca A. Underwood, Plant Manager
Wendy Grossman, Environmental Engineer

CETESB:
Flavio de Miranda Ribeiro, Cleaner Production Technology Sector
Ives Alcazar Gomes, Systems Development Division
Marcelo de Souza Minelli,

CH2M HILL:
Thomas Higgins, Vice President, Energy and Industrial Systems
Lucila Cavalari D'Alkmin Telles,
Keisha Wilson, Associate Scientist

Facility Background

On September 21, 2006, the staff from CETESB visited Air Products Polymers, L.P., located in Dayton, New Jersey. The Air Products facility produces raw materials, primarily vinyl acetate-ethylene emulsion polymers for high quality binders used for packaging, wood bonding/furniture, pressure sensitive adhesives, wall and ceiling coverings, flooring, consumer glues and film laminates. The facility operates 365 days a year, 7 days a week, 24 hours a day and produces 16 vinyl acetate ethylene products

Pollution Prevention (P2) is part of Air Product's corporate culture and is implemented voluntarily by Air Products. They make an effort to reduce the use of toxics materials at the source by substituting alternative materials to produce products. Air Products also has a hierarchy for waste minimization, with land disposal being at the bottom.

- **TRI Data Summary**

Environmental Releases, Transfers, and Production-Related Waste (Pounds from TRI sources)

Year	Air Releases	Water Releases	Land Releases	Underground Injection	Total Environmental Releases	Total Off-Site Transfers	Total Production-Related Waste
1988	43,350	0	0	0	43,350	55,950	NA
1989	35,290	0	0	0	35,290	115,120	NA
1990	37,083	0	0	0	37,083	183,912	NA
1991	28,927	0	0	0	28,927	182,290	1,324,791
1992	31,087	0	0	0	31,087	179,455	1,440,945
1993	31,581	0	0	0	31,581	182,774	1,414,144
1994	35,917	0	0	0	35,917	91,379	1,127,258
1995	34,787	0	0	0	34,787	170,995	1,007,253
1996	41,064	0	0	0	41,064	169,548	739,064
1997	120,894	0	0	0	120,894	96,612	1,952,052
1998	24,403	0	0	0	24,403	129,920	1,384,385
1999	24,330	0	0	0	24,330	230,848	1,392,377
2000	24,161	0	0	0	24,161	234,916	1,354,579
2001	28,871	0	0	0	28,871	139,446	1,230,815
2002	50,219	0	0	0	50,219	142,665	1,201,993

"NA" means that no data are available because "Total-Production Related Waste" was not reported until 1991.

Source – Scorecard The Pollution Information Site (http://www.scorecard.org)

Site Visit Activities

The staff from CETESB met with the Air Products staff. Mr. Hartig discussed the NJDEP P2 Program and how the state program affects the Air Products facility. He also provided insight on how the P2 Program could be revised to be more flexible to industries that use chemicals that are listed on the TRI lists for their primary production.

Key Points

Below are the key points that were discussed during the site visit. These key points are specifically related to toxics use reduction approaches and strategies.

NJ P2 Program –

- Air Products suggested that the NJ P2 program should be more compliance advantageous to industries by providing incentives for those firms that comply with P2 regulations.

- Mr. Hartig noted that larger companies have P2 programs as part of their corporate culture. Smaller to midsize facilities normally need more assistance developing P2 programs. He noted that if the larger companies do not help the smaller to midsize firms with P2, NJDEP may create more stringent regulations for the entire industry. Air Products have provided assistance to smaller companies in an effort to decrease the amount of regulations required for the chemical industry.

- Mr. Hartig suggested that reporting be for 2 years rather than yearly. He also felt that the TRI program by itself was the most effective at promoting toxics reductions due to the shame factor.
- Air Products also suggested that less emphasis be placed on material accounting, as it can require a lot of resources that could be used to fund actual projects.
- Many toxics use reduction ideas come from the operators of facilities. Air Products suggests obtaining operators' input while developing the TUR program in Sao Paulo.
- Air Products advises against creating regulations that are too prescriptive for manufacturing facilities. Regulations that are too prescriptive can stifle a facility's manufacturing and economic growth.

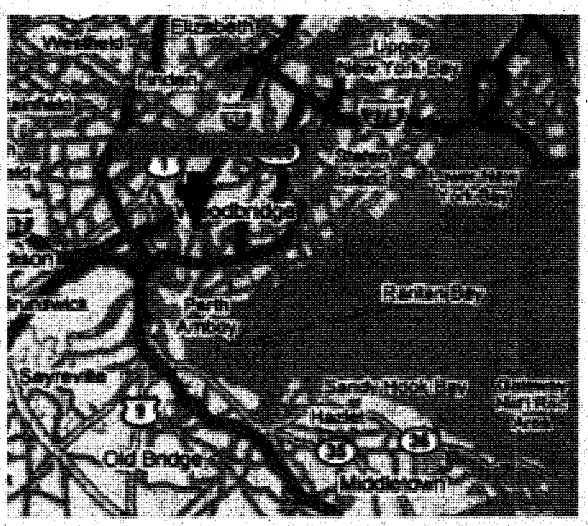
3.10.9 Company Example 3

The following subsection summarizes a discussion with Motiva Enterprises, LLC (Sewaren, New Jersey), which is required to comply with the New Jersey P2 program regulations. The goal of the discussion was to gain a better understanding of the background of the state program and its associated advantages and disadvantages.

Motiva Enterprises, LLC

www.motivaenterprises.com

Sewaren, New Jersey



Point of Contact:

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Dina Sousa, Terminal Environmental Rep.
David Bier, Environmental Coordinator

CETESB:
Flavio de Miranda Ribeiro, Cleaner Production Technology Sector
Ives Alcazar Gomes, Systems Development Division
Marcelo de Souza Minelli,

CH2M HILL:

Thomas Higgins, Vice President, Energy and Industrial Systems
Lucila Cavalari D'Alkmin Telles,
Keisha Wilson, Associate Scientist

Facility Background

On September 22, 2006, the staff from CETESB visited Motiva Enterprises, LLC, located in Sewaren, New Jersey. The 80-year old Motiva Sewaren facility is the largest Motiva liquid fuels distribution center in the US and 5th largest in the world. Fuels distributed by the facility include gasoline, diesel fuel, heating oil, jet fuel, and ethanol. The facility receives and distributes finished products and also brings in the components of products to blend finished grades of gasoline or diesel fuel. Various additives, such as ethanol are blended into the products as the products are loaded onto transport trucks for delivery to gas stations or other users. The facility has approximately 5.5 billion barrels for product storage and blending and trans-ships 350,000 barrels per day. They receive components for fuels by rail, ship and pipeline. The facility is the largest ethanol blending facility in the US, using ethanol to produce oxygenated gasoline when and where required for air quality requirements. They get much of the ethanol by ship from Brazil.

The data the facility collects to comply with NJ P2 regulations include air emissions calculated using thru-put data, waste water discharge quantities, materials discharged, waste shipped and gallons of paint used (paint for storage tanks). The facility currently reports four processes in their P2 Plan that is submitted to NJDEP:

- Gasoline Storage and Loading
- Gasoline Maintenance (tank cleaning, painting and fugitive air emissions)
- Distillate Storage and Loading
- Distillate Maintenance (tank cleaning, painting and fugitive air emissions)

The facility is currently exploring combining the processes to two processes to simplify materials accounting.

- TRI Data Summary

Environmental Releases, Transfers, and Production-Related Waste (Pounds from TRI sources)

Year	Air Releases	Water Releases	Land Releases	Underground Injection	Total Environmental Releases	Total Off-Site Transfers	Total Production-Related Waste
1998	85,215	23	0	0	85,238	8,641	101,616
1999	76,900	330	0	0	77,230	659	105,144
2000	88,727	28	0	0	88,755	3,330	91,726
2001	91,282	18	0	0	91,300	1,086	93,926
2002	92,713	21	0	0	92,734	218	130,469

Source – Scorecard The Pollution Information Site (http://www.scorecard.org)

Site Visit Activities

The staff from CETESB met with the Motiva staff and discussed the NJDEP P2 Program and how the state program affects the Motiva facility. Mr. Otis and Mr. Bier both provided insight on the advantages and disadvantages of the NJ P2 Program. The group also toured the Motiva distribution facility.

Key Points

Below are the key points that were discussed during the site visit. These key points are specifically related to toxics use reduction approaches and strategies.

NJ P2 Program –

- P2 planning quantifies the amount of materials emitted and provides data that can be evaluated to determine ways of reduction. P2 Planning is also useful by providing companies the impetus to review quantities emitted/released on a regular basis and also helps to prevent loss of products for sale.
- The USEPA TRI data that is prepared by Motiva is easily transferred over to the reporting requirements for the NJ P2 program. However, this could be difficult for facilities that have complex processes, e.g., mass balance of calculations to 5% may prove to be difficult. The more processes a facility reports in their P2 plans, the more complicated the mass balance calculations become.
- The P2 reporting process provides publicly available data to show what the Motiva facility is doing to prevent pollution, reduce emissions and waste.
- The timing of the state P2 program coincides with the federal TRI program reporting (July 1st annually), which causes facilities to report twice. Motiva suggests off-setting the two reporting periods by at least one month.
- The state computer system used to submit P2 reports and TUR data is not user-friendly and slow. It should be noted that this is the first year NJ DEP is requiring P2 reporting to be completed on-line. The system tends to run slower (during the reporting period) during normal working hours, 8 a.m. to 5 p.m., as more people try to submit their reports at the same time. Motiva has also had an issue in using the NJ system for P2 reporting, since the company system is not approved to use an outside program.
- Motiva suggested that regulations that hinder a business's growth should not be created.
- The facility has a new distillation plant for recovery of components that are mixed during pipeline delivery (transmix, which occurs when different products are shipped sequentially in a pipeline).
- Transmix became a large problem due to introduction of a requirement for low sulfur diesel fuel. It only takes a small amount of transmix to exceed the sulfur limit on diesel.
- The Motiva Sewaren facility has modified the method of support for floating internal covers on tanks to reduce air emission losses of volatile components. One of the solutions was to support these internal roofs using cable suspension of the roof rather than legs that supported the roofs above the floors. The legs required multiple penetrations of the roof which allowed a significant number of opens for fugitive emissions to escape.

3.10.10 Other Company Examples

Some examples of where manufacturers installed upgrades to their manufacturing processes to achieve a reduction in their use of toxic materials under the New Jersey P2 program are presented in Table 3-10 below. The table also shows cost reductions that have been realized by companies participating in the program.

Table 3-10 - New Jersey Technical Assistance Program	
Company Name	Paramount Metal Finishing
Company Description	Service of ferrous and nonferrous metal parts
Project Description	Replace 1,1,1-trichloroethane degreasing with aqueous degreasing system
Capital/Installation Cost	$61.745
Financial Incentive Provided	$25,000 Grant
Annual Cost Savings	$30.232
Pay Back Period	2 years
Reduction in Hazardous Waste Generation	21,737 lb/yr TCA
Reduction in Air Emissions	200 lb/yr TCA
Additional Benefits	Ventilation system no longer needed for worker safety, reduced reporting requirements

Company Name	Red Devil, Incorporated
Company Description	Manufactures hand and edge tools
Project Description	Replace 1,1,1-trichloroethane degreasing with aqueous degreasing system
Capital/Installation Cost	$108.722
Financial Incentive Provided	$50,000 Grant
Annual Cost Savings	$39.700
Pay Back Period	19 months with grant; 3 years without grant
Reduction in Hazardous Waste Generation	1,430 lb/yr TCA
Reduction in Air Emissions	27,465 lb/yr TCA
Additional Benefits	Reduced employee exposure to TCA, reduced reporting burden, eliminated need for agency inspection, eliminated hazardous chemical/waste handling, eliminated permit fee, eliminated risk of soil/groundwater contamination

Company Name	Union Ink Company
Company Description	Ink Manufacturer
Project Description	Reduced solvent emissions through tank cleaning process modifications
Capital/Installation Cost	$70.800
Financial Incentive Provided	$35,400 Grant
Annual Cost Savings	$17.217
Pay Back Period	2.7 years
Reduction in Hazardous Waste Generation	26,640 lb/yr solvent
Reduction in Air Emissions	3,570 lb/yr solvent
Additional Benefits	Reduced employee exposure to solvent, eliminated the need for personal protective equipment, reduced solvent odor in facility, increase in productivity

Company Name	Wilson Imperial
Company Description	Manufacturer of deglossers, brush cleaners, paint and graffiti removers, and specialty products
Project Description	Installed covers for solvent mixing tanks
Capital/Installation Cost	$6.504
Financial Incentive Provided	$2,750 Grant
Annual Cost Savings	$8.200
Pay Back Period	5.5. months with grant; 9.5 months without grant
Reduction in Air Emissions	32,800 lb/yr solvent
Additional Benefits	Reduced employee exposure, reduced odor in facility

Table 3-10 - New Jersey Technical Assistance Program	
Company Name	Constant Services, Inc.
Company Description	Prints and laminates vinyl web, primarily for use as wallpaper
Project Description	Eliminated solvent use between production runs by using dry rags for cleaning and substituted low volatility solvent for methyl isobutyl ketone and cyclohexane
Capital/Installation Cost	$0
Financial Incentive Provided	$0
Annual Cost Savings	$25.455
Pay Back Period	0 months
Reduction in Hazardous Waste Generation	
Reduction in Air Emissions	14,700 lb/yr solvent emissions
Additional Benefits	Reduced employee chemical exposure, increased productivity

3.11 New Jersey Technical Assistance Program

The New Jersey Technical Assistance Program (NJTAP) was founded in 1990 and is currently implemented through the New Jersey Program for Manufacturing Excellence (NJME), a component of Rutgers University's Center for Advanced Energy Systems (CAES). NJME provide free technical assistance services to industries participating in the New Jersey P2 Program. The services they provide include manufacturing plant assessments that identify energy efficiency, pollution prevention and waste minimization opportunities as well as workshops/seminars on various P2 topics such as energy efficiency and training on how to complete the mandated NJ P2 Plans that are required to be submitted to the New Jersey Department of Environmental Regulation Office of Pollution Prevention (NJ DEP OPP).

NJME conducts on-site assessments for approximately 20 facilities each year. The assessments are performed by two experienced engineers and up to three well-trained undergraduate or graduate students. During the on-site assessments opportunities to save energy, minimize waste, prevent pollution, and improve productivity are identified.

3.11.1 Basis for Program

The establishment of the NJTAP is based on prescriptive legislation, the New Jersey Pollution Prevention Act, which was passed by New Jersey lawmakers in 1991. When New Jersey lawmakers created the New Jersey P2 Act, they purposely incorporated a technical assistance component into the act. This technical assistance program was not to be implemented by the NJ DEP OPP, but by a non-regulatory institution that would be able to provide innovative and creative P2 solutions to industries seeking assistance with toxics reductions and P2 at their facilities. The lawmakers also specified the amount of funding, $200,000, that would be provided annually for the technical assistance program. Under the NJ P2 Act, the program was originally carried out by the Hazardous Substance Management Research Center at the New Jersey Institute of Technology. Since 2002, the program has

being executed out of Rutgers University's New Jersey Program for Manufacturing Excellence.

3.11.2 Program Requirements

Although NJME tries to focus their efforts on small to medium facilities, all manufacturing facilities in New Jersey are eligible, with priority being given to TRI facilities. When a facility contacts NJME for help with their P2 strategies, they are first asked to fill out a short questionnaire to help NJME prepare for the on-site assessment and to provide their specific concern to NJME regarding their facility. Facilities are also requested to provide recent energy/utility bills so that possible suggestions for energy conservation and waste reductions could also be provided with the assessment.

The on-site plant assessment is usually completed in a single day and involves the following activities:

- NMJE meets with the plant personnel;
- A tour of the facility is conducted;
- A brainstorming session and discussions with plant personnel is conducted to identify savings opportunities;
- Engineering measurement and observations are noted; and
- A short summary meeting at the end of the day is completed to make sure NJME has all the information needed to prepare the assessment report.

The assessment report is provided to the facility within 60 days of the on-site assessment and contains an analysis of utility bills, engineering calculations, associated dollar savings, implementation costs and vendor information. NJME then follows up with the facility within 6 to 12 months to check on the status of the implementation of their recommendations. It is not required that a facility carries out the recommendations provided by NJME.

3.11.3 Role of Stakeholders

Because the establishment of the NJTAP was primarily a directive in the P2 Act, the stakeholders, the industries and the NJDEP, had very little input into who would implement the NJTAP. Instead the legislators decided that a non-regulatory institution would implement the program. Both NJIT and NJME have directly assisted the New Jersey industries with their P2 issues with no involvement from the NJ DEP. The role of NJME is to assist the industries and provide recommendations for P2 solutions. The advantage of using Rutgers University to implement the NJTAP is that it is not a regulatory institution and therefore it is not required to enforce laws and regulations. In contrast, New Jersey law requires NJ DEP employees to report permit violations observed during facility site visits. The use of non-NJDEP personnel to conduct on-site assessments of facilities creates a more comfortable situation for the industries seeking P2 assistance. Industries are more inclined to seek help knowing they will not be fined or cited for permit violations noted during an on-site assessment of their facility.

3.11.4 Financial Impacts

The NJDEP Office of Pollution Prevention (OPP) receives a budget, known as the Pollution Prevention Fund from the state, as specified by the NJ P2 Act. The amount of monies funded

to the NJTAP through the Pollution Prevention Fund was also specified in the NJ P2 Act. The NJTAP receives $200,000 annually from the NJDEP OPP. Ten percent (10%) of the funding goes to the university and the department, and the remaining is used for the salaries, students, tuition, supplies and services. The funding is received by the university's grants accounting office, which sets up the account for NJME. NJME typical staff includes the following:

- A full time center director and program manager (@ approximately 40 hours/week each)
- Two (2) full-time project engineers , who split their time working on the NJME (@ approximately 10-20 hours/week each) along with other programs at CAES.
- Three graduate students (@ approximately 10 hours/week each)
- Four undergraduate students (@ approximately 10 hours/week each).

It is estimated that 20 assessments per year are able to be performed with the funding received from NJ DEP OPP, at a cost of $10,000 per assessment.

An on-site assessment conducted by NJME usually yields energy and waste minimization recommendations with a payback period of less than two years. Also, because the services are non-regulatory, confidential, *cost-free*, and there is no obligation to act on any of the recommendations, companies are more likely to use the NJME as a technical resource for P2 and energy cost-savings solutions.

3.11.5 Effectiveness of Program

Since the inception of NJTAP in 1991, over 450 site visits to manufacturing facilities have been completed by both NJIT and NJME. The ability for the NJTAP to offer a facility a variety of services is a major advantage of the program and causes it to be highly effective. For example, a representative from Howmet Castings (*See Howmet Castings Site Visit Summary*) visited the Rutgers University, NJME for a class on filling out the New Jersey P2 Plan electronic application. When there, he heard the presentation on how Rutgers has assisted another company in finding a method for regenerating ferric chloride etching solutions. He invited Rutgers to evaluate Howmet Castings' etching line, take samples and come up with an analysis of the feasibility of regenerating the facility's ferric chloride etching solution. Rutgers is currently performing this study for him, and he is impressed by it. If the technology proposed by Rutgers works and is cost effective, he hopes to reduce the facility's waste and materials purchases. Hence the Rutgers program has been helpful.

Students that work on the P2 projects for NJME are also able to gain real world experience from the usually theoretical curriculum. They are able to experience a wide range of industries, which have often offered the students jobs upon graduation. The NJME program has published papers; student design projects have been requested by and funded by clients; and graduate students have been able to prepare their thesis through this program.

In addition to the above examples, a compilation of NJTAP success stories, compiled by NJIT, can be accessed on the CD-ROM attached to this tech memo.

3.11.6 Bibliography

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3.12 California – Hazardous Waste Source Reduction and Management Review Act of 1989 (SB14)

SB (Senate Bill) 14 require that generators that routinely generate more than 12,000 kilograms of hazardous waste or 12 kilograms of extremely hazardous waste in a reporting year to comply with SB 14. These regulated industries are required to evaluate source reduction opportunities and report on accomplishments every four years. (Cal/EPA, 2006)

The regulated facilities are required to stay in compliance with the legislation by preparing a Source Reduction Evaluation Review and Plan, a Hazardous Waste Management Performance Report, and a Summary Progress Report. Toxics use reduction is not a separate program and is integrated within the P2 planning in California.

A P2 Plan and Summary are required to be prepared every four years in addition to Hazardous Waste Management Performance Reports. The generator is required to certify that the plan is being implemented unless the selected measures for source reduction are not technically feasible or economically practicable, or if attempts to implement the measure result in an adverse impact to hazardous waste reduction goals, product quality, or human health or the environment. (State of California, §6700.4(c))

3.12.1 Technical Assistance

California's Office of Pollution Prevention and Technology and Development (OPPTD) implements outreach and education programs in the form of training sessions and technical forums that target hazardous waste generators, consultants, government employees, and the general public. The training sessions are presented in cooperation with industry associations, public interest groups, academic institutions, and other agencies of the state, federal and local government. OPPTD also produces publications and videos, which are updated as technology improves and new strategies are developed. (Cal/EPA, 1999)

3.12.2 Bibliography

1. California Environmental Protection Agency Department of Toxic Substances Control, Office of Pollution Prevention and Technology Development. "*Guidance Manual for complying with the Hazardous Waste Reduction and Management Review Act of 1989*". December 2002.

2. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. "*Proposition 65 in Plain Language.*" February 2003.

3. State of California. Chapter 31. Waste Minimization, Article 1. Hazardous Waste Source Reduction and Management Review, §67100.4.(c) Plan and Summary.

3.13 California – Proposition 65

While California has many industries similar to those in São Paulo and implements programs related to toxic waste and pollution prevention (P2), the state does not have an established toxic chemical reduction program. The closest program in California is Proposition 65, which was passed by the state legislature.

In November 1986, California voters approved The Safe Drinking Water and Toxic Enforcement Act of 1986, also known as Prop 65. This act requires the State to publish a list of chemicals known to cause cancer or birth defects or other reproductive harm, and update it annually.

Any company that is located in or does business in California is prohibited from knowingly discharging listed chemicals into sources of drinking water. They must also provide "clear and reasonable" warning before exposing anyone to a listed chemical. Businesses are responsible for developing their own warnings.

3.13.1 Basis for Program

The Prop 65 chemical list contains a wide range of naturally occurring and synthetic chemicals that are known to cause cancer or birth defects or other reproductive harm. The chemicals can be naturally occurring or synthetic. They include chemicals that are present in household products, as well as those used in manufacturing and construction, or chemicals that are byproducts of chemical processes (such as motor vehicle exhaust).

To be added to the list, a chemical first has to meet guidelines identifying it as a carcinogen or reproductive toxicant. At that point, there are three main ways that chemicals are added to the list.

1. There are two independent committees of scientists and health professionals that can assign a chemical to the list. They are the Carcinogen Identification Committee (CIC), and the Development and Reproductive Toxicant (DART) Identification Committee. Committee members are appointed by the Governor.
2. If either the CIC or DART identifies an organization as an "authoritative body", that organization can classify a chemical as a carcinogen or as a chemical with potential to cause reproductive harm. The following organizations have been designated as authoritative bodies: the U.S. Environmental Protection Agency (USEPA), U.S. Food and Drug Administration (U.S. FDA), National Institute for Occupational Safety and Health (NIOSH), National Toxicology Program, and International Agency for Research on Cancer.
3. If an agency of the state or federal government identifies a chemical as a possible carcinogen or reproductive toxicant. This generally applies to prescription drugs identified by the U.S. FDA.

3.13.2 Program Requirements

Once a chemical is on the list, any company with more than 10 employees that is located in California or does business in California is prohibited from knowingly discharging listed chemicals into sources of drinking water. These companies must also provide a "clear and reasonable" warning before knowingly and intentionally exposing anyone to a listed chemical. Once a chemical is listed, businesses have 12 months to comply with warning requirements, and 20 months to comply with the discharge prohibition. Businesses are responsible for developing their own warnings, and do not have to report any Prop 65 chemicals to the California Office of Environmental Health Hazard Assessment (OEHHA). Governmental agencies and public water systems are exempt from this act.

A company does not have to follow the requirements of Prop 65 if it is determined that a chemical presents "no significant risk". For a carcinogen, this is a level of the chemical which is calculated to result in one excess case of cancer in an exposed population of 100,000, assuming lifetime exposure at the level in question. For a reproductive toxicant, it is defined as a level of an exposure to the chemical that could be increased by 1,000 and still not produce birth defects or reproductive harm. These threshold levels are called "safe harbor numbers". Businesses may or may not determine the level of a chemical present in their product. If they provide warning that listed chemical is present, it can either mean that levels of the chemical has been evaluated, and it is present above the safe harbor number, or it can mean that the chemical is present at some level, but the company did not find it worthwhile to evaluate.

3.13.3 Role of Stakeholders

Prop 65 was introduced via the California State initiative process. An initiative measure is proposed by California citizens who must present a signed petition to the California Secretary of State, outlining the text of the proposed statute or amendment to the state Constitution. The Secretary of State then submits the measure at the next general election.

The California Attorney General's Office enforces Proposition 65. Any district attorney or city attorney (for cities with a population of at least 750,000) may also enforce Proposition 65. Any individual acting in the public interest may also enforce Proposition 65 by filing a lawsuit against a business alleged to be in violation of this law. Lawsuits have been filed by the Attorney General's Office, district attorneys, consumer advocacy groups, and private citizens and law firms. Penalties for violating Proposition 65 by failing to provide notices can be as high as $2,500 per day for each violation, in addition to any other penalty established by law.

3.13.4 Financial Impacts

The Safe Drinking Water and Toxic Enforcement Fund is established in the California State Treasury. The director of the lead agency designated by the Governor to implement this chapter may expend the funds in the Safe Drinking Water and Toxic Enforcement Fund, upon appropriation by the Legislature, to implement and administer this chapter.

Any company that falls under the requirements of Prop 65 is financially responsible for all chemical analysis of their products and waste, as well as for providing a clear and

reasonable warning before knowingly and intentionally exposing anyone to a listed chemical. The warning can include labeling of a consumer product, posting signs at the workplace, distributing notices at a rental housing complex, and by publishing notices in a newspaper.

All civil and criminal penalties collected pursuant to this chapter shall be apportioned in the following manner:

- Fifty percent of all civil and criminal penalties collected under Prop 65 will be deposited in the Hazardous Substance Account in the General Fund.
- Twenty-five percent will be paid to the office of the city attorney, city prosecutor, district attorney, or Attorney General, whichever office brought the action.
- Twenty-five percent will be paid to OEHHA and used to fund the activity of the California state environmental agency, the local health officer, or other local public officer or agency which investigated the matter that led to the bringing of the action.

Because the penalties for violating Proposition 65 can be very costly, most business settle before the case goes to trial. Businesses usually pay the plaintiff's attorney fees and cost. Plaintiffs might also ask for restitution—money that goes to a public interest group, usually in lieu of penalties.

The settlement usually will also include some provision for the company to reformulate the product, give some type of warning or remove the product from the market.

3.13.5 Effectiveness of Program

Prop 65 has provided residents of California with information that allows them to limit their exposures to listed chemicals beyond restrictions established by other State and Federal Laws. It has also encouraged manufacturers to remove listed chemicals from their products. This law benefits consumers, however it adds an additional cost to companies that do business in the State of California. The list of chemicals, combined with the burden of proof on individual companies, can easily lead to lawsuits. Companies must test their products, come up with potential replacements for the toxic chemicals, reduce discharges, notify the public when necessary, and pay for any enforcement actions against their company.

Prop 65 has reduced the amount of certain chemicals in commonly used products. According to OEHHA, air emissions of certain chemicals - including ethylene oxide, hexavalent chromium, and chloroform - from facilities in California have also been significantly reduced as a result of Proposition 65. Warnings regarding the danger of alcohol to fetuses are one of the most widespread results of this program.

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3.14 European Union's (EU) Registration, Evaluation Authorization and Restriction of Chemicals (REACH) Program

Chemicals pose a quandary for the European Union (EU). Production of chemicals is Europe's third largest industry, employing 1.7 million people directly. There are over 100,000 different chemicals used in the European market and a number of these chemicals have been linked to certain health conditions, such as asbestos being connected to lung cancer and benzene to leukemia. Of the 100,000 chemicals used in the market, only a small portion has adequate information on carcinogenicity or other toxicity. In addition, new substances are introduced to the market annually.

The EU program for Registration, Evaluation, Authorization and Restrictions of Chemicals (REACH) has four basic components for dealing with toxic chemicals.

1. Registration
2. Evaluation
3. Authorization
4. Restriction

3.14.1 Basis for Program

REACH is based on Council Directives 67/548/EEC of 27 June 1967, related to regulating classification, packaging and labeling of dangerous substances; 76/769/EEC of 27 July 1976 associated with restricting marketing and use of dangerous substances; 1999/45/EC of 31 May 1999 related to the classification, packaging and labeling of dangerous preparations; and 793/93 of 23 March 1993 related to the evaluation and control of the risks of existing

substances. These directives identified problems of disparities in individual country's laws and the need to do more to protect health and environment from chemicals.

- **Program Requirements**

Registration

REACH proposes to require companies that wish to sell their products to EU countries to provide composition information if:

1. The substance is present in those products in quantities totaling over 1 metric ton per producer or importer per year; and
2. The substance is present in those products above a concentration of 0.1% by weight.

This regulation goes beyond the usual requirements of companies providing Material Safety Data Sheets (MSDSs), which do not require composition information, but rather general impacts of the chemicals such as flammability, toxicity, exposure risks, and ranges of composition of certain toxic compounds.

Registration requires a manufacturer or importer to notify an authority in advance of the intention to produce or import a substance and to submit required information in advance of importing a product. The appropriate EU authority will put this information into an electronic database, assign a registration number and then screen the registered substances for properties raising particular concern.

Registration information is to include the following:

1. Data/information on the identity and properties of the substance (including data on toxicological and ecotoxicological properties);
2. Intended uses, estimated human and environmental exposure;
3. Production quantity envisaged;
4. Proposal for the classification and labeling of the substance;
5. Safety Data Sheet;
6. Preliminary risk assessment covering the intended uses; and
7. Proposed risk management measures.

Evaluation

This component of the program will require manufacturers or importers of chemicals to supply information on the toxicity of the chemicals. The goal is to establish a single source for toxicity data on existing and new chemicals. The information can be supplied by acceptable testing in countries outside of the EU, or by evaluating toxicity of the chemicals functional groups, or toxicity of analogous compounds. The program is also driven by a desire to limit new animal testing.

The goal of the program is to expand the knowledge on chemical toxicity and to place the burden of testing and providing that information on the chemical manufacturer or users of a chemical.

The EU wishes to maximize the use of non-animal testing methods for determining toxicity of new and existing chemicals, including the use of quantitative or qualitative structure

activity relationships ((Q)SARs) to determine toxicity based on knowledge of toxicity of similar chemicals or functional groups.

Authorization

Substances with certain hazardous properties that give rise to very high concern will have to be given use-specific permission before they can be employed in particular uses. Evidence demonstrating that the specific use only presents a negligible risk or, in other cases, that the use is acceptable will be considered before granting an authorization. This evidence includes taking into account socio-economic benefits; lack of 'safer' chemicals for the same task; and measures minimizing the exposure of consumers, workers, the general public and the environment..

An authorization would be granted if the risk to human health or the environment from the use of a substance arising from the intrinsic properties specified in Annex XIV is adequately controlled; it is shown that socio-economic benefits outweigh the risk to human health or the environment; and if there are no suitable alternative substances or technologies.

One goal of authorization is to ensure the good functioning of the internal market while, assuring that the risks from substances of very high concern are properly controlled. Another goal is to ensure that these substances are eventually replaced by suitable alternative substances or technologies where these are economically and technically viable.

The EU recognizes that the authorization program will require considerable resources for industries to comply with the program, and for the regulatory community to review applications. It is expected that about 5 or 10 chemicals will be selected each year for the authorization process. The system is also organized so that one application should be prepared by interested parties for each chemical and use.

The following substances may be included:

- Category 1 or 2 Carcinogens (**Tables 3-11 and 3-12**)
- Category 1 or 2 Mutagens (**Table 3-13**)
- Category 1 or 2 Toxic for Reproduction (**Table 3-14 and 3-15**)
- Substances which are persistent, bioaccumulative and toxic (PBTs)

The following information is included in an authorization for a substance(s):

1. The person(s) to whom the authorization is granted;
2. The identity of the substance(s);
3. The use(s) for which the authorization is granted;
4. Any conditions under which the authorization is granted;
5. The time-limited review period; and
6. Any monitoring arrangement.

Notwithstanding any conditions of an authorization, the holder should ensure that the exposure is reduced to as low a level as is technically and practically possible.

Authorizations may be reviewed at any time ifthe circumstances of the original authorization have changed so as to affect the risk to human health, the environment, or the socio-economic impact; or new information on possible substitutes becomes available.

Applications for authorization may be submitted by the manufacturer(s), importer(s) and/or downstream user(s) of the substance. Applications may be submitted by one or several persons and could include one or several substances for one or more uses. Applications can be filled out for the applicant's own use(s) and/or for uses for which he intends to place the substance on the market.

An application for authorization shall include the following information:

1. The identity of the substance(s);

2. The name and contact details of the person or persons making the application;

3. A request for authorization, specifying for which use(s) the authorization is sought and covering the use of the substance in preparations and/or the incorporation of the substance in articles, where this is relevant;

4. A chemical safety report covering the risks to human health and/or the environment from the use of the substance(s) arising from the intrinsic properties; and

5. An analysis of the alternatives considering their risks and the technical and economic feasibility of substitution.

In addition, the application may also include:

1. A socio-economic analysis;

2. A substitution plan, where appropriate, including research and development and a timetable for proposed actions by the applicant; and

3. A justification for not considering risks to human health and the environment arising either from:

   (a) Emissions of a substance from an installation for which a permit was granted; or

   (b) Discharges of a substance from a point source.

PBT (Persistent, Bioaccumulative and Toxic) substances

A substance that fulfils all three of the criteria of the sections below is a PBT substance.

Persistent chemicals are those that have:

1. A half-life in marine water longer than 60 days; or
2. A half-life in fresh- or estuarine water longer than 40 days; or
3. A half-life in marine sediment longer than 180 days; or
4. A half-life in fresh- or estuarine water sediment longer than 120 days; or
5. A half-life in soil longer than 120 days.

Bioaccumulative chemicals have a bioconcentration factor (BCF) in aquatic species higher than 2,000. Data from freshwater as well as marine water species can be used.

Toxic chemicals are ones in which

1. The long-term no-observed effect concentration (NOEC) for marine or freshwater organisms is less than 0.01 mg/l; or
2. The substance is classified as carcinogenic (category 1 or 2), mutagenic (category 1 or 2), or toxic for reproduction (category 1, 2, or 3); or
3. There is other evidence of chronic toxicity.

VPBT (Very Persistent, Bioaccumulative and Toxic) Substances

Very Persistent chemicals are those that have:

1. A half-life in marine, fresh- or estuarine water longer than 60 days; or
2. A half-life in marine, fresh- or estuarine water sediment longer than 180 days, or in soil longer than 180 days.

Bioaccumulative chemicals have a BCF in aquatic species higher than 5,000.

Table 3-11 - Initial List of Category 1 Carcinogens	
Chromium (VI) trioxide	Chloroethylene
Zinc chromates including zinc potassium chromate	Bis (chloromethyl) ether
Nickel monoxide	Chloromethyl methyl ether;
Nickel dioxide	2-Naphthylamine; beta-naphthylamine
Dinickel trioxide	Benzidine; 4,4'-diaminobiphenyl;
Nickel sulfide	Biphenyl-4,4'-ylenediamine
Nickel subsulphide	Salts of benzidine
Diarsenic trioxide;	Salts of 2-naphthylamine
Arsenic trioxide	Biphenyl-4-ylamine;
Arsenic pentoxide;	Xenylamine;
Arsenic acid and its salts	4-aminobiphenyl
Lead hydrogen arsenate	Salts of biphenyl-4-ylamine;
Butane [containing ≥0,1% Butadiene	Salts of xenylamine;
Isobutane [containing ≥0,1% Butadiene	Salts of 4-aminobiphenyl
1,3-Butadiene; buta-1,3-diene	Coal tar
Benzene	Erionite
Vinyl chloride;	Asbestos
Chlorodimethyl ether	

Table 3-12 - Initial List of Category 2 Carcinogens	
Beryllium	Hexachlorobenzene
Beryllium compounds with the exception of aluminium	1,4-Dichlorobut-2-ene

Table 3-12 - Initial List of Category 2 Carcinogens	
beryllium silicates	
Beryllium oxide	2,3-dibromopropan-1-ol;
Sulfallate (ISO);	2,3-dibromo-1-propanol
2-chlorallyl diethyldithiocarbamate	Ethylene oxide;
Dimethylcarbamoyl chloride	oxirane
Diazomethane	1-Chloro-2,3-epoxypropane;
Hydrazine	epichlorhydrin
N,N-Dimethylhydrazine	Propylene oxide;
1,2-Dimethylhydrazine	1,2-epoxypropane;
Salts of hydrazine	methyloxirane
Hydrazobenzene; 1,2-	2,2'-Bioxirane;
diphenylhydrazine	1,2:3,4-diepoxybutane
Hydrazine bis(3-carboxy-4- hydroxybenzensulfonate)	2,3-Epoxypropan-1-ol;
Hexamethylphosphoric triamide;	glycidol
hexamethylphosphoramide	Phenyl glycidyl ether;
Dimethyl sulphate	2,3-epoxypropyl phenyl ether;
Diethyl sulphate	1,2-epoxy-3-phenoxypropane
1,3-Propanesultone	Styrene oxide;
Dimethylsulfamoylchloride	(epoxyethyl)benzene;
Potassium dichromate	phenyloxirane
Ammonium dichromate	Furan
Sodium dichromate	R-2,3-epoxy-1-propanol
Sodium dichromate, dihydrate	(R)-1-chloro-2,3-epoxypropane
Chromyl dichloride;	4-Amino-3-fluorophenol
Chromic oxychloride	5-Allyl-1,3-benzodioxole;
Potassium chromate	safrole
Calcium chromate	3-Propanolide;
Strontium chromate	1,3-propiolactone
Chromium III chromate;	Urethane(INN);
Chromic chromate	ethyl carbamate
Chromium (VI) compounds, with the exception of barium chromate	Methyl acrylamidomethoxyacetate (containing ≥ 0,1% acrylamide)
Sodium chromate	Methyl acrylamidoglycolate (containing ≥ 0,1%

Table 3-12 - Initial List of Category 2 Carcinogens	
	acrylamide)
Cobalt dichloride	Acrylonitrile
Cobalt sulphate	2-Nitropropane
Potassium bromate	2,4-Dinitrotoluene [1];
Cadmium oxide	dinitrotoluene [2];
Cadmium fluoride	dinitrotoluene, technical grade
Cadmium chloride	5-Nitroacenaphthene
Cadmium sulphate	2-Nitronaphthalene
Benzo[a]pyrene;	4-Nitrobiphenyl
benzo[d,e,f]chrysene	Nitrofen (ISO);
Benzo[a]anthracene	2,4-dichlorophenyl4- nitrophenyl ether
Benzo[b]fluoranthene;	2-Nitroanisole
benzo[e]acephenanthrylene	2,6-Dinitrotoluene
Benzo[j]fluoranthene	2,3-dinitrotoluene
Benzo[k]fluoranthene	3,4-dinitrotoluene
Dibenz[a,h]anthracene	3,5-dinitrotoluene
Chrysene	Hydrazine-tri-nitromethane
Benzo[e]pyrene	2,5-dinitrotoluene
1,2-Dibromoethane;	Azobenzene
Ethylene dibromide	Methyl-ONN-azoxymethyl acetate;
1,2-Dichloroethane;	methyl azoxy methyl acetate
Ethylene dichloride	Disodium {5-[(4-((2,6-hydroxy-3- ((2-hydroxy-5-sulphophenyl)azo)phenyl)azo) (1,1-biphenyl)-4-yl)azo]salicylato(4-)}cuprate(2-);
1,2-Dibromo-3-chloropropane	CI Direct Brown 95
Bromoethylene	4-o-Tolylazo-o-toluidine; 4-amino- 2,3-dimethylazobenzene;
Trichloroethylene;	o-aminoazotoluene
trichloroethene	4-Aminoazobenzene
α -Chlorotoluene;	Benzidine based azo dyes;
benzyl chloride	4,4'-diarylazobiphenyl dyes,
α ,α ,α -Trichlorotoluene;	Disodium 4-amino 3-[[4-[(2,4-diaminophenyl)azo][1,1-biphenyl]-4-yl]azo]-5-hydroxy-6-(phenylazo)naphtalene-2,7-disulphonate;
benzotrichloride	Tetrasodium 3,3′ -[[1,1-biphenyl]-4,4-

Table 3-12 - Initial List of Category 2 Carcinogens	
	dylbis(azo)]bis[5-amino-4-hydroxynaphthalene-2,7-disulphonate]
1,3-Dichloro-2-propanol	Disodium 3,3-[[1,1-bifenyl]-4,4dylbis(azo)]bis[4-aminonaphthalene-1-sulphonate);

Table 3-13 - Initial List of Category 2 Mutagens (No Category 1 Mutagens were initially listed)	
Hexamethylphosphoric triamide;	Benzo[d,e,f]chrysene
hexamethylphosphoramide	1,2-Dibromo-3- chloropropane
Diethyl sulphate	Ethylene oxide;
Potassium dichromate	oxirane
Ammonium dichromate	Propylene oxide;
Sodium dichromate	1,2-epoxypropane;
Sodium dichromate, dihydrate	Methyloxirane
Chromyl dichloride;	2,2'-Bioxirane;
chromic oxychloride	1,2:3,4-diepoxybutane
Potassium chromate	Methyl acrylamidomethoxyacetate (containing ≥ 0,1% acrylamide)
Sodium chromate	Methyl acrylamidoglycolate (containing ≥ 0,1% acrylamide)
Cadmium fluoride	Ethyleneimine;
Cadmium chloride	aziridine
Butane [containing ≥ 0,1% Butadiene	1,3,5,-Tris(oxiranylmethyl)- 1,3,5-triazine-2,4,6(1H,3H,5H)-trione;
Isobutane [containing ≥ 0,1% Butadiene	TGIC
1,3-Butadiene buta-1,3- diene	Acrylamide
Benzo[a]pyrene;	1,3,5-tris-[(2S and 2R)-2,3- epoxypropyl]-1,3,5-triazine- 2,4,6-(1H,3H,5H)-trione

Table 3-14 - Initial List of Chemicals Toxic to reproduction, Category 1	
Carbon monoxide	Trilead bis(orthophosphate)
Lead hexafluorosilicate	Lead acetate
Lead alkyls	Lead(II) methanesulphonate
Lead azide	C.I. Pigment Yellow 34;
Lead chromate	C.I. Pigment Red 104;
Lead di(acetate)	

Table 3-15 - Initial List of Chemicals Toxic to reproduction, Category 2	
6-(2-Chloroethyl)-6(2-methoxyethoxy)-2,5,7,10-tetraoxa-6-silaundecane; etacelasil	2-Methoxypropyl acetate
Flusilazole (ISO); bis(4-fluorophenyl)-(methyl)-(1H-1,2,4-triazol-1-ylmethyl)-silane	Fluazifop-butyl (ISO); Butyl (RS)-2-[4-(5-trifluoromethyl-2- pyridyloxy)phenoxy]propionate
A mixture of: 4-[[bis-(4-fluorophenyl)-methylsilyl]methyl]-4H-1,2,4-triazole; 1-[[bis-(4-	Vinclozolin (ISO); N-3,5-Dichlorophenyl-5-methyl-5-vinyl-1,3-oxazolidine-2,4-dione
fluorophenyl)methylsilyl]methyl]-1H-1,2,4-triazole	Methoxyacetic acid
Nickel tetracarbonyl	Bis(2-ethylhexyl) phthalate;
Cadmium fluoride	di-(2-ethylhexyl) phthalate;
Cadmium chloride	DEHP
Benzo[a]pyrene;	Dibutyl phthalate;
benzo[d,e,f]chrysene	(+/-) tetrahydrofurfuryl (R)-2-[4-(6-chloroquinoxalin-2-yloxy)phenyloxy]propionate
2-Methoxyethanol;	Binapacryl (ISO); 2-secbutyl-4,6-dinitrophenyl-3-methylcrotonate
Ethylene glycol monomethyl ether;	Dinoseb; 6-sec-butyl-2,4-dinitrophenol
methylglycol	Dinoterb; 2-tert-butyl-4,6-dinitrophenol
2-Ethoxyethanol;	Salts and esters of dinoterb
Ethylene glycol monoethyl ether;	Nitrofen (ISO); 2,4 dichlorophenyl 4-nitrophenyl ether
Ethylglycol	Methyl-ONN-azoxymethyl acetate;
2,3-Epoxypropan-1-ol;	methyl azoxy methyl acetate
Glycidol	Tridemorph (ISO); 2,6-dimethyl-4-tridecylmorpholine
2-Methoxypropanol	Ethylene thiourea;
Bis(2-methoxyethyl) ether	imidazolidine-2-thione;
R-2,3-epoxy-1-propanol	2-imidazoline-2-thiol
4,4'- isobutylethylidenediphenol;	Cycloheximide

Table 3-15 - Initial List of Chemicals Toxic to reproduction, Category 2	
2,2-bis (4'-hydroxyphenyl)- 4-methylpentane	Flumioxazin (ISO); N-(7-Fluoro-3,4-dihydro-3-oxo-4-prop-2-ynyl-2H-1,4-benzoxazin-6-yl)cyclohex-1-ene-1,2-dicarboxamide
2-Methoxyethyl acetate;	(2RS,3RS)-3-(2- Chlorophenyl)-2-(4-fluorophenyl)-[(1H-1,2,4-triazol-1-yl)-ethyl]oxirane
ethylene glycol monomethyl ether acetate;	N,N-dimethylformamide;
methylglycol acetate	dimethyl formamide
2-Ethoxyethyl acetate;	N, N-Dimethylacetamide
ethylene glycol monoethyl ether acetate;	Formamide
Ethylglycol acetate	N-methylacetamide
2-Ethylhexyl 3,5-bis(1,1- dimethylethyl)-4-hydroxyphenyl methyl thio acetate	N-methylformamide
Bis(2-Methoxyethyl) phthalate	

Restriction

The REACH Program has proposed to ban certain uses of chemicals. Some of these chemicals and uses are shown in Table 3-16 below.

Table 3-16 - Examples of Banned Uses of Chemicals in Proposed REACH Legislation
1. **Polychlorinated terphenyls (PCTs)** Preparations, including waste oils, with a PCT content higher than 0,005% by weight. Shall not be used. However, the following use of equipment, installations and fluids which were in service on 30 June 1986 shall continue to be permitted until they are disposed of or reach the end of their service life: (a) closed-system electrical equipment transformers, resistors and inductors; (b) large condensers (≥ 1 kg total weight); (c) small condensers; (d) heat-transmitting fluids in closed-circuit heat-transfer installations; (e) hydraulic fluids for underground mining equipment.
2. **Chloro-1-ethylene (monomer vinyl chloride)** Shall not be used as aerosol propellant for any use.
3. **Tris (2,3 dibromopropyl) phosphate** Shall not be used in textile articles, such as garments, undergarments and linen, intended to come into contact with the skin.
4. **Benzene** **(a)** Not permitted in toys or parts of toys as placed on the market where the concentration of benzene in the free-state is in excess of 5 mg/kg of the weight of the toy or part of toy. **(b)** Shall not be used in concentrations equal to, or greater than, 0,1% by mass in substances or preparations placed on the market. **(c)** However, paragraph 2 shall not apply to: (a) motor fuels.

Table 3.16 - Examples of Banned Uses of Chemicals in Proposed REACH Legislation
5. **Lead carbons and lead sulfates** Shall not be used as substances and a constituent of preparations intended for use as paints, except for the restoration and maintenance of works of art and historic buildings and their interiors, where Member States wish to permit this on their territory, in accordance with the provisions of ILO Convention 13 on the use of white lead and sulphates of lead in paint.
6. **Mercury compounds** 1. Shall not be used as substances and constituents of preparations intended for use: (a) to prevent the fouling by micro-organisms, plants or animals of: – the hulls of boats, – cages, floats, nets and any other appliances or equipment used for fish or shellfish farming, – any totally or partly submerged appliances or equipment; (b) in the preservation of wood; (c) in the impregnation of heavy-duty industrial textiles and yarn intended for their manufacture; (d) in the treatment of industrial waters, irrespective of their use. 2. The placing on the market of batteries and accumulators, containing more than 0,0005% of mercury by weight, including in those cases where these batteries and accumulators are incorporated into appliances shall be prohibited. 3. Button cells and batteries composed of button cells with a mercury content of no more than 2% by weight shall be exempted from this prohibition.
7. **Arsenic compounds** 1. Shall not be used as substances and constituents of preparations intended for use: (a) to prevent the fouling by micro-organisms, plants or animals of: – the hulls of boats, – cages, floats, nets and any other appliances or equipment used for fish or shellfish farming, – any totally or partly submerged appliances or equipment; (b) in the preservation of wood. Furthermore, wood so treated shall not be placed on the market.

3.14.2 Role of Stakeholders

Stakeholders have been consulted continuously from the early stages of the development of the legislation. An initial brainstorming meeting was held in February 1999 with more than 150 stakeholders - regulators, scientists, industry, environmental and consumer NGOs as well as representatives from applicant countries. This brainstorming meeting helped to provide the Commission with an overall view of the problems with the current system and potential solutions.

An exchange of views took place in the course of conferences, stakeholder working groups and bilateral contacts between the services and stakeholders. Specific studies, notably in relation to the likely impact of the system proposed, were also initiated.

In May 2003, the Commission launched an Internet consultation to consider the workability of the draft legislation, including the technical requirements. More than 6,000 contributions were received. Almost half of these were sent by industry – firms or associations. One hundred forty-two NGOs, including trade unions, responded. From the Member States, six governments sent comments, as well as a number of public authorities. Public authorities from three Accession countries gave their input as well as authorities and governments from third countries (Australia, Canada, Chile, China, Israel, Japan, Malaysia, Mexico, Norway, Singapore, Switzerland, Thailand, and USA).

Approximately half of the contributions came from individuals. Many raised issues in relation to animal testing, others voiced fears of job-losses or demanded increased protection of the environment and human health and better information for consumers. In addition, two petitions were submitted, supported by 34,000 individuals and organizations.

The overall thrust of the comments supported the aims, especially the sustainability dimension, of the essential features of REACH. Stakeholders questioned workability, (i.e. availability of resources, knowledge and technical capacity to operate the new system).

Based on comments, the following adjustments were made:

- Substantial simplification of the requirements to be met by manufacturers and importers in relation to Chemical Safety Assessments and Chemical Safety Reports, and a much reduced burden for downstream users;
- No registration or evaluation for polymers;
- Lighter registration requirement for substances produced between 1 and 10 metric tons, with
- Reduced testing requirements and no need to complete Chemical Safety Assessments or Chemical Safety Reports; and
- Giving the proposed chemicals agency more responsibility in the areas of registration, evaluation and data-sharing.

3.14.3 Financial Impacts

In 2003, the European Commission assessed the health benefits of REACH as well as the costs to industry and the proposed Chemical Agency as between €2.8 and €5.2 billion Euros extending over 11 to 15 years. They projected the health benefits as being on the order of €50 billion Euros over 50 years.

It was estimated that testing and registration costs would be €2.3 billion Euros (including €0.3 billion in agency fees), as shown in Table 3-17 below.

Table 3-17. Estimated Cost for REACH Registration and Testing

Cost Items	Costs (Million Euros)
Registration	€500
Testing	€1,250
Safety data sheets	€250
Authorisation procedures	€100
Reduced costs for new substances below 1t etc.	(€100)
Total Testing and Registration	€2,000
Agency fees (paid by chemicals sector)	€300
Total (Including Agency Fees)	€2,300

The costs of running the REACH system are estimated at €0.4 billion Euros over 11 years (cost of establishing and running the chemical agency). Of this €0.1 billion Euros is to be provided by EU Budget, and the rest from fees on the chemical industry.

The costs to downstream users at the introduction of REACH is assessed to be in the range of €2.8 to €5.2 billion Euros. These costs will occur in the form of higher chemical prices resulting from the passing through of testing and registration costs, and additional substitution costs for downstream users of chemicals finding potentially higher cost or less-effective replacements for those substances removed from the market.

3.14.4 Effectiveness of Program

The REACH Program is just being implemented, therefore it is too early to tell how effective it will be.

- **Bibliography**

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8. *Commission Staff Working Paper: Regulation of the European Parliament and of the Council Concerning REACH – Extended Impact Assessment*, Commission of the European Communities, October 29, 2003.
9. *The REACH Proposal Process Description*, Council of the European Union, June 2006.
10. *Questions and Answers on REACH*, Council of the European Union, March 2006.

SECTION 4

4.0 Toxic Chemical Reduction Program Options

The information developed and gathered in support of the toxic chemical reduction program, including the identification of program goals and the toxic chemicals target list, as well as the review of other government toxic reduction programs was used to develop toxic chemical reduction program options, and subsequently program alternatives for evaluation for the State of São Paulo, Brazil. Among these program options, three different, proven program alternatives and associated implementation plans that could be used by the Companhia de Tecnologia de Saneamento Ambiental (CETESB) to institute an effective operational toxic chemical reduction program in São Paulo, Brazil were developed, as detailed in Section 5.

Documentation of the institutional/legal aspects that would potentially need to be overcome in order to implement the option, as applicable, are also discussed in this Section.

4.1. Chemical Usage Reporting

Key aspects of implementing a toxic chemical reduction program is the establishment of the list of toxic chemicals that will be targeted for reporting and reduction under the program, determination of the target chemical usages, and establishment of reporting requirements under the program, such as de minimis (minimum) reporting thresholds, and reporting mechanics and frequencies.

4.1.1 Institutional/Legal Aspects

Article 225 (§1, inc. V) of the Federal Constitution and State Decree No. 9.509 from May 20, 1997 (Article 2, inc. VI, VII, and VIII) both provide CETESB with the authority to regulate and enforce the reporting and control of toxic chemicals in the State of São Paulo. Although there is currently no requirement that companies report specific chemical use, quantities of raw materials used (including a list of chemicals), products manufactured, process flow diagrams, wastes generated, etc., must be provided as part of the Project Characterization Document (MCE). The annual use of specific toxic chemicals needed for the toxic chemical use inventory could be required as part of the MCE.

CETESB is currently developing a "Unified Environmental Permitting" system (SMA Resolution – 22 of May 17, 2007), aimed at integrating and unifying the environmental permitting process in the State of São Paulo, which states in part:

> *rules on the execution of the Strategic Environmental Project "Unified Environmental Permitting", which aims at integrating and unifying the environmental permitting process in the State of São Paulo, changes permitting procedures of certain activities, and makes other provisions.*

The Unified Environmental Permitting project is intended to make the environmental permitting process more thorough, efficient, and transparent. It is recommended that permit form modifications needed for the toxic chemical use inventory be integrated into the Unified Environmental Permitting project.

4.1.2 Option Considerations

The establishment of the target chemical list and de minimis reporting thresholds for São Paulo was detailed in Section 2 of this report.

Factors to consider when determining toxic chemical usages includes incorporating the quantity of the product used multiplied by the concentration of the target chemical, by factoring in the best information available.

Factors to consider for reporting include:

- Develop a reporting form (using current permitting forms) or database interface (i.e., tailored programming of the SIPOL database system) for chemical use and permit reporting.
- Targeted chemicals are reported, only, at values greater than established de minimis thresholds
- Report the amount of each chemical used. It is recommended that CETESB specify the units for reporting. The simplest would be to require all chemical usages be reported by weight.
- Determine whether the usage needs to be reported for each year of the previous permit period (i.e., 5 yearly usage numbers), or average yearly usage for the past period of permit, or just the most recent year.
- Decide how the transition from current permit requirements to toxics chemical use reporting will be handled. Options could include reporting only for the last year in the first permit application to reporting all usage after the effective date of the new reporting requirements and subsequently keep track of all years for future permits. This would have the advantage of collecting data from all industries after the effective date of the requirement.
- Determine consequences for noncompliance of reporting requirements (i.e., fines), and if the consequences are monetary, how that funding will be subsequently utilized.

4.2 Technical Assistance

Technical assistance could include support with inventory preparation, toxic use reduction planning, and industry sector-specific chemical reduction by CETESB and/or universities/non-profit organizations.

4.2.1 Institutional/Legal Aspects

There are no regulations requiring industries to apply best management practices in using toxic chemicals. An effective technical assistance program would provide material specific to the industrial sector on best management practices for toxic chemical use.

State Decree No. 8468 of September 8, 1979 states in Article 6, Item 1 that CETESB is to establish and execute programs and plans for activities related to control and prevention of pollution. This statement provides CETESB with the authority to provide technical assistance programs for toxic chemical use reduction to industry sectors. Despite this

authority, CETESB is limited in the extent of technical assistance it can provide to individual facilities.

Based on State Decree No. 8468, CETESB representatives are required to report any permit violations observed during facility visits for enforcement actions. Under the current regulatory framework, there is no legal avenue for CETESB to provide direct technical assistance to individual facilities without reporting and citing permit violations observed during facility visits. This requirement would make it difficult for CETESB representatives to adequately provide direct assistance to facilities that need assistance with technologies to reduce their toxic chemical use. In addition, facilities are less likely to seek out individual technical assistance from CETESB, knowing there may be a possibility they could be cited for a permit violation.

A more significant limitation on CETESB in providing direct technical assistance to facilities is its inherent conflict with its legal mission, which is to control pollution sources through issuing and enforcing permits. This mission is established by State Law 997/1976 and regulated by State Decree No. 8.468/1976, which gives CETESB the administrative enforcement power on environmental issues and a duty to issue and enforce permits, to enforce environmental laws and regulations, and to control pollution sources.

4.2.2 Option Considerations

CETESB is currently working with the Federation of Industries of the State of São Paulo (FIESP) to prepare P2 and Cleaner Production (CP) technical assistance materials aimed at specific industry sectors. Since 1996, CETESB has:

- Incorporated CP considerations in some environmental permitting processes
- Developed partnerships with entities' production sectors, aimed at publishing CP technical documents for specific processes
- Published successful CP case studies
- Provided open courses and training at company sites
- Participated in Environmental Chambers

Various CP guides have been developed for specific industry sectors; each contains a description of processes, primary potential environmental impacts, and applicable CP measures.

A manual was also prepared to help organizations implement a P2 program, with a methodology that includes various stages presented in a clear and simple manner.

It is recommended that the toxic chemical reduction program technical assistance be incorporated into the current P2 and CP programs, providing targeted industry sectors with helpful information and best management practices that would lead to reduction in toxic chemicals use.

An effective technical assistance program would provide material specific to the industrial sector on best management practices for toxic chemical use. The types of technical assistance that could be provided for the program include toxics chemical usage reduction planning, opportunities for waste minimization, and innovative technologies to reduce toxics chemicals use, as well as workshops and seminars on toxics chemical usage reduction planning tools.

Assistance under this proposed Program could include the following:

- Annual training classes to complete reporting forms
- General toxics chemical usage reduction class offerings for those companies that choose to implement the voluntary toxics chemical usage reduction and reduction aspect of the program, and to increase awareness and education for those companies that have not considered doing so but may in the future

Toxics chemical usage reduction training could include providing tips on obtaining top management support (i.e., via documentation of company policy, goals, staff allocation, training, and means for rewarding successes), on identifying and characterizing wastes and chemical usage to prioritize toxics chemical usage reduction efforts and to focus on source reductions, on implementation of audits, and on encouraging technology transfer and program evaluations.

As noted above, CETESB personnel have the following restrictions limiting the ability to provide technical assistance to industries:

- CETESB representatives are required to report for enforcement action any permit violations that are observed during facility visits.
- Providing technical assistance to facilities is incompatible with CETESB's legal end objective, which is to permit, enforce, and control pollution sources.

However, CETESB can also assist companies by providing training and preparing toxic chemical reduction technical materials for companies across industry sectors. CETESB could provide industry-specific training, industry-specific study results/trends, and overall toxics chemical usage reduction methodology support on a sector-by-sector basis, as well as demonstrate how to comply with and complete specific forms. There would be no support involving the collection of site-specific data by CETESB.

Specific toxics chemical usage reduction planning, which could involve collection of actual site data, could be conducted on a company-by-company basis by an external entity. It is recommended that direct technical assistance through non-regulatory institutions be evaluated to determine if this is a feasible option for CETESB and for the program. This direct technical assistance could be provided to individual companies indirectly through a university or public institution. A separate funding source could be created specifically for this type of technical support. More specifically, CETESB could create a new agency similar to the Office of Technical Assistance (OTA) established in the Massachusetts Toxics Use Reduction Act (TURA) program, and site them at a university. This organization and arrangement would:

- Allow CETESB to have more control.

- Allow the agency to better focus on the toxics reduction program.
- Allow better implementation of technology. University professors are busy, travel a lot, and are more interested in new technology rather than existing proven technology. They are more research oriented, not implementation oriented.
- Still provide access to university experts.

4.2.3 P2 Roundtable

The National Pollution Prevention Roundtable (NPPR) is the largest membership organization in the US devoted solely to pollution prevention (P2). The mission of NPPR is to provide a national forum for promoting the development, implementation, and evaluation of efforts to avoid, eliminate, or reduce pollution at the source. Specifically, this organization brings P2 professionals across the country into contact with each other, giving them the opportunity to exchange knowledge and ideas. It provides a large number of networking opportunities annually, as well as drawing from a large pool of P2 professionals.

The P2 Roundtable has five established goals:

- **Goal 1: Information Exchange** - Advance pollution prevention by maintaining and improving opportunities for exchanging ideas and facilitating coordination of efforts.
- **Goal 2: Public Policy** - Advance pollution prevention by influencing the development and implementation of policies, legislation and regulations.
- **Goal 3: Education** - Promote education and awareness of pollution prevention concepts, programs, methods, accomplishments, and benefits.
- **Goal 4: External Partnerships** - Foster constructive, mutually beneficial relationships with other organizations which have related missions
- **Goal 5: Funding** - Provide leadership and coordination that supports sustainable funding opportunities for pollution prevention.

Basis for Program

NPPR is a tax-exempt non-profit organization under Section 501(c)(3) of the Internal Revenue Code. Non-profit organizations typically involve charitable, religious, educational, and scientific organizations. None of its earnings may incur to any private shareholder or individual. In addition, it may not attempt to influence legislation as a substantial part of its activities and it may not participate in any campaign activity for or against political candidates.

NPPR is a membership-based organization. Fees are due upon joining. Members receive a bi-monthly newsletter, keeping them up-to-date with P2 Roundtable events and also with P2 regulatory developments.

One of the most important roles of NPPR is to provide members with timely and accurate information on pollution prevention. This is done by providing forums for the direct exchange of ideas and expertise as well as through a number of programs designed for

dissemination of the most current data on pollution prevention policy developments, practices and resources.

NPPR members have the opportunity to participate in workgroups which help to disseminate information on cutting edge issues relating to pollution prevention amongst peers.

NPPR also holds national meetings that facilitate pollution prevention network building and the collaboration of ideas, resources and research on various topics. Members are able to attend these meetings with discounted registration fees, when appropriate.

Additionally, NPPR has an active Publications Program which includes newsletters and many other documents and reports.

The Roundtable also has four topic-specific Electronic Listservs, P2 Policy, P2 Tech, P2 Trainer and P2 Energy. All four listservs function as forums for sharing P2 information and act as discussion groups for pollution prevention practitioners. Through the listservs, subscribers have direct access to information and knowledge from hundreds of pollution prevention experts world wide. Listservs are currently available throughout the P2 community and are not limited to NPPR members.

The P2 Roundtable provides a forum for regulators and industry to discuss different P2 strategies. It is guided by P2 legislation, but not created by legislation. Members of different environmental agencies may participate in the Roundtable, but this is a voluntary relationship.

The P2 Roundtable provides information regarding the network of P2 professionals through its "P2 Experts" database. Participants can seek technical assistance regarding their P2 goals through a search of this database. (http://www.p2.org/p2experts)

Furthermore, the P2 roundtable provides information regarding P2 training material through its "P2 Trainer" database. (http://www.p2.org/p2trainer/)

Program Requirements

This program is not beneficial unless the resources that it provides are used. There are no specific requirements for members of NPPR.

Financial Impacts

Members must pay annual membership fees to participate in this organization. The fees range from a $30 annual student fee (with no voting rights), to an Organizational Membership annual fee of $400 for three full memberships, and finally $150 annually for an individual membership.

Organization events and publications are paid out of these annual membership fees, by event registration fees and income from any publications, and through donations. Corporations can also sponsor events.

4.3 Chemical Usage Reduction Planning

Pollution prevention occurs when raw materials, water, energy, and other resources are utilized more efficiently, when less harmful substances are substituted for hazardous ones, and when toxic substances are eliminated from the production process.

P2 is based on the concept of source reduction, which protects the environment by avoiding the generation of waste and harmful emissions. This option consists of planning for reduction opportunities, the establishment of cost-effective projects, and goal setting.

4.3.1 Option Considerations

The toxic chemical usage reduction planning requirements could entail either voluntary or mandatory preparation of a detailed Chemical Usage Reduction Plan. The Plan content would include, at a minimum:

- Identification of reduction opportunities
- Identification of cost-effective projects
- Establishment of chemical reduction goals
- Document the progress of meeting goals

Under a toxic chemical reduction program, a full Plan would be kept on-site at the company Headquarters at all times, and a summary of the Plan would be submitted to CETESB.

Factors to consider for the Plan development would be the level of detail as well as potentially the targets for goal setting (if the program does not require establishment of the targets by CETESB).

4.4 Public Disclosure

The public disclosure program option includes publishing successful reduction projects to generate positive public perception and publicity. In addition, by publishing chemical use and the Chemical Usage Reduction Plan Summary on the internet (similar to what has been done as part of the US Toxics Release Inventory), there is accountability to the public. In turn, the public can identify the highest emitters, thereby incentivizing toxic chemical use reduction by avoiding being the top emitters.

In addition, if companies that participate in the voluntary program are publicly recognized as having achieved reductions in the toxic chemicals used by their facilities, they could benefit economically (through additional business opportunities) by being viewed as being environmentally conscientious. In a survey of participating facilities conducted by the Massachusetts Toxic Use Reduction Program, 39 percent of the respondents saw some benefit to the improved environmental image they received as a result in participation in the program. Although the majority of respondents did not see any benefit, increasing public awareness of environmental issues may result in the increased value of products that are deemed to be more environmentally responsible.

As an example, as noted in the 2005 Indiana Pollution Prevention Annual Report, a dry cleaning company in Evansville, Indiana, converted from a hazardous dry cleaning solvent, perchloroethylene, to a nonhazardous, environmentally friendly solvent. To do so, the

company had to invest $225,000 in new equipment; and the new solvent costs the company an extra $9.00 per gallon. However, the company has absorbed the extra costs without raising prices for the customer, with the expectation that customers will appreciate the product benefits and do more business as a result. The company was also a Pollution Prevention/Source Reduction award winner.

4.4.1 Institutional/Legal Aspects

CETESB does have the authority to require the disclosure of information on toxic chemicals use by permitted companies through the following legislation.

- Article 193, V of the São Paulo State Constitution establishes that the State of São Paulo shall inform the population about pollution levels, environmental quality, accident hazards, and the presence of substances potentially harmful to health in drinking water and food, in addition to the results of monitoring activities and audits of pollution control systems and of activities with potential for generating pollution.
- Article 1 of Resolution 66 of December 17, 1996, establishes that:

  bodies of direct or indirect administration linked to the Secretary of the Environment are obligated to allow public access toadministrative processes that concern the environment and to provide all information of this nature under their custody, such as:

  I. data of any nature concerning emissions of solid waste, wastewater and air emissions;
  II. data concerning the environmental endangerment of areas;
  III. data concerning toxic and hazardous substances that may be of public concern;
  IV. data on the presence of substances potentially harmful to human health in drinking water and food;
  V. data concerning environmental accidents, hazards or emergencies;
  VI. data on the findings of monitoring campaigns and audits of pollution control systems and activities with potential for pollution, as well as plans and actions for the recovery of degraded areas;
  VII. data on environmental quality.

- State Law No. 10294 of April 20, 1999 - Law of Protection and Defense of São Paulo State Public Service Users, which "Rules on the protection and defense of users of the public service in the State of São Paulo and makes other provisions," establishes the rights of public service users to information and to the quality of services provided.
- Federal Law No. 10650 of April 16, 2003, establishes:

  Article 1 – This Law rules on the public access to environmental data and information in the safekeeping of bodies and entities that integrate the National Environment System - Sisnama, instituted by Law No. 6938 of August 31, 1981.

  Article 2 – The bodies and entities of direct or indirect Public Administration that integrate Sisnama are obliged to allow public access to documents, records and administrative processes related to environmental issues, and to provide all environmental information under their safekeeping, in written, visual, audio or digital media, and especially those related to:

I. *environmental quality;*
II. *policies, plans and programs with potential for environmental impacts;*
III. *findings of monitoring and auditing of pollution control systems and activities with potential for pollution, as well as plans and actions for the recovery of degraded areas;*
IV. *environmental accidents, hazards or emergencies;*
V. *production of wastewater, air emissions and solid wastes;*
VI. *toxic and hazardous substances;*
VII. *biological diversity;*
VIII. *genetically modified organisms.*

- Article 3 of Federal Law No. 10650 of April 16, 2003 establishes that, in order to meet the provisions of the Law, public authorities may require the periodic reporting of any type of information by private entities, by means of a specific system to be implemented by all bodies of the National Environmental System (SISNAMA), on potential and actual environmental impacts due to their activities, regardless of the existence of and without need for the instauration of any type of administrative process.

4.4.2 Option Considerations

Considerations of establishing the public disclosure program are as follows:

- Hire a consultant who specializes in making environmental data available to the public in a way that is interactive and user-friendly
  - An electronic-based system allows users to file a paperless report, significantly reduces data errors, and gives users the option to receive instant receipt confirmation of their submissions.
- Have a mechanism for reporting that includes a web-based application so that users have access as long as an internet connection is available
- Have a system that maintains several prior years of data for each facility
- Design and establish public querying capabilities
- Have reporting system tutorials and help desk support available
- Determine means and methods for maintaining high data quality
- Determine what type of public data release reports would be generated, and what frequency

Factors to consider for this program option include the level of detail to disclose, as well as industry concerns on trade secret data and public misperception.

4.5 Toxic Chemical Usage Fee

This program option is associated with the development of a toxic chemical usage fee.

4.5.1 Institutional/Legal Aspects

CETESB currently has the authority to issue and collect fines related to noncompliance with current environmental regulations. Although these fines are collected by CETESB, the Agency cannot currently use these fines to fund a specific program such as a toxic chemical reduction program. In addition, CETESB does not have the authority to issue a fine unless the trigger for the fine is detailed in a legal document (i.e., CETESB cannot currently impose fees on industry based on the amount of emissions released).

CETESB also does not currently have the authority to increase fees (beyond those established in the current state regulations) to industry for certain types of operations (i.e., for the use of toxic chemicals or to fund a new program such as a toxic chemical reduction program).

4.5.2 Option Considerations

The fee would be based on the usage of the toxic chemical multiplied by a toxicity factor, to provide an economic incentive for reduction. The usage fee to CETESB for each company would consist of the sum of the usage fees for each chemical used during the reporting period.

The level of the initial fee would need to be determined, and should be proportionate to the level of toxicity. The fee could also be discounted as an incentive for reduction if toxics are reduced (i.e. could be used for grants or loans to implement use reduction technologies).

Another factor to consider for this option includes the determination of how the fee will be used once collected. Some options are as follows:

- Funding for the program (taking the institutional/legal aspect into account)
- Funding for technical assistance
- Funding for a loan program

4.6 Usage Reduction Targets

This program option is associated with the development of toxic chemical usage reduction targets.

4.6.1 Institutional/Legal Aspects

CETESB does not have the general authority to ban chemicals or their specific uses. CETESB enforces chemical-specific legislation that bans or restricts the use of certain chemicals. Below is a list of decrees, articles, and laws identifying chemicals that are banned or restricted:

1. Article 116 included by State Decree 12045 of August 08, 1978, and Article 117 included by State Decree 23128 of December 19, 1994, of the Decree that regulates the work of CETESB, establish that:

    a. Art. 116 - The pollution sources listed in Article 57, including those currently existing, are prohibited from handling chemicals whose formulations contain substances, even if only residual, of the dioxin chemical group (TCDD - 2, 3, 7, 8 tetrachloro dibenzene para dioxin).

b. Sole paragraph – The ban established in this article does not encompass any pesticides registered and of use authorized by the Ministry of Agriculture.

2. Art. 117 – Bans the transportation, storage, and industrial processing of methyl isocyanide in the State of São Paulo.

3. Law 8999 of December 26, 1994 bans the use of disposable packages whose manufacturing process uses chlorofluorocarbons (CFCs) as an expansion agent.

4. State Decree No. 41629 of March 10, 1997 rules on the ban of the acquisition by bodies and entities of direct and indirect State Public Administration of products or equipment containing substances that destroy the ozone layer, controlled by the Montreal Protocol.

5. Law 12288 of February 22, 2006 rules on the controlled phasing out of PCB and PCB wastes, and the decontamination and elimination of transformers, capacitors, and other electrical equipment containing PCB.

4.6.2 Option Considerations

Factors to consider for this option include whether the establishment of the toxic chemical usage reduction target(s) is voluntary or mandatory, and whether compliance with the established target(s) is either voluntary or mandatory. In addition, it would need to be determined whether the reduction is based on an absolute % reduction, thereby having to determine the means to achieve the target, or based on the % reductions associated with specific and technically feasible identified reduction projects. Lastly, reduction targets can either set by individual companies or by CETESB on a company-by-company-basis.

Considerations of company-by-company goal setting by CETESB are as follows:

- Establish company-by-company goals after CETESB has information about quantities of chemicals from the mandatory reporting and has determined which chemicals are the biggest problems, and has subsequently chosen the target chemicals.
- Subsequently, set an initial permanent cap on the total amount of selected toxic chemicals that may be emitted by industry nationwide, and then tighten the annual limits imposed on specific industries and then companies. Determine whether limits should decrease each year and, if so, by how much and over what time period.
- Determine what individual source permits need to be eliminated or modified as a result of the imposed goal.
- Develop usage monitoring and reporting system "audits."
- Integrate an electronic tracking system with the mandatory reporting and permit system to provide complete accounting of allowances as well as program progress.
- Consider re-establishing (further lowering) the specific caps after levels of selected toxic chemicals reach the established level (from either companies directly reducing use, or from companies purchasing credits from other companies that reduced use).

4.7 Incentives

This program option consists of economic/regulatory incentives for industry to reduce the use of toxic chemicals.

4.7.1 Institutional/Legal Aspects

Economic

Brazil does not currently have specific legislation pertaining to economic incentives for the use of toxic substances, or special credit lines to finance or provide dead capital grants to companies that choose to implement toxics chemical reduction programs.

Regulatory/Permit Extensions

After the toxic chemical use inventory is established, subsequent permit data can be used to determine if chemical use has been reduced at a facility. It is recommended that if a company demonstrates that it has reduced use (per an agreed-on unit of production), it could receive a new permit for a longer period.

The current permit length is dictated by Article 2 of State Decree No. 4700/02 and State Decree No. 47397 of December 4, 2002, which establishes the lengths of each phase of permitting (i.e., Preliminary Permit, Installation Permit, and Operation Permit):

§ 4 – *At the time of operation permit renewal, the applicable body of SEAQUA-Sistema Estadual de Administração da Qualidade Ambiental, Proteção, Controle e Desenvolvimento do Meio Ambiente e Uso Adequado dos Recursos Naturais (State Administration System of the Environmental Quality, Protection, Control and Development and the Adequate Use of Natural Resources) may, based on a justified decision, maintain, expand or reduce the length of permit validity, based on a review of the environmental performance of the project or activity during the previous term.*

§ 5 - *Projects or activities which, at the time of Operation Permit renewal, corroborate the efficiency of their environmental management and auditing systems, may be granted a new permit with a length extended by up to one third of the previous length, at the discretion of the applicable body of SEAQUA.*

4.7.2 Economic Incentives

Economic incentives help companies offset the costs of participating in a toxic chemical reduction program. Economic incentives have been identified based on what is known about São Paulo industry preferences and CETESB preferences, as well as political and policy constraints. Examples of economic incentives include loans, direct reduced costs, reduced healthcare costs, and reduced regulatory burden. Another potential economic incentive, Brazilian grant programs, were researched, however, they were determined to not be directly applicable to toxic chemical reduction programs.

Loans

Low-cost loans are available from a number of sources for development or implementation of a toxic chemical reduction program. Several potential sources for loans are discussed below. The advantages and disadvantages of loans are also discussed below, based on experience with US Programs.

Brazil National Development Bank

The Brazil National Development Bank (BNDES) is a federal public company that is associated with the Ministry of Development, Industry and Foreign Trade. BNDES was created by Federal Law No. 1628, June 20, 1952; and changes were introduced with Federal Law No. 5662, June 21, 1971. The BNDES mission is to encourage the sustainable and competitive development of the Brazilian economy, generating new jobs and decreasing social and regional inequalities, and providing long-term financing for endeavors that contribute to the development of the country. BNDES also serves the investment needs of companies of all sizes and industry sectors. A BNDES program that may be relevant to the Toxic Chemical Use Reduction Program is the Program for the Modernization of Machines and Equipment. This program provides funding to companies to rebuild, recuperate, or modernize machinery or equipment to extend their useful life or improve performance. BNDES has extended about $1 billion in loans to industries in Brazil to install or implement environmental technologies (i.e., install end-of-pipe pollution control equipment, make process changes, or implement recycling or waste recovery projects).

Pollution Control Program

Pollution prevention projects in the State of São Paulo are currently funded through the Pollution Control Program (PROCOP). PROCOP provides technical support to and finances projects that preserve and improve the São Paulo environment. PROCOP provides loans with interests very similar to the ones that industry can obtain through a bank. Companies that are eligible for PROCOP funding are those that are significant sources of pollution and require wastewater and solid waste management facilities. PROCOP finances the following types of projects:

- Projects that implement systems for wastewater treatment or to reduce emissions of particulates, sulfur dioxide, odor, solid waste, industrial noise
- Modification of production processes to reduce pollution as approved or recommended by CETESB
- Relocation of industrial facilities

PROCOP support can be provided for:

- Purchase and installation of pollution control systems (also imported machines and equipment), including shipping and insurance.
- Civil, electrical, and piping improvements required to implement the pollution control systems.

- Operation and maintenance of the implanted systems. CETESB currently reviews applications submitted by São Paulo companies to obtain PROCOP financing. The companies' applications must be approved by CETESB to obtain a line of credit through the bank that is managing the funding.

There is no formal criterion used as guidance to evaluate applications. CETESB serves as a "technical agent" and evaluates the content of the applications based on the following:

- Is the proposal for a P2 activity?
- Is the project likely to solve a pollution problem, result in the proposed improvements, and is the proposed solution feasible?
- Is the estimated cost for the project reasonable?
- One issue CETESB staff has with previous PROCOP applications is that insufficient technical information is included for CETESB to adequately evaluate the feasibility of the proposed P2 projects.

PROCOP is an established source of funding for P2 projects in São Paulo; therefore, it is recommended that CETESB consider requesting that a portion of this funding be targeted to toxics chemicals use reduction projects. In addition, other sources of funding should also be sought to assist companies in implementing projects.

Recently, due to the merging of Banco Nossa Caixa (current financial agent) and Banco do Brasil (future owner of Banco Nossa Caixa), the PROCOP support is temporarily ceased.

International Funding Sources

Various international banking institutions could be sources of funding through lines of credits or loans. To be eligible for P2 funding, a thorough business plan would be needed, with a realistic forecast of the benefit stream.

The World Bank. The Environmental and Social Sector Unit of the World Bank is organized around thematic sectors and country teams, each having different organizational structures. There is a specific unit for Brazil: the Brazilian Country Management Team. Country Assistance Strategies, developed for each country, include shared goals between the bank and the country government for financial and/or technical support. The Environmental Unit works with the country teams through its sustainable development network. Currently, the World Bank is providing support to Brazil for environmental licensing and permitting (e.g., how Brazil can reform its permitting and licensing procedures to make them more efficient).

Currently, there are no projects/programs at the World Bank that would be able to provide assistance specifically for the Toxic Chemical Use Reduction Program. The World Bank tends to make loans for public infrastructure to support national policy change rather than to support states like São Paulo. CETESB may be able to get assistance, however, in setting up the program or in modifying the permit program.

The investment arm of the World Bank is the International Finance Corporation (IFC). IFC offers a variety of financial products for private sector projects in developing countries. Brazil is a member country of IFC; therefore, businesses in São Paulo are eligible to apply for

IFC financial assistance. A company in São Paulo that is seeking assistance from the IFC would first need to meet a number of criteria to be eligible for funding, such as being in the private sector, having good prospects for being profitable, benefiting the local economy, and being environmentally and socially sound. The qualifying company would then submit an investment proposal. After the preliminary review of the proposal, IFC may then request a detailed feasibility study or business plan to determine whether or not to approve the project.

The World Bank has found that establishment of a fund specifically for P2 projects would be complex and would require high-level involvement from environmental and industrial authorities. The World Bank recommends that subsidies and grant components are best used to assist in identifying opportunities and preparing detailed proposals. It found that a major obstacle to obtaining funding is turning engineering reports into financial proposals.

Assistance would be needed to train enterprise staff in how to prepare financing proposals. The World Bank also found that initial sums needed for P2 planning can be small, so simple procedures are needed for small loans so that transaction costs are not prohibitive.

Inter-American Development Bank. The Inter-American Development Bank (IDB) is a multilateral financial institution for the development of Latin American countries. Its loans and grants help finance sustainable economic and social development projects and support strategies to reduce poverty; expand growth; increase trade, investment, and regional integration; and promote private sector development and modernization of the state. The IDB Group is composed of the IDB, the Inter-American Investment Corporation (IIC), and the Multilateral Investment Fund (MIF). The IIC focuses on support for small- and medium-sized businesses, while the MIF promotes private sector growth through grants and investments.

United States Agency for International Development. The United States Agency for International Development (USAID) provides grants to help build institutional networks that empower local communities, generate and disseminate sound resource management practices, and contribute to the formulation of public policies that support and encourage such practices. The purpose of the USAID environmental program in Brazil is to increase environmentally sustainable benefits and economic opportunities to the rural poor; reduce the deforestation rate; and, in general, shape the environmental impact of future land-use trends over large geographic areas of Brazil, especially the Amazon, while continuing to mitigate the global impact of climate change and biodiversity loss. Currently, there are no projects/programs at USAID that are likely to provide assistance specifically for the Toxic Chemical Use Reduction Program.

Advantages of Loans

Government loan programs often provide loans at lower interest rates (as compared to those for commercial loan and bond financing) (EPA. *Guidebook of Financial Tools – Comprehensive Financial Tools 1-5*) (http://www.p2pays.org/ref/11/10593/tools1-5.pdf). Loans involve fewer and lower transaction costs (as compared to bonds). In addition, loans from different sources may be co-mingled, including with grant funds; and loans requiring matching funds are highly leveraged. Loans are especially flexible with respect to application deadlines and cost overruns.

An example of a successful P2 loan program includes the Michigan Department of Environmental Quality (MDEQ) (http://www.michigan.gov/documents/deq/deq-ess-p2-2005p2rept_250542_7.pdf). The MDEQ has a Small Business P2 Loan Program that provides low-interest loans for projects that reduce waste or conserve water or energy. According to the 2005 annual report, since the inception of the program in 2000, over $1,760,000 in loans have been funded to 23 small businesses. Many environmental benefits have resulted from the loans across the 23 companies, among them including a reduction of 3,566 gallons per year of perchloroethylene (over 24 tons); 516 gallons per year of x-ray photo developing chemicals; 2,180 pounds per year plating make-up chemicals; 151,440 pounds of commercial potassium fertilizer; and a savings of $8,240 on agri-chemical use (25 percent reduction).

Disadvantages of Loans

Government loans are subject to borrower competition as well as the availability of approved funds. Such loans may carry onerous governmental mandates, and most federal loans have complicated application procedures and deadlines.

Other Economic/Regulatory Incentives

There are several other incentives that could result from the development of a toxics reduction program. This section provides some quantitative examples of the link between different economic incentives and associated reductions. It is important to note, however, that in almost every case, toxics reductions are due to a combination of factors including mandated controls, public disclosure of chemical releases, and/or local technical assistance programs, in addition to economic incentives.

Direct Reduced Costs

The companies in each industry sector that choose to participate in the program may notice reduced operating costs associated with the purchase, handling, disposal, and cleanup of toxic chemicals. The most frequent reason given by attendees of the 1997 EPA Region III TRI workshop to undertake waste reduction activities was cost reduction (98 percent of respondents). Although results will vary at each facility, most of the case studies show substantial reductions in chemical use and chemical emissions with a payback period of 2 years or less. Some other examples are also noted below.

For example, The Haartz Corporation, located in Acton, Massachusetts, makes coated fabrics used in automobiles and estimated a savings of $200,000 annually by reducing its methyl ethyl ketone releases.

Recommendations provided by the State of Washington Technical Resources for Engineering Efficiency (TREE) program typically involve a capital investment that provides a payback within a few years. Recommended improvements, if implemented, have estimated potential savings of over $1 million per year for Washington businesses since 1998. The estimated savings of past analyses have shown up to a sevenfold return of investment within the first year.

In the Lean and the Environment Program, as of September 2006, the cabinet manufacturing facility is expected to save $1,090,947 annually in cost, time, material, and environmental

savings from actions implemented during the pilot project (May to August 2006), and is expected to save an additional $465,618 annually from actions pending implementation.

Also, as noted in the 2005 *Indiana Pollution Prevention Annual Report,* Ryobi Die Casting Inc., a company that makes transmission castings for automobile manufacturers, voluntarily implemented various pollution prevention projects, including reduction of aluminum waste (dross) production. This, in turn, reduced the company's natural gas usage by 27 percent, or 34,440 million British thermal units (Btus) per year, and reduced the dross production by 759,600 pounds annually. Annual energy and material cost savings of this project amounted to nearly $900,000. The company received a loan to begin this project.

According to the Wisconsin Department of Natural Resources *Environmental Cooperation Pilot Program: 2007 Progress Report* (October 31, 2007), from 2000 to 2005, 3M Company (Menomonie site) reduced TRI releases per pound of good output by 54 percent, volatile organic compounds (VOCs) per pound of good output by 26 percent, waste per pound of good output by 18 percent, and reduced hazardous waste levels/pound by good output by 10 percent. They also implemented 14 Pollution Prevention Pays projects, resulting in savings of $2.67 million and prevented 2,603 tons of pollution. Separately, they also prevented 24 tons of pollution (includes recycling, reuse, reformulation, and replacement), resulting in a total savings of $26,516 and energy savings of 19.32 million Btus, among other beneficial outcomes.

Furthermore, in a survey of participating facilities conducted by the Massachusetts Toxic Use Reduction Program, 67 percent of the respondents saw some cost savings from the toxics use planning and reduction program in the state.

Reduced Healthcare Costs

Although potential cost savings cannot be quantified without a more detailed study, evidence in the U.S. points to the fact that the health and social benefits of enforcing tough new clean-air regulations during the past decade were five to seven times greater in economic terms than were the costs of complying with the rules. One study (*Washington Post,* September 27, 2003) noted that "the value of reductions in hospitalization and emergency room visits, premature deaths and lost workdays resulting from improved air quality were estimated between $120 billion and $193 billion from October 1992 to September 2002. By comparison, industry, states and municipalities spent an estimated $23 billion to $26 billion to retrofit plants and facilities and make other changes to comply with new clean-air standards, which are designed to sharply reduce sulfur dioxide, fine-particle emissions and other health-threatening pollutants."

Reduced Regulatory Burden

If a company demonstrates that there has been a reduction in usage (relative to production), it could be rewarded by being provided a longer period for its new permit.

This incentive would provide a cost savings to the company because it would have a longer period of time between permit application submittals. CETESB would also benefit through a reduced number of permits submitted. This may provide additional incentive in conjunction with a more comprehensive program for toxics chemical reduction. Some examples of cases where good environmental stewardship (including reduction of toxic chemicals) resulted in

the regulatory agencies working with companies to reduce regulatory burdens on both sides, and the cost savings associated with this, are noted below.

According to the Wisconsin Department of Natural Resources (DNR) *Environmental Cooperation Pilot Program: 2007 Progress Report* (October 31, 2007), between 1996 and 2006, the Northern Engraving Corporation (NEC) reduced VOC use by 63 percent, hazardous air pollutants (HAPs) by 94 percent, water use by 74 percent, hazardous waste by 69 percent, and solid waste by 78 percent. In 2002, the company and the Environmental Cooperative Compliance Program entered into an agreement that included an innovative regulatory approach. This resulted in a decrease of roughly 2.5 construction permits being issued to NEC annually prior to 2002 to an average of one permit per year after 2002. This was a saving to state engineers of over 1,000 hours, and to the company of over 3,000 hours annually in reduced paperwork during the first year of the agreement (as well as approximately 4,000 pages of paper and 2,500 million cubic feet of natural gas at two different locations during the first year of the agreement).

In addition, in 2004, due to 3M's commitments to environmental improvement, the DNR and EPA approved a flexible permit (under Title V Part III) for 3M (Menomonie site). From 2005 to October 2007, 12 new construction projects were submitted and approved without going through traditional permitting processes, 18 months of startup time were saved, and 315 hours of 3M administrative time and over 1,500 hours of DNR time were saved.

- An example of how the permit extension could be quantified and tied to usage reduction is demonstrated through the following equation:

  $$E = A \times (B-C)$$

  where:

  E= Length of time for permit extension, rounded up to the nearest year

  A = Reduction % by chemical volume and toxicity:

  Sum {(Toxicity $Chemical_1$ x Volume $Chemical_1$), (Toxicity $Chemical_2$ x Volume $Chemical_2$), etc.} during the current reporting year divided by the Sum {(Toxicity $Chemical_1$ x Volume $Chemical_1$), (Toxicity $Chemical_2$ x Volume $Chemical_2$), etc.} during the previous reporting year

  B = Maximum Legal Permit Length

  C = Current Permit Length

  For example, if the maximum legal permit length (B) is 8 years, and the current legal permit length (C) is 3 years, and the reduction % (A) from the current reporting year as compared to the previous reporting year is 25 percent, the permit extension granted would be 1.25, or 1 additional year, resulting in a total new permit length of 4 years.

Expedited Permit Processing

As an incentive to encourage companies to use P2 planning tools, a priority could be placed on project requests that use these tools. A number of US permitting agencies, such as the South Coast Air Quality Management District, the air permitting agency in Los Angeles, have programs for expedited permit processing where the applicant will pay a higher fee to

have the permit application processed more quickly. The fact that industrial facilities are willing to pay a premium of 50 percent or more above the standard permitting fee to receive expedited permit processing indicates that improved permit processing time would provide an incentive to some industries.

SECTION 5

5.0 Toxic Chemical Reduction Program Alternatives

Under this section, the general framework of the toxic chemical reduction program that was developed under Sections 2 through 4 was used to develop toxic chemical reduction program alternatives for evaluation for the State of São Paulo, Brazil. Specifically, this section identifies three different, proven program alternatives that could be used by CETESB to institute an effective operational toxic chemical reduction program in São Paulo. Evaluation of the program alternatives is based on technical/operational issues, financial aspects, and potential environmental and development impacts resulting from program implementation. Lastly, implementation plans are also detailed for each of the proposed programs, and the selected program is discussed.

5.1 Program Objectives and Evaluation Criteria

The objectives of establishing a toxics chemical reduction program are to gather data on toxics chemical use, targeted to those chemicals with the highest toxicity and use volume, and to encourage industries to reduce the usage of these target chemicals to reduce impacts on human health and environment due to chemical releases.

The toxic chemical reduction program alternatives presented in this Section were evaluated based on the degree to which these program objectives will be met, including considerations as to technical and operational issues, financial aspects, and potential environmental and development impacts.

5.2 Toxic Chemical Reduction Program Alternatives

The following subsections present the features of the three program alternatives developed for potential implementation in São Paulo. Table 5-1 presents the program options that comprise each of the three developed program alternatives.

Table 5-1: Developed Toxic Chemical Reduction Program Alternatives and Associated Program Options

Program	1	2	3
Chemical Usage Reporting	X	X	X
Technical Assistance	X	X	X
Chemical Usage Reduction Planning		X	X
Public Disclosure		X	X
Toxic Chemical Usage Fee		X	X
Usage Reduction Targets		X	X
Mandatory Chemical Use Reduction			X
Incentives	X	X	X

5.2.1 Program 1

- Mandatory chemical usage reporting to CETESB
- No usage reduction goal setting
- Voluntary toxics chemical usage reduction planning
- Voluntary reduction of targeted chemicals
- Public disclosure highlighting company successes with permission
- Continued technical assistance (i.e., annual training classes to complete forms, general and industry sector toxics chemical usage reduction classes)
- Incentives for reduction in toxics (i.e., assistance in preparing winning loan applications, reduced regulatory burden, reduced permitting fees for reductions)
- Enforcement based on failure to report chemical usage inventories to CETESB
- Program Phasing:
  - In Phase 1, CETESB would set up the program, and industry would submit its chemical usage inventory to CETESB.
  - In Phase 2, CETESB would re-evaluate the chemical usage inventory and its effect on the environment to determine if the initially selected chemicals should continue to be

reported, and whether other chemicals need to be added. In addition, CETESB would publicly disclose company successes.

- In Phase 3, CETESB would evaluate program effectiveness and determine if a more comprehensive mandatory plan needs to be implemented.

5.2.2 Program 2

- Mandatory chemical usage reporting to CETESB
- Mandatory establishment of individual goals for toxics chemical use reduction by each company
- Mandatory preparation of a detailed Chemical Usage Reduction Plan
  - The detailed plan would be kept onsite and available to a CETESB inspector on demand.
  - A Summary of the Plan would be submitted to CETESB.
  - Both the detailed Plan and the associated Summary will document progress in meeting goals from the previous reporting period, and set goals for the next reporting period.
- Establishment of a toxic chemical usage fee
  - CETESB would assign a unit price per kilogram (kg) usage for each chemical based on the toxicity factor for that chemical. Fees would thus be proportional to toxicity multiplied by the usage.
  - The usage fee to CETESB for each company would consist of the sum of the usage fees for each chemical used during the reporting period.
- Public Disclosure
  - Public disclosure highlighting company successes with permission
  - Mandatory public disclosure of chemical usage inventories and Chemical Usage Reduction Plan Summaries
- Technical assistance (i.e., non-regulatory public institution and/or university that would provide innovative and creative solutions to industries seeking assistance with toxics chemical usage reductions at their facilities)
- Incentives for reduction in toxics (i.e., assistance in preparing winning loan applications, reduced regulatory burden, and reduced permitting and usage fees for reductions)
- Enforcement would be based on failure to report chemical usage inventories to CETESB, failure to submit Summary reduction plans that meet established requirements to CETESB, and failure to have the detailed Plan onsite
- Program Phasing:
  - In Phase 1, CETESB would set up the program, and industry would submit its chemical usage inventory to CETESB.

- In Phase 2, industry would perform chemical usage reduction planning and set goals.
- In Phase 2, CETESB would establish the toxics chemical usage fee program and publicly disclose the chemical usage inventories and Chemical Usage Reduction Plan Summaries.
- In Phase 3, industry would evaluate the success of its previous plan and make adjustments if needed.
- In Phase 3, CETESB would publicly disclose company successes, collect fees based on the previous inventory, and re-evaluate the chemical usage inventory and targeted chemicals.
- In Phase 4 CETESB would evaluate program effectiveness and determine if a more comprehensive mandatory plan needed to be implemented.

5.2.3 Program 3

- Mandatory chemical usage reporting to CETESB
- Establishment of company-by-company goals for toxics chemical use reduction by CETESB
- Preparation of a detailed Chemical Usage Reduction Plan by each company
  - The detailed plan would be kept onsite and available to a CETESB inspector on demand.
  - A Summary of the Plan would be submitted to CETESB.
  - Both the detailed Plan and the associated Summary would document progress in meeting goals from the previous reporting period, and set goals for the next reporting period.
- Establishment of a toxic chemical usage fee
  - CETESB would assign a unit price per kg usage for each chemical based on the toxicity factor for that chemical. Fees would thus be proportional to toxicity multiplied by the usage.
  - The usage fee to CETESB for each company would consist of the sum of the usage fees for each chemical used during the reporting period.
- Public Disclosure
  - Public disclosure highlighting company successes with permission
  - Public disclosure of chemical usage inventories and Chemical Usage Reduction Plan Summaries
- Technical assistance (i.e., non-regulatory public institution and/or university that would provide innovative and creative solutions to industries seeking assistance with toxics chemical usage reductions at their facilities)

- Support for reduction in toxics (i.e., assistance in preparing winning loan applications, access to loans, reduced regulatory burden, and reduced permitting and usage fees for reductions)
- Enforcement based on failure to report chemical usage inventories to CETESB, failure to submit Summary reduction plans that meet established requirements to CETESB, failure to have the detailed Plan onsite, and failure to meet CETESB-established usage reduction goals .
- Program Phasing:
  - In Phase 1, CETESB would set up the program, and industry would submit its chemical usage inventory to CETESB.
  - In Phase 2, CETESB would set company-by-company reduction goals.
  - In Phase 2, industry would perform chemical usage reduction planning based on the goals established by CETESB.
  - In Phase 2, CETESB would also publicly disclose chemical usage inventories and Chemical Usage Reduction Plan Summaries.
  - In Phase 3, CETESB would re-evaluate the chemical usage inventory and targeted chemicals list.
  - In Phase 3, industry would evaluate the success of its previous plan and determine if adjustments are needed.
  - In Phase 4, CETESB would publicly disclose company successes and evaluate the effectiveness of the program.

In the following subsections, each of these Program alternatives is evaluated based on technical and operational issues, institutional and legal aspects, financial aspects, and potential impacts to the environment.

5.3 Technical and Operational Considerations

Technical and operational considerations associated with the three program alternatives are discussed below.

5.3.1 Program 1

Program 1 requires reporting of toxic chemicals; without the mandatory goal and disclosure component.

With the exception of mandatory chemical use reporting, this program is a voluntary program and relatively easy to implement. Under this program, some degree of toxic reduction is expected, as implementation of this program will trigger many companies to inventory their toxics chemical usage for the first time. The degree of toxic reduction, however, is expected to be relatively lower than programs that have the element of public disclosure and associated public pressure (Programs 2 and 3). Although public pressure to

reduce toxics is not part of this proposed program, the advantage to industry is that the concern for disclosure of proprietary information is eliminated.

One incentive for toxics chemical use reduction will be a reduction in regulatory burdens (e.g., elimination of some of the administrative burden of reporting). Facilities that eliminate or substantially reduce toxics chemical use below de minimis thresholds for reporting can avoid or minimize some of their requirements for reporting.

In a voluntary program, facilities are primarily motivated by improving their competitiveness in the marketplace. Therefore, although fewer projects will be undertaken, it is expected that most projects that are implemented under this voluntary program will have a relatively short (preferably less than 1 year) payback period. Toxic reduction projects that were implemented in successful voluntary programs in the United States have been shown to have a payback period of less than 3 years and, in many cases, less than 1 year.

5.3.2 Program 2

Program 2 requires mandatory toxics chemical reporting and public disclosure with added mandatory toxics chemical usage reduction planning, a toxics chemical usage fee, and goal setting.

Specifically, in addition to mandatory chemical use reporting (as under Program option 1), this option includes the mandatory development of Chemical Usage Reduction Plans; however, chemical usage reduction goals would be established by individual companies. Under this proposed Program, the Chemical Usage Reduction Plan Summary (including established chemical usage reduction goals) would be submitted to CETESB. The Chemical Usage Reduction Plan itself would be kept at the facility, and could be inspected by agency officials during site visits. The requirement for companies to develop a Chemical Usage Reduction Plan and submit the Chemical Usage Reduction Plan Summary to CETESB would force companies to evaluate their usage of toxics chemicals. It would also allow companies to prioritize chemical usage reduction planning. Although reporting requirements are time consuming for facilities, and goals are established by each individual company, companies are also more likely to actually implement the components of the Chemical Usage Reduction Plan (including meeting their goals) if they are required to submit the Chemical Usage Reduction Plan Summary to the agencies and to the public. This is the case under this Program option. It is important that CETESB ensure a holistic approach is taken by companies as part of the chemical usage reduction planning when determining the environmental impact of the reduction of a given chemical, including the environmental impacts of any new chemicals or processes implemented.

Maximum benefit to both CETESB and industry can be achieved when flexibility is allowed in their means of achieving those goals. Laws and policies that "command" but not "control" (i.e., "Second Generation" policy) encourage the redesign of industrial processes to produce less waste, instead of relying on costly equipment to reduce or eliminate chemicals at the end of the production process. Regulations that promote upstream pollution prevention (P2) and promote continuous innovation toward an overall cleaner process result in comprehensive discharge reductions and not requiring specific technologies.

Generally, the concept of "command" but not "control" in the context of toxics chemical usage reduction could include mandating chemical usage reduction goals ("command"

component), however leaving it up to industry to determine the means by which to reduce the usage ("not control" component), in other words, not mandating the methods of achieving the mandated goals.

More specifically, as demonstrated with the United States Environmental Protection Agency (EPA) Acid Rain program, a "cap and trade" program does this by setting permit limits on chemicals or the operation as a whole (instead of for individual pieces of equipment) that companies cannot exceed when they are in operation. This established "cap" is reduced over time to maximize the program benefits to the environment. At the same time, the program also lets companies decide what equipment, processes, and materials they will use to meet their toxics chemical reduction requirements. Companies that are innovative and reduce chemical use to below to the allowable permit limit, or cap, can then sell excess chemical use reductions to other firms. Buyers of the chemical use reduction credits are companies that find the cost of buying credits cheaper than buying and installing new equipment or otherwise controlling chemical use. This type of program harnesses the power of the marketplace. For industry, the program translates to increased flexibility and a financial incentive to reduce air pollution beyond what laws and traditional "command-and-control" rules require. For the public, the program translates into guaranteed annual reductions that, in turn, protect public health.

A problem with a traditional cap and trade program is that each company must be equitably allocated their specific cap, which takes considerable regulatory staff time for something with relatively few chemicals such as greenhouse gases or acid rain. For a multiple chemical program, this would be difficult. Moreover, this type of program sets a floor on reductions below which there is little incentive to reduce.

With the proposed toxics chemical usage fee system, CETESB would not have to set individual and equitable usage limits by company; and it provides industry with the flexibility to decide what goals will be established. The toxics chemical usage fee system provides industry with an economic incentive to reduce its toxics chemical usage down to, ideally, zero, with the further incentive that more toxic compounds will cost more to use. In addition, this system would provide a funding source to CETESB to support the program (although this would not be a sole funding source, but more of a by-product of the system).

Public disclosure of both the chemical usage inventory and Chemical Usage Reduction Plan Summary and established goals makes the data available to the public. This public disclosure can be used as a public relations tool. Public disclosure also provides public pressure to reduce toxics to a greater degree than a voluntary program with no public disclosure requirements (as under Program option 1).

The technical assistance element by an outside organization (i.e., non-regulatory public institution and/or university) leads to a fresh look and an unbiased viewpoint for the facilities in the program.

5.3.3 Program 3

Program 3 requires mandatory toxics chemical reporting and public disclosure, with added mandatory toxics chemical usage reduction planning and a mandatory reduction component coupled with a toxics chemical usage fee.

Specifically, this program includes mandatory reporting of chemical usage and a Chemical Usage Reduction Plan Summary and associated reductions. It also includes the element of public disclosure and associated pressure, as under Program option 2, but additionally includes CETESB-established and mandatory company-by-company goals (vs. companies establishing their own individual goals). Following submittal of the first phase of chemical usage inventories, goal setting will be based on the chemical usage inventories as well as toxicity information and knowledge of media-specific impacts from the targeted chemicals. CETESB would need to understand each company in order to assign a goal, which would be resource-intensive.

Under voluntary programs, most projects that are implemented will have a short payback period; however, these projects may not be sufficient to meet target program goals. In these cases, projects implemented under a mandatory reduction program may have a much longer or no payback period. The primary driver is to achieve compliance with the reduction mandate at the least cost. The added toxics chemical usage fee component, however, provides an economic incentive for industry to reduce its toxics chemical usage even further (than the CETESB-established goal), as the use of more toxic compounds will cost more to industry. In addition, this system would provide a funding source to CETESB to support the program (although this would not be a sole funding source, but more of a by-product of the system).

As under Program option 2, Program 3 provides for technical assistance by an outside organization (i.e., non-regulatory public institution and/or university). This assistance leads to a fresh look and an unbiased viewpoint for the facilities in the program.

5.4 Financial Aspects

The financial aspects of each of the toxic reduction Program options as they pertain to both CETESB as well as the regulated community are outlined below.

5.4.1 Level of Effort

The levels of effort (in full-time equivalents, or FTEs) to implement the three Program option elements both by CETESB and by industry are presented in Tables 5-2 through 5-5 and subsequently summarized by program below. The levels of effort provided are order-of-magnitude estimates, with the intention of being able to compare the relative level of effort associated with each of the three proposed programs.

TABLE 5-2
Program 1 – Order-of-Magnitude Level of Effort Required to Implement Key Program Elements*

Program Element	Startup Level of Effort (CETESB) – FTEs	Subsequent Program Maintenance Level of Effort (CETESB) – FTEs	Estimated Level of Effort for Industry – FTE (Startup and Maintenance)
Inventory of Chemical Usage	2 FTEs	1 FTE	50-100 hours per chemical per facility
Technical Assistance Program – *Current CETESB Program*	N/A	N/A	N/A
Program Promotion	0.5 FTE	N/A	N/A
Public Disclosure of Company Successes	0.5 FTE	0.5 FTE	N/A

*The level of effort included in this table excludes time for development of new regulation. In addition, the level of effort does not include the effort associated with development and programming of the new database.

TABLE 5-3
Program 2 – Order-of-Magnitude Level of Effort Required to Implement Key Program Elements*

Program Element	Startup Level of Effort (CETESB) – FTEs	Subsequent Program Maintenance Level of Effort (CETESB) – FTEs	Estimated Level of Effort for Industry – FTE (Startup and Maintenance)
Inventory of Chemical Usage	2 FTEs	1 FTE	50-100 hours per chemical per facility
Preparation of Chemical Usage Reduction Plan and Summary	2 FTEs	1 FTE	100-400 hours per company per reporting event
Toxic Chemical Usage Fee Program	1 FTE annually	1 FTE annually	8 hours per chemical per facility per reporting period (to pay for usage fees)
Public Disclosure of Company Successes	0.5 FTE	0.5 FTE	N/A
Program Promotion	1 FTE (1st 2 years)	0.5 FTE (3rd / 4th years) 0 FTE (after 4th year)	N/A
Public Disclosure of Data	1 FTE	1 FTE	N/A
Technical Assistance Program – "Outsourced" Program	3 FTEs at the Outsourced Location	3 FTEs at the Outsourced Location	N/A

*The level of effort included in this table excludes time for development of new regulation. In addition, the level of effort does not include the effort associated with development and programming of the new database.

TABLE 5-4
Program 3 – Order-of-Magnitude Level of Effort Costs Required to Implement Key Program Elements*

Program Element	Startup Level of Effort (CETESB) – FTEs	Subsequent Program Maintenance Level of Effort (CETESB) – FTEs	Estimated Level of Effort for Industry – FTE (Startup and Maintenance)
Inventory of Chemical Usage	2 FTEs	1 FTE	50-100 hours per chemical per facility
Preparation of Chemical Usage Reduction Plan and Summary	2 FTEs	1 FTEs	100-400 hours per company per reporting event
Company-by-Company Goal Setting	8 FTEs	4 FTEs	Unknown; Likely expensive to meet the established goal
Toxic Chemical Usage Fee Program	1 FTE annually	1 FTE annually	8 hours per chemical per facility per reporting period (to pay for usage fees)
Program Promotion	0.5 FTE	0.25 FTE	N/A
Public Disclosure of Company Successes	0.5 FTE	0.5 FTE	N/A
Public Disclosure of Data	1 FTE	1 FTE	N/A
Technical Assistance – "Outsourced" Program	3 FTEs at the Outsourced Location	3 FTEs at the Outsourced Location	N/A

*The level of effort included in this table excludes time for development of new regulation. In addition, the level of effort does not include the effort associated with development and programming of the new database.

TABLE 5-5
Summary of Order-of-Magnitude Level of Effort Required to Implement Key Program Elements*

Program Number	Startup Level of Effort (CETESB) – FTEs	Subsequent Program Maintenance Level of Effort (CETESB) – FTEs	Estimated Level of Effort to Industry – FTE (Startup and Maintenance)
1	3 FTEs at CETESB	1.5 FTEs at CETESB	50-100 hours per chemical per facility
2	7.5 FTEs at CETESB 3 additional FTEs at the outsourced location	5 FTEs at CETESB 3 additional FTEs at the outsourced location	50-100 hours per chemical per facility 100-400 hours per company per reporting event 8 hours per chemical per facility per reporting period
3	15 FTEs at CETESB 3 additional FTEs at the outsourced location	8.5 FTEs at CETESB 3 additional FTEs at the outsourced location	50-100 hours per chemical per facility 100-400 hours per company per reporting event 8 hours per chemical per facility per reporting period (to pay for usage fees) Additional LOE to meet established goals (likely to be expensive)

*The level of effort included in this table excludes time for development of new regulation. In addition, the level of effort does not include the effort associated with development and programming of the new database.

Implementation of the toxics chemical reduction program would consist of two components: startup and ongoing maintenance. The first couple of years of the program will likely be the most expensive because of the level of effort associated with program startup activities. As the program becomes established, however, the level of effort for CETESB will likely decrease, consisting mainly of monitoring and analysis, updates (as required), and training activities.

5.4.2 Financing Options for CETESB and Industry

Potential financing options for CETESB and/or industry include general/pollution taxes, toxic chemical usage fees (generation money for the actual program), and/or loans, as detailed below.

Taxes

Taxes can be a source of funding for a toxic chemical reduction program and may be used as an incentive for compliance.

As noted below, many of the programs discussed in Section 3 pay for the administration of their toxic chemical reduction programs through either general revenue taxes or specific chemical use taxes.

U.S. Toxic Release Inventory Program

The administration of the United States Environmental Protection Agency (EPA) TRI Program is funded through the general taxes paid to the U.S. Treasury. Funding is allocated to EPA by the U.S. government in its annual budgeting process, and EPA then allocates the funding to its particular programs. There is also a "non-compliance tax" in that the TRI Program is an enforced program; a violation of the requirements of the TRI regulations is a civil penalty of $25,000 each day for each violation. Fines collected go into the General Fund and are not designated for a specific program.

EU REACH Program

As of the start of registrations of chemical substances on June 1, 2008, the basic registration fee ranges from EUR 1,600 for substances produced in volumes below ten tons, to EUR 31,000 for those above 1,000 tons. There is a 90 percent discount for micro enterprises, 60 percent for small sized companies, and 30 percent for medium sized companies. There is a 25 percent reduction for firms that cooperate together on registrations (to account for the reduced workload). These fees will account for the submission and update of registration material and for the submission of an authorization request or a review report. Other fees are associated with notification of certain research and development activities, certain confidentiality requests, and for appeals against the decisions of the European Chemicals Agency (ECHA). Industry fee revenue will largely finance the operations of the ECHA, with the remaining finance coming from the EU budget as approved by the European Parliament and Council/community subsidy (http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/582&format=HTML&aged=1&language=EN&guiLanguage=en).

REACH allows non-EU companies to be represented by an "only representative" (OR). Each manufacturer or importer established in the EU must register, on its own or jointly. If more than one non-EU company retained the same OR to register a common substance, the OR

had to submit just a single registration on its behalf. Each registration would entail a separate fee. As a result, a foreign company producing the same quantity of a substance as a European company with more than one EU establishment could end up paying lower fees (http://www.icis.com/Articles/2008/06/02/9128039/reach-registration-fees-vulnerable-to-legal-challenge.html).

The European Commission has conducted an extended impact assessment on REACH. Macroeconomic effects in terms of gross domestic product (GDP) are expected to be limited. REACH is expected to yield business benefits such as innovation improvements, competitiveness, workers' safety, and health cost savings. The costs of registration, including the necessary testing, are estimated at EUR 2.3 billion over the 11 years that it will take to register all the substances covered by REACH. The total costs, including those to downstream users, are estimated at EUR 2.8 billion to EUR 5.2 billion. This represents approximately 0.05 to 0.09 percent of the annual turnover of the chemical industry. In addition, if REACH succeeds in reducing chemical-related diseases by even 10 percent, the health benefits are estimated at EUR 50 billion over 30 years (http://ec.europa.eu/environment/pubs/pdf/factsheets/reach.pdf).

Other studies, however, predict that the program will result in losses in GDP of between 0.4 and 6.4 percent in Germany and France, with corresponding increases in job losses. Because chemicals are used in some manner in the manufacture or use of most products, the U.S. government has predicted that REACH could affect the majority of U.S. goods exported to the European Union. Hundreds of companies located in 37 of the 50 United States (as well as Puerto Rico and the Virgin Islands, at as many as 78 sites per state) produce or import hundreds of chemicals designated as dangerous by the EU. As a result, these companies will be directly affected by controls imposed under the new chemicals regulation of the EU (http://www.edf.org/pressrelease.cfm?contentID=8397) (http://www.cmsforum.org/REACH_article.pdf).

State of New Jersey Programs

Likewise, the funding for the New Jersey Department of Environmental Protection (NJDEP) Pollution Prevention Right to Know (P2RTK) to implement the P2 planning program is from revenues from fees charged to employers pursuant to the Worker and Community Right to Know Act (CRTK). Every facility subject to the NJ CRTK reporting requirements (based on their North America Industry Classification System [NAICS] codes) is assessed a fee. The fee schedule is $4.00 per employee, with a minimum of $75.00 for CRTK and $2.00 per employee with no minimum for P2 Planning. From 1994 to 2004, Nonproduct Output (NPO) and releases of hazardous substances decreased by 45 percent; and onsite releases decreased by 80 percent when adjusted for production.

The NJDEP Office of Pollution Prevention (OPP) receives an annual budget each fiscal year, known as the Pollution Prevention Fund from the state, as specified by the New Jersey Pollution Prevention Act (NJP2 Act). Although the amount appropriated has been slightly higher, the cost to implement the program is approximately $900,000 per year. Paying salaries constitutes the largest percentage of spending. Staffing is currently at 12 individuals, which includes managerial, technical (half of the staff), data management, and secretarial support. They also contract every year with Rutgers University to provide P2 technical assistance. This contract is typically around $200,000 per year, which comes out of the

annual appropriation. There is also a $140,000 per year cost to the Department of Labor, which covers the cost for them to send out the P2 fee assessments. Lastly, approximately $10,000 to $15,000 per year is spent for a vendor to maintain, upgrade, and/or enhance the program tracking database; and $30,000 is spent per year for general office-type costs (i.e., printing, telephone, information systems).

The amount of monies funded to the New Jersey Technical Assistance Program (NJTAP) through the Pollution Prevention Fund was also specified in the NJP2 Act. As mentioned above, the NJTAP receives $200,000 annually from the NJDEP OPP. Ten percent (10%) of the funding goes to the university and the department; and the remaining is used for the salaries, students, tuition, supplies, and services. The funding is received by the university grants accounting office.

Washington State Department of Ecology P2 Program

The Washington State Department of Ecology (WSDE) P2 Program expenses are funded primarily from three taxes applied to waste generators totaling about $3.4 million per year. The first tax is an education fee of $46 per year per facility and is applicable to small-quantity, medium-quantity, and large-quantity generators. There is an additional generator fee applied to all generators based on the amount of waste generated. The generator fee totals about $800,000 per year, with funding coming primarily from medium- and large-quantity generators, as the small-quantity generator fee is small by comparison. If a generator can reduce its waste to qualify as the next lower class of generator, then the generator fees are also reduced.

The third tax is a P2 Planning fee applied only to large-quantity hazardous waste generators. Large-quantity generators are required to have a P2 Plan, but are not required to implement the plan. As P2 measures are implemented, large-quantity generators can reduce their P2 Planning fee. P2 Planning fees can also be reduced if a large-quantity generator converts its status to a medium-quantity or small-quantity generator. P2 Planning fees generate about $1.8 million per year.

The WSDE Targeted Chemicals (Mercury) Program is paid for out of funds that are appropriated by the legislature from the state Toxics Control Account for the implementation of the department persistent bioaccumulative toxic chemical strategy. Since 2001, there has been a reduction of approximately 2,700 pounds of mercury released in Washington.

The Toxics Control Account is primarily funded by a Hazardous Substance Tax, which is a tax imposed on petroleum products, pesticides, and certain chemicals and is applied primarily to medium- and large-quantity hazardous waste generators. This tax generates about $800,000 per year and is paid by the first in-state possessor of the hazardous substance and is calculated based on a percentage of the wholesale value of the hazardous substance. As with the P2 Planning fee, if a generator can reduce its waste to qualify as the next lower class of generator, then the Hazardous Substance Tax is also reduced. There are approximately 8,000 different hazardous substances subject to the tax.

Other lesser sources of funding for the Toxics Control Account include Cost Recovery (recovery of contaminated site cleanup costs from the responsible parties), Fines & Penalties (issued to companies that do not comply with the toxics control laws), Technical Assistance

Fees (imposed for review of a liable party's planned and completed remedial actions), and Mixed Waste Fees (fees collected from facilities that manage mixed waste.)

California Proposition 65

California Proposition 65 is funded through the Safe Drinking Water and Toxic Enforcement Fund that is established in the California State Treasury. Any company that falls under the requirements of Proposition 65 is financially responsible for all chemical analysis of its products and waste, as well as for providing a clear and reasonable warning before knowingly and intentionally exposing anyone to a listed chemical. Based on an excerpt from the Proposition 65: Blue Print for Effective Implementation for the Fiscal Year 1988-89, fiscal resources needed for the implementation of the program were approximately $7.4 million. At inception of the program, there were eight state agencies responsible for implementing Proposition 65, with the following three agencies having the largest portion of funding: Department of Health Services (responsible for risk assessments; $2.9 million), Department of Food and Agriculture (provides data on pesticides; $1.9 million), and State Water Resources Control Board (water quality planning and regulatory programs; $1.5 million). The lead agency, now currently called the Office of Environmental Health Hazard Assessment (OEHHA), was responsible for coordinating all the efforts from affected agencies and was allotted a budget of $372,000 of the $7.4 million needed to implement the program. Since then, recent administrative costs for running Proposition 65 through the OEHHA for the fiscal 2007-2008 year were $383,000; $360,000 for fiscal year 2006-2007; and $301,000 for fiscal year 2005-2006. The current budget of the program for the fiscal year 08-09 is set at $383,000. The majority of the budget (70 percent) is dedicated to the salaries of staff involved directly in the implementation activities and the compensation of the Science Advisory Board's members. There are also salary costs for three Deputy Attorney Generals from the state Attorney General's Office to enforce Proposition 65. Administrative staff of the program consists of two full-time positions. The program is also supported by the Executive Office for policy matters, the Chief Counsel and one full-time attorney for legal and regulatory affairs, and several scientific staff from the Reproductive and Cancer Hazard Assessment Branch for scientific matters (18 positions).

The Enforcement Fund is funded by monetary settlements of civil lawsuits against businesses or organizations that have violated the requirements of Proposition 65. These lawsuits may be brought by the Attorney General, any district attorney, city attorneys, or private parties acting in the public interest. A business found to be in violation of Proposition 65 is subject to civil penalties of up to $2,500 per day for each violation. In addition, the business may be ordered by a court of law to stop committing the violation.

In 2007, there were 156 settlements, totaling $11.8 million; 199 settlements in 2006 totaling $13.6 million; and 148 settlements in 2005 totaling $10.3 million. The settlements include civil penalties, attorney fees, and injunctive relief (product reformulation, emission reduction, or warnings). This injunctive relief is often complex and requires reference to actual settlement documents to accurately assess all the components of the settlement. All civil and criminal penalties collected are distributed as follows:

- Fifty percent of all civil and criminal penalties collected under Proposition 65 will be deposited in the Hazardous Substance Account in the General Fund.

- Twenty-five percent will be paid to the office of the city attorney, city prosecutor, district attorney, or Attorney General, whichever office brought the action.
- Twenty-five percent will be paid to OEHHA and used to fund the activity of the California state environmental agency, the local health officer, or other local public officer or agency that investigated the matter that led to the bringing of the action.

There is no accurate way to determine hazardous or toxic waste reductions as a result of Proposition 65 because no agency is currently tracking that information. Improvement is tracked through enforcement action. In 1998, however, the Environmental Defense Fund estimated that the California Proposition 65 inventory of toxic air emissions dropped from 21 million pounds in 1988, the first year the law went into effect, to 6 million pounds in 1995, a decrease of about 73 percent. Nationally, those emissions dropped 48 percent during the same time period.

Advantages of Pollution Taxes

There are several advantages of pollution taxes to the enforcing agency over a direct control, or command-and-control approach. (http://sorrel.humboldt.edu/~economic/econ104/pollute/sld012.htm). Pollution taxes generate money for the program(s) (instead of spending it on enforcement). Because enforcement under this market-based approach is simply based on payment of taxes, it is relatively straightforward, more immediate, and less costly as compared to enforcing rules and regulations (under the command-and-control approach).

In addition, program efficiency (both time and cost) is gained (over a command-and-control approach) because firms have flexibility in deciding how to implement emission reductions. Specifically, those who are able to reduce pollution the cheapest will likely do so first, and without specific and timely enforcement program monitoring/prosecution.

From the industry perspective, firms subject to pollution taxes, which are not passed on to customers, would have an incentive to develop cleaner technologies (thus reducing their "cost of pollution" over time). On the other hand, firms that pass their costs on to customers may ultimately be confronted with a falling demand for their products provided there are cheaper, less-polluting, substitutes available. This, in turn, will provide firms with an incentive to alter their products and production processes to meet the altering demand. (2500 Pollution Tax. Groosman, Britt. *Center for Environmental Economics and Management Faculty of Economics and Applied Economics*. University of Ghent. © Copyright 1999 Britt Groosman.)

In the case of New Jersey, an advantage of the Pollution Prevention Fund is that it is considered a special-purpose fund and not a general treasury fund. Funding for P2 is dedicated for that function and cannot be used for other purposes.

Disadvantages of Pollution Taxes

Under the market-based approach of implementing pollution taxes, while enforcement may be met by tax payment, there is no provision as far as how much a firm can release/reduce (http://sorrel. humboldt.edu/~economic/econ104/pollute/sld012.htm.) This may especially be of concern in the case of chemical reductions that should be reduced or

eliminated immediately. In addition, without direct controls, it may be difficult to monitor chemical releases/reductions.

In other words, assuming the ultimate intent of a pollution tax is environmental improvement, the degree of this improvement will often depend on the availability of alternatives and the price sensitivity of consumer demand. If the tax does not change consumer behavior and, instead, consumers simply pay a higher price for the good, the tax will have little effect on the environment, and in the end may be used merely as a revenue-generating instrument. (2500 Pollution Tax. Groosman, Britt. *Center for Environmental Economics and Management Faculty of Economics and Applied Economics*. University of Ghent. © Copyright 1999 Britt Groosman.) It is important to note that relying on pollution taxes as revenue is a viable revenue-generating source as long as the tax is imposed. (In theory, as the level of pollution is reduced over time, this source of revenue to the enforcing agency would also be decreased over time.)

From the industry perspective, firms mostly view market-based approaches, such as pollution taxes, to impose much greater costs on them than command-and-control policies (standards and voluntary agreements). In addition, although this holds true for any type of nationally implemented environmental regulation, from the industry perspective, implementing an environmental tax may damage the competitive position of domestic industries in comparison with international competitors. This is viewed as a temporary comparative disadvantage, however, as the imposed tax may form an incentive for companies to improve (for example, quality and the use of new technologies). In addition, a country that introduces national policies to protect the environment will be more competitive when international environmental regulation is implemented (2500 Pollution Tax. Groosman, Britt. *Center for Environmental Economics and Management Faculty of Economics and Applied Economics*. University of Ghent. © Copyright 1999 Britt Groosman.)

Essentially, one can only fulfill one goal efficiently when using just one policy instrument. Over time, pollution taxes alone will either fulfill the goal as a means to environmental improvement or fulfill the goal of serving as a sole/primary revenue-generating source for the enforcing agency. Even under the command-and-control approach, firms also have the "right" to releases, to a degree, with no monetary penalties; and emission permit systems are also essentially giving firms "licenses" to pollute the air.

A combination of a "command" (but not "control") regulation and a "market-based" approach has been shown to be effective, and is used extensively in the U.S. The California South Coast Air Quality Management District (SCAQMD) Regional Clean Air Incentives Market (RECLAIM) program is an emission trading program for the greater Los Angeles, California, region, and is a good example of a combination approach. This "cap and trade" program sets permit limits on nitrogen oxide (NO_X) and sulfur oxide (SO_X) (for the operation as a whole instead of for individual pieces of equipment) that companies cannot exceed when they are in operation. These limits get more restrictive over time. At the same time, the program also lets businesses decide what equipment, processes, and materials they will use to meet their emission limits. Companies that are innovative and reduce emissions to below to the allowable emissions permit limit, or cap, can then sell excess emission reductions to other firms. Buyers of the emissions reduction credits are companies that find the cost of buying credits cheaper than buying and installing new equipment or that requires more time to clean up. The program harnesses the power of the marketplace. For

industry, the program translates to increased flexibility and a financial incentive to reduce air pollution beyond what laws and traditional command-and-control rules require. For the public, the program translates into guaranteed annual reductions that, in turn, protect public health.

Since the start of the program in 1993, RECLAIM has resulted in the reduction of approximately 25,000 tons of NO_X annually. In addition, the SCAQMD has created a phased program to reduce the daily emissions of NO_X by about 22.5 percent, or 7.7 tons daily. Specifically, the first phase entails a 4-ton daily supply reduction in 2007, followed by a 0.925-ton daily supply reduction annually from the period of 2008-2011 (http://www.spectrongroup.com/tabid/199/Default.aspx).

According to a 2002/2003 report, SCAQMD met its environmental targets while saving businesses $57.2 million (1987 dollars) annually as compared to traditional command-and-control approaches. In addition, it is estimated that 1,147 jobs were preserved as a result of this program (http://www.emissions.org/publications/member_articles/ef12ema31.pdf).

Other potential financing options (toxic chemical usage fees, loans) were detailed further in Section 4.

It is important to note that currently, CETESB does not currently have the authority to use general state taxes or potentially even its own resources to help fund a toxics chemical reduction program. Legislative modifications would be required to use these mechanisms as incentives for compliance and/or as toxics chemical reduction program funding sources.

Table 5-6 outlines potential sources of CETESB financing options and the advantages and disadvantages of each one.

TABLE 5-6
Summary of Toxic Reduction Program Financing Options for CETESB

Financing Option	Applicability of Financing Option	Types	General Advantages	General Disadvantages
Allocation of General Taxes Paid to Government	• For CETESB (all three programs)	N/A	• When available, can potentially provide a relatively large source of funding	• A general treasury fund is not dedicated for a specific purpose (unlike special purpose funds in which funding is dedicated for a particular function and cannot be used for other purposes) • Subject to annual budgeting process and allocation
Toxic Chemical Usage Fee	• For CETESB (Programs 2 and 3)	• By chemical	• Serves as an incentive for industry to reduce toxic chemicals, if the fee is set high enough (financial goal to eliminate toxic chemical usage) • One revenue source for CETESB (by-	• Potentially expensive to Industry

			product, not the goal of the fee)	
Pollution Taxes (i.e., fee charged per employee for companies falling under relevant CNAE codes or taxes charged per facility and based on the amount of waste generated) Noncompliance Fines	• For CETESB (all three programs)	• By number of facilities and amount of waste generated • By CNAE code and number of employees	• Generate money for the program (instead of spending it on enforcement) • Relatively straightforward and immediate source of funds • Financial incentive for industry to reduce toxic chemical usage	• Requires implementation in conjunction with direct controls to make environmental progress (vs. simply complying with fines) • In theory, as the levels of toxics chemical usage decrease, this funding source would also decrease • Impose greater costs to industry and may temporarily hurt the competitive position of domestic industries as compared to international competitors

Potential industry financing options include loans, again depending on loan funding availability, eligibility criteria, and the timeframe between the application process and the desired program commencement. Table 5-7 outlines industry financing options and the advantages and disadvantages of each one.

TABLE 5-7
Summary of Toxic Reduction Program Financing Options for Industry

Financing Option	Applicability of Financing Option	Types	General Advantages	General Disadvantages
Loans	• For Industry (all three programs) Exception: World Bank (Brazilian Country Management Team) may be applicable to CETESB	• Pollution Control Program (PROCOP) • The Brazil National Development Bank (BNDES) Program for the Modernization of Machines and Equipment • World Bank (Brazilian Country Management Team) • World Bank Financing Arm [International Finance Corporation (IFC)] • Inter-American Development	• PROCOP is an established source of funding for P2 projects in São Paulo. • Government loan programs often provide loans at lower interest rates (as compared to those for commercial loan and bond financing). • Involve fewer and lower transaction costs • Loans from different sources may be commingled, including with grant funds. • Loans are especially flexible with respect to application	• Currently no projects or programs at the World Bank (Brazilian Country Management Team) for a toxic reduction program; however, CETESB may be able to get assistance in setting up the program or in modifying the permit program. • Government loans are subject to borrower competition as well as the availability of approved funds. • Government loans may carry onerous governmental mandates. • Most federal loans have complicated application procedures.

TABLE 5-7
Summary of Toxic Reduction Program Financing Options for Industry

Financing Option	Applicability of Financing Option	Types	General Advantages	General Disadvantages
		Bank (IDB)	deadlines and cost overruns.	

5.5 Implementation Plan – Program 1

This section provides a description of the actions needed to bring proposed Program 1 to an operational phase and presents an implementation schedule.

5.5.1 Mandatory Toxics Chemical Usage Reporting (to CETESB)

Implementation details of the mandatory toxics chemical usage reporting to CETESB, including establishment of the targeted chemicals list, and establishment of the de minimis levels were detailed in Section 2 of this report. Considerations for the reporting element was presented in Section 4. Implementation of each of these elements applies for Programs 1, 2, and 3 in the same manner.

5.5.2 Voluntary Chemical Usage Reduction Plan and Chemical Use Reduction Tracking (Permits)

This component includes voluntary toxics chemical usage reduction planning and goal setting, completely at the discretion of individual companies. There will be no submittals to CETESB and no enforcement by CETESB for this particular component. Enforcement under this program would simply be based on failure to report chemical usage inventories to CETESB. CETESB would also have discretion for further verification and enforcement when reporting is deemed inaccurate.

Two methods are recommended for monitoring the effectiveness of the toxic chemicals use reduction program. First, data on toxic chemical use collected in permit applications should be aggregated by industrial sectors to estimate industry-wide use (and reductions year-to-year). Second, the existing CETESB environmental monitoring programs, such as the Environmental Quality Reports, should be modified if needed to include toxic chemicals targeted in the use reduction program, and such data should be analyzed to determine if there are changes year-to-year.

As detailed further in Section 4, CETESB would provide industry-specific training, industry-specific study results/trends, and overall toxics chemical usage reduction methodology support on a sector-by-sector basis, as well as demonstrate how to comply with and complete specific forms. There will be no support involving the collection of site-specific data by CETESB.

5.5.3 Economic Incentives

The economic incentives detailed in Section 4 that have direct CETESB involvement under this program include the following:

- Potential to use loans, as needed

Table 5-8

Proposed Schedule for Program 1

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Beyond Year 13
PHASE 1														
1. CETESB to set up the program.														
2. Industry to submit chemical usage inventory to CETESB.														
PHASE 2														
1. CETESB to disclose company successes.														
2. CETESB to re-evaluate the chemical usage inventory and its effect on the environment to determine if the initially selected chemicals should continue to be reported and whether other chemicals need to be added.														
PHASE 3														
1. CETESB to evaluate program success to determine if a more comprehensive mandatory plan needs to be implemented.														

Notes:	This schedule is based on the assumption of a 5-year permit cycle. Specifically, it is assumed that toxic chemical usage reporting coincides with each permit renewal application.

5.6 Implementation Plan – Program 2

This section provides a description of the actions needed to bring proposed Program 2 to an operational phase and presents an implementation schedule.

5.6.1 Mandatory Toxics Chemical Usage Reporting

The implementation of this component will be the same as under Program 1.

5.6.2 Mandatory Chemical Usage Reduction Planning and Establishment of Toxics Chemical Usage Fees

The Chemical Usage Reduction Planning requirements will entail mandatory preparation of a detailed Chemical Usage Reduction Plan to be kept onsite and available to a CETESB inspector on demand. A Summary of this plan will be submitted to CETESB. The detailed Plan and the associated Summary will document progress in meeting goals from the previous reporting period.

As detailed in Section 4, to establish a toxics chemical usage fees, CETESB would assign a unit price per kg usage for each chemical based on the toxicity factor for that chemical. Fees would thus be proportional to toxicity multiplied by the usage. The usage fee to CETESB for each company would consist of the sum of the usage fees for each chemical used during the reporting period.

Enforcement under this program would be based on failure to report chemical usage inventories to CETESB, failure to submit Summary reduction plans that meet established requirements to CETESB (i.e., format, content), and failure to have the detailed Plan onsite. CETESB would also have discretion for further verification and enforcement when reporting is deemed inaccurate.

Two methods are recommended for monitoring the effectiveness of the toxic chemicals use reduction program. First, data on toxic chemical use collected in permit applications should be aggregated by industrial sectors to estimate industry-wide use (and reductions year-to-year). Second, the existing CETESB environmental monitoring programs, such as the Environmental Quality Reports, should be modified if needed to include toxic chemicals targeted in the use reduction program, and such data should be analyzed to determine if there are changes year-to-year.

5.6.3 Mandatory Disclosure Program

This program includes positive public disclosure (company success stories) as well as full public disclosure. Requirements of establishing the disclosure program are as discussed in Section 4.

5.6.4 Technical Assistance Program

The technical guidance provided to industry sectors under this proposed program could be enhanced through partnerships with non-regulatory institutions (i.e., institutions that are not required to enforce laws and regulations) to provide innovative and creative toxics chemical usage reduction solutions to industries seeking assistance at their facilities, as detailed further in Section 4.

5.6.5 Economic Incentives

The implementation of this component will be the same as under Program 1, with the potential for reduced usage fees for toxic chemical usage reductions.

5.6.6 Financing Options

The implementation of this component will be the same as under Program 1.

5.6.7 Schedule

The proposed schedule for implementation of the Program 2 elements is shown in Table 5-9.

Table 5-9

Proposed Schedule for Program 2

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Beyond Year 13
PHASE 1														
1. CETESB to set up the program.														
2. Industry to submit chemical usage inventory to CETESB.														
PHASE 2														
1. CETESB to establish the toxic chemical usage fee program.														
2. CETESB to include public disclosure of the chemical usage inventories and Chemical Usage Reduction Plan Summaries.														
3. Industry to implement goal setting and chemical usage reduction planning.														
PHASE 3														
1. CETESB to collect fees based on the previous inventory.														
2. CETESB to disclose company successes.														
3. CETESB to re-evaluate the chemical usage inventory and its effect on the environment to determine if the initially selected chemicals should continue to be reported and whether other chemicals need to be added.														
4. Industry to evaluate of the success of its previous plan to determine if adjustments need to be made.														
PHASE 4														
1. CETESB to conduct a program evaluation to determine if any program modifications need to be made.														

Notes:	This schedule is based on the assumption of a 5-year permit cycle. Specifically, it is assumed that toxic chemical usage reporting coincides with each permit renewal application.

5.7 Implementation Plan – Program 3

This section provides a description of the actions needed to bring proposed Program 3 to an operational phase and presents an implementation schedule.

5.7.1 Mandatory Toxics Chemical Usage Reporting

The implementation of this component will be the same as under Programs 1 and 2.

5.7.2 Mandatory Chemical Usage Reduction Planning

The implementation of this component will be the same as under Program 2. In addition to enforcement being based on failure to report chemical usage inventories to CETESB, failure to submit Summary reduction plans that meet established requirements to CETESB, and failure to have the detailed Plan onsite, however, this program also includes enforcement of failure to meet CETESB-established usage reduction goals.

Two methods are recommended for monitoring the effectiveness of the toxic chemicals use reduction program. First, data on toxic chemical use collected in permit applications should be aggregated by industrial sectors to estimate industry-wide use (and reductions year-to-year). Second, the existing CETESB environmental monitoring programs, such as the Environmental Quality Reports, should be modified if needed to include toxic chemicals targeted in the use reduction program, and such data should be analyzed to determine if there are changes year-to-year.

5.7.3 Mandatory Disclosure Program

The implementation of this component will be the same as under Program 2.

5.7.4 Mandatory Company-by-Company Goal Setting and Establishment of Toxic Chemical Usage Fees

The steps required to implement this program option is detailed in Section 4.

5.7.5 Technical Assistance Program

The implementation of this component will be the same as under Program 2.

5.7.6 Economic Incentives/Support

The implementation of this component will be the same as under Program2.

5.7.7 Financing Options

The implementation of this component will be the same as under Programs 1 and 2.

5.7.8 Schedule

The proposed schedule for implementation of the Program 3 elements is shown in Table 5-10.

Table 5-10

Proposed Schedule for Program 3

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Beyond Year 12
PHASE 1													
1. CETESB to set up the program.													
2. Industry to submit chemical usage inventory to CETESB.													
PHASE 2													
1. CETESB to set company-by-company goals.													
2. Industry to implement chemical usage reduction planning based on the goals established by CETESB.													
3. CETESB to include public disclosure of the chemical usage inventories and Chemical Usage Reduction Plan Summaries.													
PHASE 3													
1. CETESB to re-evaluate the chemical usage inventory and its effect on the environment to determine if the initially selected chemicals should continue to be reported and whether other chemicals need to be added.													
2. Industry to evaluate of the success of its previous plan to determine if adjustments need to be made.													
PHASE 4													
1. CETESB to disclose company successes.													
2. CETESB to conduct a program evaluation to determine if any program modifications need to be made.													

Notes:	This schedule is based on the assumption of a 5-year permit cycle. Specifically, it is assumed that toxic chemical usage reporting coincides with each permit renewal application.

5.8 Evaluation of the Proposed Program Alternatives

5.8.1 Environmental Impacts

The ultimate goal of a toxic chemical reduction program is to have a positive impact on human health and the environment. As demonstrated in Section 3, toxic chemical reduction programs in the US and elsewhere have achieved these goals and had positive impacts on the environment. Additionally, other environmental impacts can be realized, as detailed below.

To estimate toxics chemical reductions by industry for São Paulo, TRI data were obtained on the industry average % reduction of total TRI onsite and offsite reported, disposed of, or otherwise released chemicals in the U.S. between 1989 and 1998. The industry average % reduction was based on the total mass of all compounds. Table 5-11 provides an indication of the level of toxic chemical reductions that could be achieved by implementing a similar program in São Paulo. It is important to note that the reductions presented in the table are merely on U.S.-based industry averages. Many other country/program-specific factors will come into play, such as program specifics (i.e., market-based, command-and-control approach, or a combination of the two); actual list of key chemicals of concern that will be determined once the database is established; ability for product elimination/, substitution by industry; market conditions; release conditions; extent of exposure; and environmental conditions.

TABLE 5-11
Industry Average % Reduction/Increase of Total TRI Onsite and Offsite Reported, Disposed of, or Otherwise Released Chemicals in the U.S. Between 1989 and 1998

CNAE Code	CNAE Description (Industry)	Industry Average % Reduction/Increase of Total TRI Onsite and Offsite Reported, Disposed of, or Otherwise Released Chemicals in the U.S. between 1989 and 1998
15	Food and Beverage Manufacturing	15%
17	Textile Mills	-69%
18	Apparel and Accessories Manufacturing	-76%
19	Leather and Allied Products Manufacturing	-65%
20	Wood Product Manufacturing	27%
21	Paper Manufacturing	-15%
22	Printing and Reproduction	-60%
23	Petroleum, Coke, Nuclear, Fuels and Sugar Cane Fuel Production	-40%
24	Chemical Manufacturing	-45%
25	Plastics and Rubber Products Manufacturing	-37%
26	Nonmetallic Mineral Product Manufacturing	-4%
27	Primary Metal Manufacturing	-6%
28	Metal Product Manufacturing (except machinery)	-48%
29	Machinery and Equipment Manufacturing	-73%
31	Electrical Equipment, Appliance, and Component Manufacturing	-73%
32	Electronic Product and Communications	-87%

TABLE 5-11
Industry Average % Reduction/Increase of Total TRI Onsite and Offsite Reported, Disposed of, or Otherwise Released Chemicals in the U.S. Between 1989 and 1998

CNAE Code	CNAE Description (Industry)	Industry Average % Reduction/Increase of Total TRI Onsite and Offsite Reported, Disposed of, or Otherwise Released Chemicals in the U.S. between 1989 and 1998
	Equipment	
33	Medical Equipment and Supplies Manufacturing	-76%
34	Motor Vehicle Manufacturing	-56%
35	Other Transportation Equipment Manufacturing	-56%
36	Furniture and Other Industries	-68%

Other environmental benefits from toxics chemical reduction program implementation could include changes in the level of energy and water consumption at the facility. Although some process improvements may result in increased water or energy usage at a facility, many of the case studies reviewed (including technical assistance programs in New Jersey and Washington) resulted in dramatic reductions in water and energy usage because potential efficiency opportunities were identified while the manufacturing processes were being reviewed.

Examples of links between toxic substances reduction with environmental quality improvement include the dichlorodiphenyltrichloroethane (DDT) ban on pelican/large bird populations as well as the reduction of airborne lead with the implementation of lead-free gasoline in countries. DDT is the best known of a number of chlorine-containing pesticides used in the 1940s and 1950s. Among many other adverse effects, it became known to cause eggshell thinning in large bird populations, including pelicans. After the ban of DDT in the early 1970s in the U.S., brown pelican populations started to recover almost immediately in the southeast as residues and eggshell thinning declined and productivity increased (http://www.pwrc.usgs.gov/whatsnew/events/carson/Pres_Web/blus_pelicantalk051107.pdf).

In addition, there may also be opportunities to reduce greenhouse gas emissions.

Chemical reduction programs, however, can have unintended negative environmental impacts. If a reduction program causes an industry to replace one toxic chemical that is regulated or reported with another one that is not regulated and the replacement chemical is more toxic, then the program can have a negative impact. For example, approximately 20 years ago, when trichloroethylene (TCE) was banned, industry switched to 1,1,1-trichloroethane (TCA), which was not banned, as a degreasing solvent. However, TCA has an equivalent toxicity to TCE; therefore, the use of both is now highly discouraged. Another example includes the switch from polychlorinated biphenyl (PCB)-containing transformer oil to mineral oil. Although mineral oil is not a toxic compound, it does have health and safety impacts because it is flammable and explosive, causing potential unintended exposure of flames/fire. Therefore, it is very important that any program that is put in place have a periodic review process built in where industries are monitored to see what new chemicals they are using and if there are any new chemicals that need to be included in the reduction program.

Similarly, even if the replacement chemical is less toxic, if the source for that replacement is further from the user, then additional pollution will be generated in the transport of the replacement chemical. Other process changes also might be required to allow for the replacement of a given chemical, and these changes could require an increase in energy use or could generate more toxic waste products. Therefore, a holistic approach must be used when determining the environmental impact of the reduction of a given chemical including the environmental impacts of any new chemicals or processes implemented.

5.8.2 Development Impacts

Although the primary goal of a toxic products reduction program is the reduction in impacts to human health and the environment, a secondary goal can be economic stimulus. The subsections below discuss potential positive and negative impacts that may be realized by a toxics reduction program in Sao Paolo, Brazil.

Infrastructure/Industry

As demonstrated in Section 3, there are numerous examples of where manufacturers installed upgrades to their manufacturing processes to achieve a reduction in their use of toxic materials. The scale and scope of these investments varied widely by industry and the size of the industrial installation. One study found that larger firms are generally more successful at pollution-prevention efforts because they integrate the pollution-prevention processes into other existing management activities such as quality teams. Small and mid-size firms also generally have fewer internal resources to complete pollution-prevention activities and rely more "on external resources for identifying pollution prevention options. They tend to look at published literature, trade associations, vendors and technical assistance programs" (Pollution Prevention: People are the Key by McClees, Ga Tech Research Horizons Spring 1995).

The infrastructure changes also varied by the type of toxics chemical reduction programs put in place. In a voluntary program, facilities are primarily motivated by improving their competitiveness in the marketplace. Therefore, it is expected that most projects that will be implemented under a voluntary program will have a relatively short (preferably less than 1 year) payback period. Projects in successful voluntary programs in the United States have been shown to have a payback period of less than 3 years, and in many cases, less than 1 year. Examples of potential projects include:

- Installation of aqueous parts-washing equipment to replace vapor degreasers and eliminate the use of chlorinated solvents to clean parts before metal finishing (plating or painting)
- Installation of covers on storage or mixing tanks to reduce evaporation
- Replacement of solvent-based lacquers with water-based coatings and ultraviolet (UV) dryers
- Installation of a glycol recovery and reuse system
- Conversion from mercury cell electrolytic production of chlorine and caustic soda to a mercury-free membrane process

Implementation of these types of projects would also lead to the development of equipment manufacturers, who would need to cater to these process modifications.

In voluntary programs, most projects that are implemented will have a short payback period, but these projects may not be sufficient to meet target program goals. In a mandatory program, the economic analysis shifts from selecting projects that only provide payback in a short period to selecting projects that meet the program goals at the least total cost. Therefore, projects implemented under a mandatory reduction program may have a much longer or no payback period. The primary driver is to achieve compliance with the reduction mandate with as little impact to the facility as possible.

An example includes the company Fiberglas Fabricators, in Le Center, Minnesota. To achieve reductions in the use of styrene, Fiberglas Fabricators invested $47,800 to replace its spray equipment in the open mold process with nonatomized equipment and raw material monitoring equipment (http://www.mntap.umn.edu/fiber/61-FibFab.htm). Among other environmental benefits, styrene emissions were reduced by 50,400 pounds annually. Savings in materials include $8,000 per year in gelcoat purchases and $10,000 per year as a result of a narrower range for overweight parts. In addition, it is estimated that the company will save $17,000 per year in resin purchases. TRI and air-permit-related fees will decrease by $1,700 per year. Payback is 1 to 5 years, including the loan interest.

Market-Oriented Reforms

Market-oriented reforms such as regulations, laws, and institutional changes should not be required to implement a voluntary toxics reduction program in Sao Paulo. Researchers, however, have found that voluntary programs have a higher success rate when there is the "threat" of a future mandated program if the voluntary program is not complied with (Glachant, *Journal of Environmental Economics and Management*, Volume 54 [2007] pp. 32-48) or when implemented with a "command" but not "control" approach.

Key Issues of Required Monitoring and Inventorying

It is possible to provide incentives to facilities that implement toxics use reduction projects through positive publicity. For example, a "green seal" program could be implemented, whereby participating facilities could use some form of labeling on their products to advertise their participation in the program. Researchers, however, have found that participants in the chemical industry Responsible Care Program, a hotel "eco-label" program in Costa Rica, and the ski area Sustainable Slopes Program showed inferior environmental performance to those who chose not to participate in those voluntary programs (King and Toffel, Self-Regulatory Institutions for Solving Environmental Problems). Their conclusion was that these programs failed to improve environmental performance because they did not require independent monitoring. Conversely, plants that became certified under ISO 14001, which requires independent monitoring, reduced their pollution levels faster than plants that did not become certified. Therefore, if some sort of recognition is given as part of the voluntary toxics reduction program, then CETESB should ensure that independent monitoring and verification are a part of the program. Specifically, monitoring and verification would need to be conducted by an entity independent of the industrial group that is organizing the reduction program. CETESB can serve in this monitoring and verification role, rather than leaving it to the industries or their association

(Industry Federation of the State of São Paulo, or FIESP) to do the monitoring and verification.

Considerations for Regulations and Laws

State Law 997/1976 regulated by State Decree No. 8.468/1976 gives CETESB the administrative enforcement power on environmental issues and a duty to issue and enforce permits, to enforce environmental laws and regulations, and to control pollution sources. Currently, CETESB enforces chemical-specific legislation that bans or restricts the use of certain chemicals. In São Paulo, the following decrees and laws identify the prohibited and restricted use substances:

1. State Decree No. 8468, September 8, 1976, which regulates the State Law No. 997, May 31, 1976, in its Article 116 (from an amendment inserted by the State Decree No. 12.045, August 8, 1978), prohibits the handling of any chemicals containing dioxins by industries subject to environmental permitting. This prohibition does not include any pesticide registered and with authorized use by the Ministry of Agriculture.
2. State Decree No. 8468, September 8, 1976, Article 117 (amendment inserted by the State Decree No. 23.128, December 19, 1984) prohibits all regulated sources on the transportation, storage, and any type of processing of methyl isocianate in São Paulo.
3. State Law No. 8.999, December 26, 1994, prohibits the use of disposable packaging, which uses chlorofluorocarbons (CFCs) as an expanding agent in its manufacturing process.
4. State Decree No. 41.629, March 10, 1997, prohibits the acquisition of any equipment or product containing ozone-depleting substances (applies to all state entities), in accordance with the Montreal Protocol.
5. State Law No. 12.288, February 22, 2006, regulates the phase-out of PCBs and their residues and the cleanup and the elimination of transformers, capacitors, and any other electrical equipment containing PCBs.

As noted above, CETESB, however, does not have the general authority to ban chemicals or their specific uses. Specifically, other than through voluntary participation, CETESB currently has no legal authority to require the industries to report toxics chemical use, identify opportunities for toxics chemical use reduction, and set goals for the reduction of chemical use. CETESB only has the authority to obtain information regarding raw materials used. This legislation would need to be modified to give CETESB the general authority to require reporting, to require banning or reducing toxics chemical use, or to impose a national-level cap and trade program goal if such a program is desired for toxics chemical reductions.

In addition, specific raw material composition information is not currently readily available from suppliers in Brazil. And, new requirements to obtain this information from chemical suppliers would need to be put in place such that the regulated industries that use toxic chemicals could report their usage accordingly.

Lastly, according to current federal and state regulation, CETESB must give the public access (there are some exceptions) to all documents associated with the permitting process.

Industries falling under the commercial, industrial, or financial sectors, however, could choose to not authorize the public access to some information, including quantities and lists of the raw materials used at a facility. Legal modifications, therefore, would be required to implement any type of public disclosure associated with a toxics chemical usage program.

According to an innovative Progressive Policy Institute (PPI) policy report, it is important to adopt standards and regulations that are stringent in their goals, but flexible in their means of achieving those goals (http://www.ppionline.org/ppi_ci.cfm?knlgAreaID=116&subsecID=150&contentID=1159). Laws and policies that "command" but not "control" (i.e., "Second Generation" policy) encourage the redesign of industrial processes to produce less waste, instead of relying on costly equipment to clean pollutants at the end of the production process. According to PPI, the following should be noted when establishing pollution prevention policies.

1. **Established policy should continuously stimulate and reward technological innovation.** According to PPI, laws and regulations should be written such that they prevent pollution and at the same time drive innovation, instead of the "command-and-control" approach in which specific technologies to control pollution (i.e., at the end of a discharge pipe or smokestack) are mandated, oftentimes by a costly permitting process. The traditional command-and-control approaches also require reductions in rates of end-of-pipe single pollutants (versus continuous innovation toward an overall cleaner process resulting in comprehensive pollutant discharge reductions). "Second generation" approaches would take the following into account:

   - Implement standards that specify a set of desired environmental outcomes rather than end-of-pipe rate reductions in single pollutants
   - Eliminate outdated mandates in laws (federal and state) requiring specific technologies
   - Favor upstream pollution prevention (vs. downstream)
   - Establish "cap and trade" programs
   - Reform hazardous waste laws to promote reuse and recycling

   By offering more choices in how standards are achieved, it has been shown (at both the federal and state level) that strict environmental standards can be maintained and even exceeded over time. For example, the Clean Air Act sulfur dioxide (SO_2) emissions trading program achieves major reductions using a cap on total emissions. The program also eliminates individual permit review of technology.

2. **By creating the opportunity for technology innovation (and thereby avoiding the permitting process and associated regulator lack of familiarity with the new technology and time delays), along with reducing the number of enforcing jurisdictions, the chance for developing and marketing environmental technologies increases.** According to PPI, the traditional laws and regulations that have led to the traditional scenarios (technology restriction, costly and timely permitting, and numerous enforcing jurisdictions) have resulted in far less funding for environmental technology than for telecommunications, health, and general industrial sectors. In

addition, a declining trend of funding for environmental technology has been seen within just the past 10 to 20 years.

As noted in the PPI report, the following case study presents the benefits of applying second-generation policy toward mercury reduction. More than half of the mercury releases to the environment is from the intentional and typically nonessential use of mercury in processes and products (i.e., in older chloralkali plants [160 tons], wiring [57 tons], dentistry [40 tons], lamps [29 tons], and measurement instruments [24 tons]). Substitutes are available for most products, and recycling programs that do exist only capture a small percentage of the mercury that is used. Current regulations to control mercury pollution derived from these uses focus on air emissions from waste incinerators, which is expensive and fails to address major releases through product breakage, leakage, and disposal. There have been some focused efforts to reduce mercury at its source (e.g., elimination of mercury in paints/most batteries, and through some industry-driven volunteer programs), however not on a comprehensive scale due to the control-oriented Clean Air Act regulations for air toxics. By focusing more on source reductions of mercury by all intentional users instead of focusing on emissions reductions as is done today, the environmental effectiveness would be more permanent, resulting in 100 percent elimination of mercury waste (vs. none), and would be significantly more cost-effective, as the regulation of waste incinerators imposes costs of $500 to $3,000 per pound of mercury reduced.

Human Capacity Building

One additional market consequence of implementing a toxics chemical reduction program could be the development and growth of industries that support projects related to toxic chemical reduction. These industries include toxic chemical reduction consulting services and non-profit technical assistance (as described in Section 4) as well as equipment providers that would have the potential to export their services to other countries, thereby fueling economic growth in São Paulo. The development of these support industries could further encourage participation in the toxic chemical reduction program because these companies would have a market incentive to promote the use of their products and services.

The human capacity building would occur fastest under a mandated chemical reduction program. A mandated program would provide a driver for firms to make capital investments and hire outside consultants, regardless of the payback period. It would stimulate entrepreneurs to develop products and services to meet the requirements for toxics chemical reduction.

Example of Human Capacity Building—U.S.

As part of the State of Michigan governor's economic plan, the Cool Cities Program helps revitalize Michigan cities by retaining and attracting the jobs and people critical to emerging economies, while also reducing pollution (http://www.michigan.gov/documents/deq/deq-ess-p2-2005p2rept_250542_7.pdf). Communities across the state create vibrant, attractive places for people to live, work, and play. P2 opportunities for Cool Cites include (but are not limited to) recycling, "green" building development, and landscaping for water quality. Additional P2 tools that Cool Cities can make use of are the Retired Engineer Technical Assistance Program (RETAP), RETAP Student Internship Program, and the Small Business P2 Loan Program. As of 2005, the first-year participants in the program reported

the designation helped create 400 new jobs and retain 500 existing jobs, and enabled 19 projects to have priority access to more than $100 million in existing grants, loans, and other resources.

In addition, the chloralkali industry is the largest user (and has the largest inventory of) mercury. This industry has moved away from mercury cells and into a membrane process. Making this type of change in Brazil would provide membrane and related equipment sales opportunities.

Program Promotion

CETESB could retain a good public relations firm to prepare presentations to industry executives.

As noted by Lyon and Maxwell, "Far and away the most common components of public voluntary agreement programs are information provision and public recognition" (Lyon, T.J. and J.W. Maxwell. 2004. *Corporate Environmentalism and Public Policy*. Cambridge Univ. Press). The information provision is necessary to convince industries that a voluntary program is beneficial to them. In a mandatory program, training and information provision is recommended, but is not the main driver for industries entering the program.

- The strategy is to provide coordinated, well-organized, effective outreach to industry executives to encourage them to participate in CETESB's Toxic Reduction Program.
- The purpose is to educate the management personnel on what the program entails, and what it does not entail.
- As executives are limited on time, an agenda should be prepared, together with a short (maximum 5 pages) outline of the presentation.
- Time requested for a meeting should not exceed 1 hour. The presentation should be designed for approximately 30 minutes, leaving ample time for questions.
- The presentation should be tailored to the particular facility being visited or, if being given at a corporate office, limited to one facility. The presentation should emphasize the benefits of the program and explain why the facility should participate in the program. The presentation should include recommended projects that could yield the facility a rapid return on their investment.
- The public relations specialist needs to be prepared and educated about the facility. Talking in generalities about a facility will not be effective.
- Preparation for the presentation should begin with the environmental and safety staff at a facility. Their support is likely needed in order to obtain management level support. Determine if staff already have ideas of projects they would like to implement in reducing toxics and help them develop the ideas. These can serve as excellent suggestions to include in the presentation to executives.
- The public relations expert should explain how implementing the project will not result in delays if any permits are required. If permits from other governmental entities other than CETESB are required, CETESB should pave the way for expedited approvals. Once an industry decides to implement a toxic reduction project. CETESB must ensure that no public agency delays occur in industry's ability to implement it.

- The public relations expert should have certain qualifications over and above typical public relations experts. Specifically, the person should have the following qualifications:
  - A technical background so that he/she will understand the chemicals of concern and the processes he or she discussing to executive management.
  - Experience in public administration, especially in environmental permitting.
  - At least 10 years' experience in developing communication strategies, media relations, interagency coordination and project outreach.
  - Experience interfacing at a working level with executives of industries of the type being targeted by CETESB to induce to participate in the Toxics Reduction Program.
  - Experience in assisting with implementing projects including, but not limited to, developing project support, preparing scopes of work and budgets.

Loan Application Specialists

If loan funding is available, CETESB could retain one or more consultants who are experts in preparing loan applications for funding the implementation of all or part of the specific toxics reduction plan developed by a particular plant.

- Preparing successful loan applications requires very specialized expertise. It is important to say the right things using the right language and phraseology in the right places in the application, and to supply all the required information in the right formats.
- Awards loans are becoming harder and harder, especially given the world economy.
- Industrial facilities, which use most of the toxic chemicals CETESB is attempting to reduce, do not typically prepare loan applications.
- CETESB should reach out and have professional loan application preparation experts available for industrial facilities to use in seeking funding for the Toxics Reduction Program.
- These experts who prepare successful loan applications preferably should have specialized expertise in dealing with toxic and hazardous chemicals used in industrial processes.
- Typically universities that perform large environmental science or engineering research projects, especially where funding for development of a prototype piece of equipment or series of existing equipment to test out a new process, would be a good place to start a search to find qualified people with this type of experience and expertise.
- Obtaining low interest loans to implement a project where industry can see will provide a return on their investment will persuade that industrial facility (and other facilities having the same or similar industrial processes that use the same toxic chemicals) to invest more of their own funding to implement additional toxic reduction programs.
- To further persuade other industrial facilities to apply for loans, CETESB, by retaining such experts, can ensure that the application packages prepared for a particular loan entity for a particular industry type also be used to prepare templates, with instructions, so that other facilities can use these for applying for loans for their own projects.

Technical Assistance (non-profit)

As detailed in Section 4, technical assistance could include support with inventory preparation, toxic use reduction planning, and industry sector-specific chemical reduction by CETESB and/or universities/non-profit organizations.

Technical Consultants

The concept of CETESB hiring consultants to pick a common industry and obtain agreements with a plant to prepare a detailed waste minimization feasibility plan with at least partial funding on a follow-on demonstration project will be an incentive to other similar facilities on the feasibility and short-term cost-effectiveness of nontoxic chemical substitution, waste minimization, and recycling.

CETESB could have a list of consultants who are experts in pollution control technology and implementation, as well as expert consultants in industrial processes and controls.

- Recommend listing consultants by name of the individual rather than a company name so that the consulting firms cannot make substitutions.
- Include negotiated labor rates for each consultant that is published in the list.
- Recommend separate list of such consultants by industry type.

Demonstration Projects

Conduct one or more demonstration projects for a common process for an industry sector and demonstrate cost-effective toxics reductions.

Technology Transfer and Productivity Enhancement

The implementation of toxics chemical reduction programs will inevitably lead to new technologies and manufacturing techniques through the exploration of process improvements that could include:

- New technologies required to implement material substitutions (new cleaning equipment, coating application methods, drying techniques, etc.).
- Process improvements for reducing the need for toxic chemicals (reducing the soiling of parts to reduce the need for cleaning).
- Beneficial substance substitution (replacement of toxic chemicals with ones that are less toxic, and that do not generate additional pollution in transport, increased energy use, or the generation of more toxic waste products). An example includes the installation of aqueous parts-washing equipment to replace vapor degreasers and eliminate the use of chlorinated solvents to clean parts before metal finishing (plating or painting).

Furthermore, process improvements examined during the review of manufacturing methods may lead to increased efficiency and productivity. One method by which efficiencies could be gained is the implementation of Lean Manufacturing techniques, whereby all aspects of the manufacturing process are examined to improve efficiencies. Productivity enhancements from toxics chemical use reduction projects could include:

- Reduced labor from the handling of toxic materials.

- Improved health of employees due to reduced exposure to toxic chemicals (more productive on the job, fewer sick days, fewer trips to the doctor, etc.).
- Reduced need for personal protective equipment.

There is a current debate about the potentials and limitations of using regulation to promote innovation and technology transfer, and enhance productivity for the environment. A number of analysts have proposed models for how environmental regulation can promote innovation and be more effective in the process. The most famous hypothesis argues that the right kind of regulation can lead to competitive advantages for firms taking early and decisive action to improve "resource productivity." Others have criticized this limited view of "innovation-friendly regulation" as motivating only incremental innovations in pollution control, arguing instead that regulation should drive "radical innovation." Others argue that a key to moving forward to spur real innovation requires the development of policies for "social learning." These policies move beyond specific strategies (such as market mechanisms and pollution prevention) and should create or realign relationships to collectively solve environmental problems.

Taken together, these hypotheses provide insights into strategies to support innovation, technology transfer, and enhancement of productivity by focusing on performance outcomes (rather than standards). These insights mandate that firms conduct some form of self-evaluation and planning process, that they employ market incentives (such as economic cost-benefit analyses of technology options), and promote "preventive" and proactive approaches to solving environmental problems. At a minimum, this literature argues that regulators can support firm innovations, technology transfer, and productivity enhancement through technical assistance and pooling of learning among firms.

The Massachusetts Toxics Use Reduction Act (TURA) program offers some methods that were successful in motivating industry. First, TURA mandates a chemical accounting system consisting of a materials balance. The materials balance requires companies to assess the quantity of chemicals present in the entire production process, including the quantity of chemical substances transported to the facility, produced at the facility, and transported from the facility as wastes or products. Materials accounting includes six throughput measures: "starting inventory, quantity of chemicals brought onsite, quantity produced onsite, quantity consumed in the production process, quantity shipped offsite as products, and ending inventory." By measuring chemicals at key points in the production process, a materials accounting system can provide crucial facilitywide information about toxics chemical use and industrial efficiency.

The state primary strategy for motivating implementation of TURA plans is not based on traditional "control" strategies such as inspections and fines. Instead, the Department of Environmental Protection (DEP) routinely refers firms to the Office of Technical Assistance for Toxics Use Reduction (OTA), an agency that provides free, onsite, and confidential engineering assistance to identify and implement toxics use reduction opportunities. DEP also regulates Toxics Use Reduction Planners, the professionals accredited to certify TURA plans. Under TURA, the Toxic Use Reduction Institute (TURI) at the University of Massachusetts was established as a technical consultant for industry.

OTA and TURI provide tools to industry to learn how to reduce its own toxics. In addition to providing information on specific technical options for certain industries, these agencies help build the internal capacity of firms through training, educational materials, and seminars. The state also serves as an "information and knowledge network-broker" for gathering and distributing information on new strategies for pollution prevention.

In this regard, state agencies serve as facilitators of experimentation and learning about new technological processes. While the TURA program established these entities as state agencies, they do not have to be government agencies for the process to encourage innovation and technology transfer. Adding experts in industrial processes and lean manufacturing will further enhance productivity in industry.

Using lean enterprise consultants as CETESB establishes the regulations will also enhance the toxics reduction process because it will force CETESB regulators to look at the processes industry will have to go through to implement the regulations so that the regulations can be written in the "least waste" or most productive way, remembering that it is the result that matters and should be set; CETESB should not control the process to get there.

Table 5-10 shows the motivation that TURA provided to industrial facilities.

More interestingly, TURA planning requirements motivated consultant and software firms to develop systematic procedures for tracking and reducing chemical and other resource uses. The program fostered the development of chemical tracking systems, preventive equipment maintenance programs, water conservation programs, and new environmental accounting systems. Thus it appears that by commanding firms to plan for specific chemical use reductions, TURA has been able to motivate deeper, more systematic changes that support continuous process improvements and that support more extensive production process changes, thereby enhancing technology and improving productivity.

TABLE 5-10
Survey of TURA Participants

	Percentage of Respondents 'Very Involved' in Activity	
Activity	**Before TURA**	**After TURA**
Tracking quantities of wastes generated	49%	89%
Tracking quantities of chemicals used	48%	90%
Establishing a corporate or facility environmental team	24%	68%
Setting goals for waste reduction	24%	73%
Reviewing changes in production processes for their environmental, health, and safety impact	30%	76%
Allocating environmental costs to process or products	21%	52%

Source: Abt Associates (1997).

Finally, by implementing the Toxic Reduction Plans developed under TURA, industries became demonstration projects to enhance the technology of toxics reduction while, at the same time, showing that such projects result in surprisingly short-term return on investment (ROI) resulting in long-term savings.

Although there have been clear reductions in by-product and total chemical use, the TURA goal of a 50 percent reduction in by-products between 1987 and 1997 was not achieved. Nonetheless, quantities of onsite releases to the environment were reduced by 80 percent by 1999 under TURA. When adjusted for production increases, onsite releases were reduced by 87 percent. In addition, when compared to the TRI, another pollution-prevention success story, the TURA achievements remain impressive. For the last 5 years for which comparable data are available, TURA has out-performed the TRI on emissions reductions.

TURA has also been cost-effective. In December 1996, Abt Associates conducted a cost-benefit analysis of TURA that showed that total costs (including costs of compliance and capital investments) were $76.5 million in 1995, while total monetary benefits were $90.5 million. If nonmonetary benefits such as gains to human health and ecological conditions had been included, the analysis would have shown TURA to be even more cost-effective.

Other

Other developmental benefits of the voluntary toxics reduction program would be the establishment of spin-off or demonstration projects. There are numerous examples of these types of projects that are either in-place or currently being set up in the U.S. (e.g., Oregon, Kentucky, Arizona, and New Hampshire). One of the projects that is highlighted below, however, has a different aspect to it than the others. Other example demonstration/spin-off projects highlighted in this memorandum include the one in Hungary (Section 3.3), as well as the Massachusetts TURA program (Section 3.5).

California AB2588 Air Toxics "Hot Spots" Program

The California Assembly Bill (AB) 2588 Air Toxics "Hot Spots" program is a spin-off of the air toxics program in California. The Air Toxics "Hot Spots" Information and Assessment Act (AB 2588, 1987, Connelly) was enacted in September 1987. This law and implementing regulations have done more to reduce air toxics air emissions than any other law or regulation. What makes the program unique is that the Air Toxics "Hot Spots" Act establishes a formal air toxics emission inventory risk quantification program for districts to manage. The goal of the Air Toxics "Hot Spots" Act is to collect emission data indicative of routine predictable releases of toxic substances to the air, to identify facilities having localized impacts, to evaluate health risks from exposure to the emissions, and to notify nearby residents of significant risks. Senate Bill (SB) 1731, which amends the "Hot Spots" Program, added a requirement that facilities determined to have a significant risk must conduct an airborne toxic risk reduction audit and develop a plan to implement airborne toxic risk reduction measures. Due to SB 1731, another goal of the program is to reduce risk below the determined level of significance.

Information gathered from this program has complemented the California Air Resources Board (ARB) existing toxic air contaminant program by locating sources of substances that were not under evaluation and by providing exposure data needed to develop regulations

for control of toxic pollutants. Additionally, under the program, the reporting and the requirements to do the risk assessments are mandatory; the subsequent reductions are voluntary. The program has been a motivating factor for facility owners to voluntarily reduce the toxic emissions of the facilities, and has demonstrated that the mandatory risk assessment/notification component has been a powerful tool in getting industry to produce results. It is important to note that skilled and sophisticated risk assessors/modelers are required under this type of program to conduct the risk analyses required.

The "Hot Spots" program is an example of how a law can be good for the environment and business. Some of the surveyed companies reported that the preparation of their air toxics "Hot Spots" emission inventory alerted them to the actual cost of waste in their processes and motivated them to look for ways of streamlining their operations. In addition, the "Hot Spots" emission inventory, combined with concern for worker safety and the possibility of future regulation, led companies to reduce emissions by substituting fewer toxic materials in their processes or by establishing more efficient operations. These emission reductions lower the health risk to workers and the public while helping to improve company performance and relations with the community.

Inherent in this program are two very strong factors that motivated industry (as with the Massachusetts TURA example in Section 3.5): (1) that the plans allowed industry to analyze its production processes that use toxic chemicals to see that cost-effective improvements can be made and (2) the public disclosure of the amounts of toxic chemicals used and the assessment of the risk of those chemicals on the residents and workers surrounding an industrial facility. Individually or combined, both these factors have resulted in improvements in toxics reduction technology, in productivity enhancement in industrial processes, and in encouraging the development of new technologies.

An ARB survey found 21 companies that voluntarily reduced air toxics emissions by almost 2 million pounds in recent years. This sample of the California air toxics sources suggests a larger, statewide trend and points to a significant benefit of the "Hot Spots" regulation. The state ARB has not compiled the emissions reductions from the AB 2588 program, rather left it up to the various local air pollution agencies to report progress. While it is difficult to document the precise emissions reductions of air toxics due to the Air Toxics "Hot Spots" program in California, the counties that reported actual emission reductions in their reports indicated overall air toxics reductions of 60 to 90 percent. Reductions of individual toxic air emissions vary up to 100 percent.

An example of a specific success story under the program is Reichhold Chemical, Incorporated, a manufacturer of polyester resin in Oxnard. When the company found that alternatives to methylene chloride would contribute to the formation of smog, they adopted controls that allowed them to condense, recover, and reduce leakages of the toxic material. This reduced annual methylene chloride emissions by over 49,000 pounds from 1991 levels. Reichhold reported savings on raw materials and anticipates saving on long-term waste disposal.

In addition, for their work to advance pollution prevention and the control of hexavalent chromium emissions, the ARB and the Metal Finishing Association of Southern California received a South Coast Air Quality Management District 1992 Clean Air Award. The two organizations cooperated in a demonstration project showing that simple process changes,

combined with control equipment used successfully in other industries, consistently reduced hexavalent chromium emissions well below the required emission limit. The findings from this project will reduce exposure of the public to hexavalent chromium, thus preventing up to 2,600 potential cancer cases over the next 70 years.

5.8.3 Relative Comparison of Program Alternatives

The ease in implementation of any of the proposed programs needs to be weighed against the relative level of toxic chemical usage reduction expected. All three identified Programs will likely have some level of success as far as reduction in toxic chemical usage; however, Program 1 will be limited in expected reduction given that it only has a mandatory reporting component, with no public disclosure and no mandatory toxic chemical usage reduction planning/goal setting. Because Program 1 does not have the element of public disclosure and mandatory usage reduction planning, it is estimated that the level of toxic chemical usage reductions would be approximately one-third of the reductions associated with Program 2, which does include these additional elements. Program 2 will be more effective in reducing toxic chemical usage, given the added component of mandatory goal setting (and associated usage fees) coupled with mandatory public disclosure. The U.S. 33/50 Industrial Toxics Reduction Program was also a voluntary reduction program that included the element of public disclosure, although it was a program associated with emissions reductions (versus usage reductions). Based on a March 1999 EPA report (*33/50 Program, The Final Record*) over the 5 years that the 33/50 Program operated, releases and transfers of the 17 targeted chemicals reported to the U.S. Toxic Release Inventory (TRI) decreased by 47 percent. This results in an average percent decrease of just over 9 percent per year during the program duration from 1990 to 1995, compared to less than 8 percent per year for the two previous years (1988 to 1990) and nearly 11 percent for the year after (1995 to 1996). Lastly, Program 3 would yield the greatest toxics chemical use reductions. Specifically, the reductions under Program 3 would be based on the company-by-company reduction goals established by CETESB, coupled with the further incentive to reduce the use of toxic chemicals due to the toxics chemicals usage fee. The resources required to implement this Program (specifically the company-by-company goal-setting aspect), however, would be extensive relative to Programs 1 and 2.

5.8.4 Selected Approach

The three proposed program options were presented to industry and CETESB at a workshop held at CETESB headquarters in São Paulo on May 15, 2009. The general conclusion from the workshop was that additional discussions between industry and CETESB were needed before a program could be fully developed. However, based on initial comments from industry and CETESB, and the practical aspects of developing a toxic chemical reduction program, the recommended first step is to prepare a toxic chemical inventory through mandatory chemical usage reporting by industry.

As previously mentioned, the data indicates that the top 5 chemicals contribute 80% of the toxic risk in São Paulo, the top 10 contribute 90%, and the top 5 contribute 97%. Based on this analysis, it is recommended to collect data for the top 15 toxic chemicals (based both on toxicity and volume of use, as noted above), and subsequently choose the top 5 toxic chemicals to target for reductions. The list of targeted chemicals (reported and for reductions) can increase as the program progresses. Following the initial phase of the

program, CETESB would need to re-evaluate the chemical usage inventory to determine if the initially selected chemicals should be continued to be reported, and whether other chemicals need to be added.

A mandatory inventory may lead to some reductions in toxic chemical use due to an increased focus by industry on the targeted chemicals and their associated cost and risk. Furthermore, some reductions could be implemented by companies in order to get below the reporting thresholds, thereby avoiding cost, effort, and potential regulatory scrutiny that results from conducting the inventory. In any case, the toxic chemical inventory would allow CETESB to develop a toxic chemical reduction program based on actual data collected in São Paulo instead of data that is extrapolated from other countries.

After data has been collected from an inventory, a targeted list of chemicals can be compiled and a program can be developed using a number of the program options which include:

- **Technical Assistance**
- **Chemical Usage Reduction Planning**
- **Public Disclosure**
- **Toxic Chemical Usage Fee**
- **Usage Reduction Targets**
- **Incentives**

While three program alternatives were presented in this report, a successful program can be developed by using a "cafeteria-style" approach of selecting the elements of the above program options that are most likely to yield positive results. Based on the discussions following the workshop, a more staged approach that progressively introduces additional toxic chemical reduction measures may be the most successful approach. For example, once the inventory is completed, technical assistance programs can be introduced that focus on measures that will reduce targeted chemicals. Depending on the success of the technical assistance programs, voluntary or mandatory toxic chemical reduction planning could then be introduced. As the program progresses, the need for more stringent measures such as mandatory public disclosure and toxic chemical usage fees can be assessed.

The development of this program has just begun. The success of a program based on a partnership between CETESB and industry will depend on selecting carefully considered program options that result in the maximum possible toxic chemical use reduction with the least possible regulatory burden.

SECTION 6

6.0 US Sources of Supply

This section identifies prospective U.S. Sources of Supply of services and equipment that may be required by industries in São Paulo as a result of the implementation of the toxic chemical reduction program described in this report. At this point, the program is expected to evolve over time, starting with a requirement that industry provide an inventory of usage of toxic chemicals. As the program evolves, different options will be added to produce a result of reduced usage of toxic chemicals.

Methods of reduction are likely to include CETESB providing technical assistance to industries to reduce their usage. Due to the difficulties with CETESB providing technical assistance directly to specific companies facilities, this will provide a market for a separate entity to contract with CETESB to provide pollution prevention consulting services. This would be similar to the relationship between New Jersey and the Rutgers TAP program, discussed in Section 3 of this report. Such programs can range from several hundreds of thousands of dollars per year to millions in essentially engineering consulting services.

The Toxic Chemical Use Reduction program is also likely to include either voluntary or mandatory pollution prevention planning by industries. A typical pollution prevention opportunity assessment, when performed by a consultant is in the $50,000 to $200,000 range. If only 500 companies participate in the program, this could result in $50 million in consulting. These assessments have been performed by consultants in the US for over 25 years. US companies therefore have a technical edge in performing these studies and preparing pollution prevention plans.

A larger expenditure from implementation of a toxic chemicals reduction program would be in retooling manufacturing facilities to reduce or eliminate the usage of the chemicals. For instance, mercury is a world-wide toxic chemical issue, with current emphasis on eliminating its use in all manufacturing processes. The single largest user of mercury is in the chlor-alkali industry, where literally tons of mercury are sitting in brine cells acting as electrodes for the electrolytic conversion of simple salt (sodium chloride) into gaseous chlorine and sodium hydroxide. These chemicals end up containing trace quantities of mercury, which then introduce mercury to the products produced with these chemicals. There is a market for mercury-free chlorine and sodium hydroxide, and a membrane process was developed to eliminate mercury from the process. The Brazil chlor-alkali industry uses mercury cells. Conversion of a chlor-alkali plant from mercury cells to membrane process can cost in excess of a $ billion, with much of this going to companies that manufacture membrane equipment. The US is a leader in membrane technology, and would be a good candidate for providing equipment for this conversion.

Residential and industrial lighting is another example. Much lighting is currently accomplished using incandescent bulbs. These bulbs have low efficiency, turning most of the electricity used into heat, with a small fraction producing useful light. Due to their high heat, they typically last less than 1,000 hours before burning out. Due to their low efficiency, this type of bulb is slated to be phased out in the US and Brazil. These are being replaced by fluorescent bulbs, which use less than a third of the electricity of incandescent

bulbs and are somewhat cooler, and last some 6 times longer than incandescent bulbs. Due to their energy efficiency , fluorescents have been used by commercial buildings for years. One problem with fluorescent bulbs is that they contain mercury, and their widespread use and disposal can result in unacceptable releases to the environment. One technology that is just in its infancy is light emitting diode (LED) lamps. These are more expensive than fluorescents, but last 5 times as long as them, and consume approximately half to a third of the electricity. Over their lifetime, even at the current high price, they save money in reduced bulb purchase and electricity They also do not use any mercury. A mercury use reduction program would provide a market for LED bulbs as well as manufacturing equipment.

A number of the chemicals targeted for reduction are organic solvents used for products such as solvent cleaners and paints. Conversion to water or citrus based cleansers would result in a market for cleaning products and the equipment that uses them for cleaning operations.

These are just a few examples of the potential markets that would become available for consulting and manufacturing equipment sales if the toxic chemical use reduction program is implemented in Sao Paulo. Each chemical that is replaced will require that substitute "green" chemicals and the equipment to use them.

The following have been identified as potential U.S.-based companies and companies located in the US that may be able to provide services related to the program described above:

Toxic Chemical Reduction Planning and Consulting

CH2M HILL
Rua do Rocio, 351, -5° Andar
São Paulo SP - CEP 04552-000
Brazil
Contact: Mr. Tom Higgins
tom.higgins@ch2m.com
Phone: +1.703.376.5139
Fax: +1.703.376.5639

AECOM
Contact: Mr. Paulo Coelho
Praia de Botafogo, 440-240 andar
22250-050 Botafogo
Rio de Janeiro - RJ
Brazil
paulo.coelho@aecom.com
Phone +55.21.2005.3677
Fax +55.21.2005.3660

URS Corporation
Rua Oliveira Rocha 50, Conj. 301
Jardim Botanico
Rio de Janeiro, RJ, 22461-070
Brazil
Phone: +55.21.2226.6245
Fax: +55.21.2226.6245

CDM
One Cambridge Place
50 Hampshire Street
Cambridge, MA 02139
U.S.A.
Phone: +1.617.452.6000
Fax: +1.617.452.8000

Facility Design and Modification

CH2M HILL
Rua do Rocio, 351, - 5° Andar
São Paulo SP - CEP 04552-000
Brazil
Contact: Mr. Tom Higgins
tom.higgins@ch2m.com
Phone: +1.703.376.5139
Fax: +1.703.376.5639

URS Corporation
Rua Oliveira Rocha 50, Conj. 301
Jardim Botanico
Rio de Janeiro, RJ, 22461-070
Brazil
Phone: +55.21.2226.6245
Fax: +55.21.2226.6245

Fluor Corporation (Headquarters)
6700 Las Colinas Blvd
Irving, TX 75039
U.S.A.
Phone: +1.469.398.7000
Fax: +1.469.398.7255

Bechtel Corporation (Headquarters)
50 Beale Street
San Francisco, CA 94105
U.S.A.
Tel: +1.415.768-1234
Fax: +1.415.768.9038

Chlor-Alkali Facility Equipment

Uhde Corporation of America
1370 Washington Pike
Bridgeville, PA 15017
U.S.A.
+1.412.257.8277
Contact: Bill Richards

ELTECH Systems Corporation
100 Seventh Avenue Suite 300
Chardon, OH 44024
U.S.A.
Phone: +1 440 285 0300

INEOS Technologies
1900 Fort Amanda Road
Lima, OH 45804
U.S.A.
Phone:: +1 419 226 1200

Alternatives to Incandescent Lightbulbs

Westinghouse
Westinghouse Lighting Corporation
12401 McNulty Road
Philadelphia, PA 19154-1029
Phone: (305) 461-3833
Fax: (305) 461-1380
info@westinghouselighting.com

General Electric
Parque Industrial Thomas Edison
Rua Miguel Angelo, 37
Maria da Graca
Rio de Janiero 20783-900
Brazil
Phone: +55.21.582.6533
Fax: +55.21.582.6471
Contact: Richard Frank
(216) 606-6620
rfrank@ge.com

FEIT Electric Company, Inc.
4901 Gregg Road
Pico Rivera, CA 90660-2108
Phone: +1.562.463-2852
Fax: +1.562.908.6360

American Lighting
7660 East Jewell Avenue, Suite A
Denver, CO 80231
USA
Phone: +1.303.695.3019
Fax: +1.303.923.1159

Water-Based Cleaning Products

Simple Green
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Appendix A - Tables 2-1 – 2-10

Table 2-1 - Economic Output Ratio

CNAE Code	CNAE Description	SP Economic Output (1000 USD)	SIC	SIC Description	US Economic Output (1000 USD)	Economic Output Ratio
15	Food and Beverage Manufacturing	$30.057.608	20	Food	$406.962.767,00	0,074
17	Textile Mills	$5.437.997	22	Textile	$70.752.971,00	0,077
18	Apparel and Acessories Manufacturing	$2.180.061	22	Textile	$70.752.971,00	0,031
19	Leather and Allied Products Manufacturing	$1.806.368	31	Leather	$9.693.763,00	0,186
20	Wood Product Manufacturing	$1.007.628	24	Lumber	$81.564.818,00	0,012
21	Paper Manufacturing	$9.278.480	26	Paper	$133.200.703,00	0,070
22	Printing and Reproduction	$5.147.930	27	Printing	$166.153.125,00	0,031
23	Petroleum, Coke, Nuclears Fuels and Sugar Cane Fuel Production	$15.625.135	29	Petroleum	$150.226.893,00	0,104
24	Chemical Manufacturing	$30.618.743	28	Chemical	$305.420.096,00	0,100
25	Plastics and Rubber Products Manufacturing	$11.920.781	30	Plastics	$113.592.768,00	0,105
26	Nonmetallic Mineral Product Manufacturing	$5.176.665	32	Stone	$62.520.611,00	0,083
27	Primary Metal Manufacturing	$9.065.632	33	Primary Metals	$138.286.991,00	0,066
28	Metal Product Manufacturing (except machinery)	$6.428.370	34	Fabricated Metals	$166.532.038,00	0,039
29	Machinery and Equipment Manufacturing	$13.723.461	35	Machinery	$258.661.356,00	0,053
31	Electrical Equipment, Appliance, and Component Manufacturing	$5.854.403	36	Electrical	$216.764.287,00	0,027
32	Eletronic Product and Communications Equipment	$4.663.394	35	Machinery	$258.661.356,00	0,018
33	Medical Equipment and Supplies Manufacturing	$1.506.909	38	Measure Photo	$134.940.392,00	0,011
34	Motor Vehicle Manufacturing	$24.244.660	37	Transportation	$399.269.283,00	0,061
35	Other Transportation Equipment Manufacturing	$4.347.617	37	Transportation	$399.269.283,00	0,011
36	Furniture and other industries	$3.012.894	25	Furniture	$43.825.926,00	0,069

Table 2-2 - Chemical Groupings

CAS Number	Analyte	Group
7429-90-5	ALUMINUM (FUME OR DUST)	ALUMINUM
1344-28-1	ALUMINUM OXIDE (FIBROUS FORMS)	ALUMINUM
7440-38-2	ARSENIC	ARSENIC
N020	ARSENIC COMPOUNDS	ARSENIC
7440-39-3	BARIUM	BARIUM
N040	BARIUM COMPOUNDS	BARIUM
7440-41-7	BERYLLIUM	BERYLLIUM
N050	BERYLLIUM COMPOUNDS	BERYLLIUM
71-36-3	BUTYL ALCOHOL, N-	BUTYL
78-92-2	BUTYL ALCOHOL, SEC-	BUTYL
75-65-0	BUTYL ALCOHOL, TERT-	BUTYL
7440-43-9	CADMIUM	CADMIUM
N078	CADMIUM COMPOUNDS	CADMIUM
7440-47-3	CHROMIUM	CHROMIUM
N090	CHROMIUM COMPOUNDS	CHROMIUM
7440-50-8	COPPER	COPPER
N100	COPPER COMPOUNDS	COPPER
1319-77-3	CRESOL (MIXED ISOMERS)	CRESOL
108-39-4	M-CRESOL	CRESOL
95-48-7	O-CRESOL	CRESOL
106-44-5	P-CRESOL	CRESOL
N106	CYANIDE COMPOUNDS	CYANIDE
74-90-8	CYANIDE, HYDROGEN	CYANIDE
95-50-1	DICHLOROBENZENE, 1,2-	DICHLOROBENZENE
106-46-7	DICHLOROBENZENE, 1,4-	DICHLOROBENZENE
7439-92-1	LEAD	LEAD
N420	LEAD COMPOUNDS	LEAD
7439-96-5	MANGANESE	MANGANESE
N450	MANGANESE COMPOUNDS	MANGANESE
7439-97-6	MERCURY	MERCURY
N458	MERCURY COMPOUNDS	MERCURY
86-30-6	NITROSODIPHENYLAMINE, N-	NITROSODIPHENYLAMINE
156-10-5	NITROSODIPHENYLAMINE, P-	NITROSODIPHENYLAMINE
7782-49-2	SELENIUM	SELENIUM
N725	SELENIUM COMPOUNDS	SELENIUM
7440-28-0	THALLIUM	THALLIUM
N760	THALLIUM COMPOUNDS	THALLIUM
584-84-9	TOLUENE-2,4-DIISOCYANATE	TOLUENE
91-08-7	TOLUENE-2,6-DIISOCYANATE	TOLUENE
71-55-6	TRICHLOROETHANE, 1,1,1-	TRICHLOROETHANE
79-00-5	TRICHLOROETHANE, 1,1,2-	TRICHLOROETHANE
1330-20-7	XYLENE (MIXED ISOMERS)	XYLENE
108-38-3	XYLENE, M-	XYLENE
95-47-6	XYLENE, O-	XYLENE
106-42-3	XYLENE, P-	XYLENE

Table 2-3 - Metals Disregarded

CAS Number	Analyte
7440-36-0	ANTIMONY
7440-48-4	COBALT
7440-02-0	NICKEL
7440-22-4	SILVER

Table 2-4 - Releases to Air, Water, and Land

Release Destination	Discharge Type
Off-Site Disposal-Land Treatment	LAND
Off-Site Disposal-Other Land Disposal	LAND
Off-Site Disposal-Other Off-Site Management	LAND
Off-Site Disposal-Solidification/Stabilization-Metals Only	LAND
Off-Site Disposal-Storage Only	LAND
Off-Site Disposal-Unknown	LAND
Off-Site Disposal-Waste Broker	LAND
Off-Site Disposal-Wastewater Treatment-Metals Only	WATER
On-site Fugitive Air	AIR
On-site Land Treatment/Application Farming	LAND
On-site Other Land Disposal	LAND
On-site Stack Air	AIR
On-site Surface Water Discharges	WATER
Total Off-Site Disposal-Landfill/Surface Impoundments	LAND
Total Off-Site Disposal-Underground Injection	WATER
Total On-Site Landfills	LAND
Total On-site Surface Impoundments	WATER
Total On-Site Underground Injection	WATER
Transfers to POTWs Metal and Metal Compounds	WATER

Table 2-5 - Estimated São Paulo Industrial Releases by CNAE Code

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
15	71-55-6	1,1,1-Trichloroethane	22.094	413	57	22.563
15	95-63-6	1,2,4-Trimethylbenzene	2.374	0	57	2.431
15	106-99-0	1,3-Butadiene	403	0	57	460
15	123-91-1	1,4-Dioxane	1.269	0	0	1.269
15	95-95-4	2,4,5-Trichlorophenol	18	18	0	37
15	78-93-3	2-Butanone (Methyl Ethyl Ketone)	162.644	262	118	163.024
15	79-46-9	2-Nitropropane	4.417	0	111	4.528
15	75-07-0	Acetaldehyde	58.665	0	0	58.665
15	67-64-1	Acetone	88.137	2.051	0	90.188
15	7429-90-5	Aluminum (Fume Or Dust)	0	739	672	1.410
15	7664-41-7	Ammonia	1.126.324	155.822	152.222	1.434.369
15	6484-52-2	Ammonium Nitrate (Solution)	18	0	3.364	3.383
15	7783-20-2	Ammonium Sulfate (Solution)	44	103.402	100.118	203.565
15	7440-38-2	Arsenic	266	4.251	0	4.517
15	7440-39-3	Barium	0	205	425	630
15	71-43-2	Benzene	4.611	23	85	4.718
15	92-52-4	Biphenyl	74	0	0	74
15	103-23-1	Bis(2-Ethylhexyl) Adipate	666	0	0	666
15	74-83-9	Bromomethane	23.510	0	0	23.510
15	85-68-7	Butyl Benzyl Phthalate	111	28.901	0	29.011
15	75-15-0	Carbon Disulfide	0	0	57	57
15	N230	Certain Glycol Ethers	26.578	0	0	26.578
15	7782-50-5	Chlorine	16.707	20.647	10.578	47.932
15	10049-04-4	Chlorine Dioxide	295	0	18	314
15	67-66-3	Chloroform	3.539	2.483	0	6.021
15	18540-29-9	Chromium (VI)	107	3.551	636	4.293
15	7440-48-4	Cobalt	55	0	0	55
15	7440-50-8	Copper	3.504	16.580	314	20.398
15	1319-77-3	Cresol (Mixed Isomers)	739	0	0	739
15	98-82-8	Cumene	187	0	1	188
15	110-82-7	Cyclohexane	14.684	41	60	14.785
15	75-09-2	Dichloromethane	12.659	0	0	12.659
15	106-89-8	Epichlorohydrin	37	0	0	37
15	100-41-4	Ethylbenzene	2.235	0	7	2.242
15	74-85-1	Ethylene	2.052	0	57	2.109
15	107-21-1	Ethylene Glycol	19.918	3.035	100	23.053
15	75-21-8	Ethylene Oxide	8.119	0	0	8.119
15	50-00-0	Formaldehyde	794	0	0	794
15	76-13-1	Freon 113	6.872	0	0	6.872
15	7647-01-0	Hydrochloric Acid	210.761	39.857	30.483	281.101
15	7664-39-3	Hydrogen Fluoride	1.580	0	0	1.580
15	67-63-0	Isopropyl Alcohol	13.747	0	0	13.747
15	7439-92-1	Lead	37	2.223	90	2.350
15	7439-96-5	Manganese	1.780	2.437	214	4.431
15	67-56-1	Methanol	109.378	5.447	812	115.638
15	108-10-1	Methyl Isobutyl Ketone	222	0	0	222
15	1634-04-4	Methyl Tert-Butyl Ether	1.234	0	882	2.117
15	101-68-8	Methylene Bisphenyl Isocyanate (MDI)	54	0	0	54

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
15	NA	Mixture	1.358	2.344	3.305	7.008
15	91-20-3	Naphthalene	258	96	57	411
15	71-36-3	N-Butyl Alcohol	46.097	0	18	46.115
15	7440-02-0	Nickel	1	20.748	269	21.017
15	7697-37-2	Nitric Acid	1.811	15.294	3.224	20.329
15	98-95-3	Nitrobenzene	0	0	57	57
15	79-21-0	Peracetic Acid	37	0	0	37
15	108-95-2	Phenol	0	0	57	57
15	7664-38-2	Phosphoric Acid	15.521	89.761	29.875	135.157
15	7723-14-0	Phosphorus (Yellow Or White)	131	0	0	131
15	115-07-1	Propylene	9.006	0	57	9.063
15	75-56-9	Propylene Oxide	28.337	48	37	28.422
15	81-07-2	Saccharin	37	18	0	55
15	7782-49-2	Selenium	185	61	0	245
15	100-42-5	Styrene	0	0	62	62
15	7664-93-9	Sulfuric Acid	9.511	21.974	209.982	241.466
15	961-11-5	Tetrachlorvinphos	18	0	0	18
15	108-88-3	Toluene	89.338	3.122	96	92.555
15	584-84-9	Toluene-2,4-Diisocyanate	89	0	0	89
15	79-01-6	Trichloroethylene	0	0	57	57
15	108-05-4	Vinyl Acetate	37	0	0	37
15	1330-20-7	Xylene (Mixed Isomers)	12.603	1.250	79	13.932
15	7440-66-6	Zinc (Fume Or Dust)	832	598	350	1.780
15	N982	Zinc Compounds	3.369	11.851	2.910	18.129

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
17	71-55-6	1,1,1-Trichloroethane	356.617	1.578	0	358.195
17	120-82-1	1,2,4-Trichlorobenzene	19.341	2.121	290	21.752
17	95-63-6	1,2,4-Trimethylbenzene	20.740	0	0	20.740
17	95-50-1	1,2-Dichlorobenzene	648	0	0	648
17	94-75-7	2,4-D	19	0	0	19
17	78-93-3	2-Butanone (Methyl Ethyl Ketone)	642.175	37.829	39	680.043
17	110-80-5	2-Ethoxyethanol	94	0	0	94
17	109-86-4	2-Methoxyethanol	311	0	0	311
17	67-64-1	Acetone	315.196	1.286	224	316.706
17	7429-90-5	Aluminum (Fume Or Dust)	311	4.066	0	4.378
17	7664-41-7	Ammonia	123.953	892	16.484	141.328
17	6484-52-2	Ammonium Nitrate (Solution)	840	19	489	1.348
17	7783-20-2	Ammonium Sulfate (Solution)	7.871	96	30.255	38.222
17	7440-36-0	Antimony	195	5.410	676	6.280
17	7440-39-3	Barium	1.175	17.079	38	18.292
17	92-52-4	Biphenyl	21.185	332	2.663	24.180
17	103-23-1	Bis(2-Ethylhexyl) Adipate	116	19	0	136
17	85-68-7	Butyl Benzyl Phthalate	215	92	0	307
17	7440-43-9	Cadmium	0	364	38	402
17	75-15-0	Carbon Disulfide	19	0	0	19
17	N230	Certain Glycol Ethers	4.282	876	2.344	7.502
17	7782-50-5	Chlorine	6.912	0	5.202	12.113
17	10049-04-4	Chlorine Dioxide	788	0	0	788
17	18540-29-9	Chromium (VI)	52	636	1.221	1.909
17	7440-48-4	Cobalt	0	0	6	6
17	7440-50-8	Copper	39	898	2.042	2.979
17	98-82-8	Cumene	4.842	0	0	4.842
17	N106	Cyanide Compounds	0	24	17	41
17	1163-19-5	Decabromodiphenyl Oxide	126	3.475	0	3.601
17	117-81-7	Di(2-Ethylhexyl) Phthalate	3.069	5.169	0	8.238
17	25321-22-6	Dichlorobenzene (Mixed Isomers)	4.425	0	0	4.425
17	75-09-2	Dichloromethane	40.756	141	0	40.897
17	111-42-2	Diethanolamine	38	0	2.198	2.237
17	100-41-4	Ethylbenzene	1.925	0	0	1.925
17	107-21-1	Ethylene Glycol	21.286	28	4.779	26.093
17	50-00-0	Formaldehyde	57.587	543	149	58.278
17	76-13-1	Freon 113	23.938	0	0	23.938
17	7647-01-0	Hydrochloric Acid	10.596	0	67	10.663
17	67-63-0	Isopropyl Alcohol	6.998	0	0	6.998
17	7439-92-1	Lead	39	1.077	58	1.173
17	108-31-6	Maleic Anhydride	0	19	0	19
17	7439-96-5	Manganese	2	18	769	788
17	67-56-1	Methanol	337.901	1.483	1.412	340.795
17	108-10-1	Methyl Isobutyl Ketone	103.535	5.204	0	108.739
17	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	271	0	0	271
17	1313-27-5	Molybdenum Trioxide	19	115	0	135
17	91-20-3	Naphthalene	1.903	0	0	1.903
17	71-36-3	N-Butyl Alcohol	3.801	19	99	3.920
17	117-84-0	N-Dioctyl Phthalate	82	630	0	712
17	7440-02-0	Nickel	6	137	178	321

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
17	108-95-2	Phenol	5.060	6.883	0	11.943
17	7664-38-2	Phosphoric Acid	315	58	115	488
17	1336-36-3	Polychlorinated Biphenyls	0	2.044	0	2.044
17	100-42-5	Styrene	2.178	0	0	2.178
17	7664-93-9	Sulfuric Acid	1.468	96	192	1.757
17	100-21-0	Terephthalic Acid	0	39.336	0	39.336
17	127-18-4	Tetrachloroethylene	105.595	331	3.078	109.004
17	108-88-3	Toluene	596.748	6.114	39	602.901
17	584-84-9	Toluene-2,4-Diisocyanate	22	0	0	22
17	79-01-6	Trichloroethylene	88.488	8	80	88.576
17	1330-20-7	Xylene (Mixed Isomers)	131.015	1.243	6.405	138.664
17	7440-66-6	Zinc (Fume Or Dust)	58	0	58	115
17	N982	Zinc Compounds	496	2.961	2.635	6.092

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
18	71-55-6	1,1,1-Trichloroethane	142.966	633	0	143.598
18	120-82-1	1,2,4-Trichlorobenzene	7.754	850	116	8.720
18	95-63-6	1,2,4-Trimethylbenzene	8.314	0	0	8.314
18	95-50-1	1,2-Dichlorobenzene	260	0	0	260
18	94-75-7	2,4-D	8	0	0	8
18	78-93-3	2-Butanone (Methyl Ethyl Ketone)	257.444	15.165	16	272.625
18	110-80-5	2-Ethoxyethanol	38	0	0	38
18	109-86-4	2-Methoxyethanol	124	0	0	124
18	67-64-1	Acetone	126.360	516	90	126.966
18	7429-90-5	Aluminum (Fume Or Dust)	125	1.630	0	1.755
18	7664-41-7	Ammonia	49.692	357	6.608	56.658
18	6484-52-2	Ammonium Nitrate (Solution)	337	8	196	540
18	7783-20-2	Ammonium Sulfate (Solution)	3.156	39	12.129	15.323
18	7440-36-0	Antimony	78	2.169	271	2.518
18	7440-39-3	Barium	471	6.847	15	7.333
18	92-52-4	Biphenyl	8.493	133	1.068	9.694
18	103-23-1	Bis(2-Ethylhexyl) Adipate	47	8	0	54
18	85-68-7	Butyl Benzyl Phthalate	86	37	0	123
18	7440-43-9	Cadmium	0	146	15	161
18	75-15-0	Carbon Disulfide	8	0	0	8
18	N230	Certain Glycol Ethers	1.717	351	940	3.008
18	7782-50-5	Chlorine	2.771	0	2.085	4.856
18	10049-04-4	Chlorine Dioxide	316	0	0	316
18	18540-29-9	Chromium (VI)	21	255	490	765
18	7440-48-4	Cobalt	0	0	2	2
18	7440-50-8	Copper	15	360	818	1.194
18	98-82-8	Cumene	1.941	0	0	1.941
18	N106	Cyanide Compounds	0	10	7	16
18	1163-19-5	Decabromodiphenyl Oxide	50	1.393	0	1.444
18	117-81-7	Di(2-Ethylhexyl) Phthalate	1.230	2.072	0	3.302
18	25321-22-6	Dichlorobenzene (Mixed Isomers)	1.774	0	0	1.774
18	75-09-2	Dichloromethane	16.339	57	0	16.395
18	111-42-2	Diethanolamine	15	0	881	897
18	100-41-4	Ethylbenzene	772	0	0	772
18	107-21-1	Ethylene Glycol	8.534	11	1.916	10.460
18	50-00-0	Formaldehyde	23.086	218	60	23.363
18	76-13-1	Freon 113	9.596	0	0	9.596
18	7647-01-0	Hydrochloric Acid	4.248	0	27	4.275
18	67-63-0	Isopropyl Alcohol	2.805	0	0	2.805
18	7439-92-1	Lead	16	432	23	470
18	108-31-6	Maleic Anhydride	0	8	0	8
18	7439-96-5	Manganese	1	7	308	316
18	67-56-1	Methanol	135.463	594	566	136.623
18	108-10-1	Methyl Isobutyl Ketone	41.507	2.086	0	43.593
18	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	108	0	0	108
18	1313-27-5	Molybdenum Trioxide	8	46	0	54
18	91-20-3	Naphthalene	763	0	0	763
18	71-36-3	N-Butyl Alcohol	1.524	8	40	1.571
18	117-84-0	N-Dioctyl Phthalate	33	253	0	286
18	7440-02-0	Nickel	2	55	71	129

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
18	108-95-2	Phenol	2.029	2.759	0	4.788
18	7664-38-2	Phosphoric Acid	126	23	46	196
18	1336-36-3	Polychlorinated Biphenyls	0	820	0	820
18	100-42-5	Styrene	873	0	0	873
18	7664-93-9	Sulfuric Acid	589	39	77	704
18	100-21-0	Terephthalic Acid	0	15.770	0	15.770
18	127-18-4	Tetrachloroethylene	42.333	133	1.234	43.699
18	108-88-3	Toluene	239.233	2.451	15	241.700
18	584-84-9	Toluene-2,4-Diisocyanate	9	0	0	9
18	79-01-6	Trichloroethylene	35.474	3	32	35.509
18	1330-20-7	Xylene (Mixed Isomers)	52.523	498	2.568	55.589
18	7440-66-6	Zinc (Fume Or Dust)	23	0	23	46
18	N982	Zinc Compounds	199	1.187	1.057	2.442

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
19	71-55-6	1,1,1-Trichloroethane	63.289	0	0	63.289
19	78-93-3	2-Butanone (Methyl Ethyl Ketone)	470.439	22.152	47	492.637
19	110-80-5	2-Ethoxyethanol	25.865	0	0	25.865
19	109-86-4	2-Methoxyethanol	8.486	0	0	8.486
19	67-64-1	Acetone	445.733	10.454	345	456.532
19	7664-41-7	Ammonia	52.725	8.915	44.452	106.092
19	7783-20-2	Ammonium Sulfate (Solution)	10.118	1.074	10.914	22.106
19	7440-43-9	Cadmium	0	1	0	1
19	N230	Certain Glycol Ethers	293.244	0	0	293.244
19	7782-50-5	Chlorine	0	0	466	466
19	74-87-3	Chloromethane	2.199	0	0	2.199
19	18540-29-9	Chromium (VI)	1.463	210.109	133.406	344.978
19	7440-50-8	Copper	0	24	0	24
19	117-81-7	Di(2-Ethylhexyl) Phthalate	233	140	0	373
19	75-09-2	Dichloromethane	50.457	0	0	50.457
19	107-21-1	Ethylene Glycol	0	280	0	280
19	50-00-0	Formaldehyde	1.519	0	0	1.519
19	7647-01-0	Hydrochloric Acid	47	0	0	47
19	7439-92-1	Lead	0	29	0	29
19	7439-96-5	Manganese	2	18.529	103.241	121.772
19	67-56-1	Methanol	7.478	0	0	7.478
19	108-10-1	Methyl Isobutyl Ketone	139.019	9.876	0	148.895
19	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	0	7.937	0	7.937
19	71-36-3	N-Butyl Alcohol	39.178	0	0	39.178
19	117-84-0	N-Dioctyl Phthalate	0	0	0	0
19	7440-02-0	Nickel	0	1.113	4	1.117
19	7664-38-2	Phosphoric Acid	1	0	0	1
19	1336-36-3	Polychlorinated Biphenyls	0	950	0	950
19	7440-22-4	Silver	0	34	0	34
19	7664-93-9	Sulfuric Acid	4.311	0	233	4.544
19	127-18-4	Tetrachloroethylene	11.861	0	0	11.861
19	108-88-3	Toluene	595.450	19.706	140	615.295
19	75-01-4	Vinyl Chloride	2.236	0	0	2.236
19	1330-20-7	Xylene (Mixed Isomers)	161.193	9.643	0	170.836
19	N982	Zinc Compounds	47	512	1	560

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
20	71-55-6	1,1,1-Trichloroethane	7.729	12	0	7.741
20	95-63-6	1,2,4-Trimethylbenzene	1.519	0	0	1.519
20	123-91-1	1,4-Dioxane	164	0	0	164
20	78-93-3	2-Butanone (Methyl Ethyl Ketone)	37.048	851	3	37.903
20	75-07-0	Acetaldehyde	2.814	0	3	2.817
20	67-64-1	Acetone	26.127	618	94	26.840
20	7429-90-5	Aluminum (Fume Or Dust)	0	131	49	180
20	7664-41-7	Ammonia	10.036	37	1.250	11.324
20	6484-52-2	Ammonium Nitrate (Solution)	3	0	3	6
20	7783-20-2	Ammonium Sulfate (Solution)	0	30	3	33
20	120-12-7	Anthracene	235	1.928	8	2.172
20	7440-36-0	Antimony	0	3	10	13
20	7440-38-2	Arsenic	294	2.049	17	2.359
20	7440-39-3	Barium	406	0	0	406
20	71-43-2	Benzene	50	0	0	51
20	92-52-4	Biphenyl	173	51	0	224
20	103-23-1	Bis(2-Ethylhexyl) Adipate	5	3	0	8
20	85-68-7	Butyl Benzyl Phthalate	40	3	0	43
20	N230	Certain Glycol Ethers	5.967	58	3	6.028
20	7782-50-5	Chlorine	1.887	0	3	1.891
20	10049-04-4	Chlorine Dioxide	6.674	0	0	6.674
20	67-66-3	Chloroform	7.906	0	173	8.079
20	18540-29-9	Chromium (VI)	284	2.044	324	2.652
20	7440-50-8	Copper	266	1.599	17	1.882
20	110-82-7	Cyclohexane	1.099	0	0	1.099
20	117-81-7	Di(2-Ethylhexyl) Phthalate	258	19	0	277
20	132-64-9	Dibenzofuran	308	1.411	2	1.721
20	84-74-2	Dibutyl Phthalate	1	3	0	4
20	75-09-2	Dichloromethane	4.549	493	0	5.042
20	100-41-4	Ethylbenzene	6.466	0	3	6.469
20	107-21-1	Ethylene Glycol	1.449	51	12	1.513
20	50-00-0	Formaldehyde	55.340	234	55	55.629
20	76-13-1	Freon 113	195	0	0	195
20	7647-01-0	Hydrochloric Acid	440	0	182	622
20	67-63-0	Isopropyl Alcohol	4.926	0	0	4.926
20	7439-96-5	Manganese	0	6	139	145
20	67-56-1	Methanol	34.183	229	3	34.416
20	108-10-1	Methyl Isobutyl Ketone	23.028	220	3	23.252
20	80-62-6	Methyl Methacrylate	1.360	0	0	1.360
20	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	36	3	0	39
20	NA	Mixture	22.220	0	0	22.220
20	91-20-3	Naphthalene	2.296	2.625	23	4.943
20	71-36-3	N-Butyl Alcohol	12.419	149	3	12.570
20	117-84-0	N-Dioctyl Phthalate	96	3	0	99
20	7697-37-2	Nitric Acid	3	0	0	3
20	87-86-5	Pentachlorophenol	116	154	59	328
20	108-95-2	Phenol	7.917	130	13	8.061
20	7664-38-2	Phosphoric Acid	6	0	528	534
20	1336-36-3	Polychlorinated Biphenyls	0	1	0	1
20	115-07-1	Propylene	3	0	0	3

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
20	91-22-5	Quinoline	411	105	0	516
20	100-42-5	Styrene	2.385	0	0	2.385
20	7664-93-9	Sulfuric Acid	726	0	538	1.264
20	100-21-0	Terephthalic Acid	12	695	3	710
20	127-18-4	Tetrachloroethylene	1.712	0	0	1.712
20	108-88-3	Toluene	114.668	1.677	79	116.425
20	79-01-6	Trichloroethylene	9	3	3	15
20	108-05-4	Vinyl Acetate	254	0	0	254
20	1330-20-7	Xylene (Mixed Isomers)	117.045	530	148	117.723
20	7440-66-6	Zinc (Fume Or Dust)	0	63	1	64
20	N982	Zinc Compounds	0	13	9	22

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
21	71-55-6	1,1,1-Trichloroethane	341.659	7.725	188	349.573
21	95-63-6	1,2,4-Trimethylbenzene	21.444	115	0	21.559
21	123-91-1	1,4-Dioxane	4.064	0	0	4.064
21	88-06-2	2,4,6-Trichlorophenol	0	0	261	261
21	78-93-3	2-Butanone (Methyl Ethyl Ketone)	1.729.286	10.052	1.254	1.740.592
21	110-80-5	2-Ethoxyethanol	24.153	0	0	24.153
21	109-86-4	2-Methoxyethanol	3.135	0	0	3.135
21	79-46-9	2-Nitropropane	380	0	0	380
21	80-05-7	4,4'-Isopropylidenediphenol	0	70	0	70
21	75-07-0	Acetaldehyde	4,957	19	2.090	7.065
21	67-64-1	Acetone	1.225.827	14.302	45.647	1.285.777
21	79-10-7	Acrylic Acid	1.158	0	17	1.176
21	7429-90-5	Aluminum (Fume Or Dust)	220	8.087	0	8.307
21	7664-41-7	Ammonia	263.184	4.529	153.933	421.646
21	6484-52-2	Ammonium Nitrate (Solution)	0	99	89.601	89.700
21	7783-20-2	Ammonium Sulfate (Solution)	28.368	4.012	928.949	961.330
21	7440-36-0	Antimony	36	3.426	501	3.963
21	1332-21-4	Asbestos (Friable)	87	3.291	0	3.378
21	7440-39-3	Barium	22	989	12.072	13.083
21	92-52-4	Biphenyl	255	1.228	69	1.552
21	141-32-2	Butyl Acrylate	16	0	0	16
21	85-68-7	Butyl Benzyl Phthalate	6.769	469	49	7.287
21	569-64-2	C.I. Basic Green 4	0	17	17	35
21	75-15-0	Carbon Disulfide	13.772	17	17	13.807
21	120-80-9	Catechol	183	5.830	23.449	29.461
21	N230	Certain Glycol Ethers	51.549	129	2.842	54.520
21	7782-50-5	Chlorine	753.828	35	8.769	762.632
21	10049-04-4	Chlorine Dioxide	409.130	0	70	409.199
21	67-66-3	Chloroform	1.565.299	1.307	81.160	1.647.766
21	18540-29-9	Chromium (VI)	2.037	4.099	18.348	24.484
21	7440-48-4	Cobalt	1	0	0	1
21	7440-50-8	Copper	0	4.542	223	4.765
21	98-82-8	Cumene	2.985	53	0	3.038
21	110-82-7	Cyclohexane	154.920	52	52	155.025
21	1163-19-5	Decabromodiphenyl Oxide	0	3.026	0	3.026
21	117-81-7	Di(2-Ethylhexyl) Phthalate	72	1.435	0	1.507
21	84-74-2	Dibutyl Phthalate	2.510	0	2	2.512
21	75-09-2	Dichloromethane	80.735	3.173	1.419	85.328
21	111-42-2	Diethanolamine	17	2	153	173
21	84-66-2	Diethyl Phthalate	2.020	0	0	2.020
21	100-41-4	Ethylbenzene	3.776	0	0	3.776
21	107-21-1	Ethylene Glycol	3.871	89	5.026	8.986
21	75-21-8	Ethylene Oxide	35	0	0	35
21	96-45-7	Ethylene Thiourea	17	0	0	17
21	50-00-0	Formaldehyde	52.272	1.160	19.557	72.989
21	76-13-1	Freon 113	2.229	0	0	2.229
21	7647-01-0	Hydrochloric Acid	1.719.304	49	184.984	1.904.337
21	67-63-0	Isopropyl Alcohol	34.203	575	731	35.509
21	7439-92-1	Lead	19	1.247	188	1.454
21	108-31-6	Maleic Anhydride	2	0	0	2

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
21	7439-96-5	Manganese	888	11.737	4.885	17.511
21	7439-97-6	Mercury	87	348	17	453
21	67-56-1	Methanol	6.000.603	553.999	991.958	7.546.560
21	108-10-1	Methyl Isobutyl Ketone	74.037	232	1	74.270
21	80-62-6	Methyl Methacrylate	352	0	0	352
21	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	57	0	0	57
21	NA	Mixture	7.127	0	0	7.127
21	91-20-3	Naphthalene	9.383	198	649	10.230
21	71-36-3	N-Butyl Alcohol	36.307	166	88	36.561
21	7440-02-0	Nickel	0	0	70	70
21	7697-37-2	Nitric Acid	315	0	1.156	1.471
21	108-95-2	Phenol	34.484	3.565	3.320	41.368
21	7664-38-2	Phosphoric Acid	264	54	101	419
21	1336-36-3	Polychlorinated Biphenyls	0	5.104	0	5.104
21	115-07-1	Propylene	70	0	0	70
21	100-42-5	Styrene	4.908	0	0	4.908
21	7664-93-9	Sulfuric Acid	1.006.289	7.774	584.920	1.598.983
21	127-18-4	Tetrachloroethylene	11.294	1.505	0	12.799
21	108-88-3	Toluene	3.630.946	81.560	832	3.713.337
21	584-84-9	Toluene-2,4-Diisocyanate	70	0	0	70
21	79-01-6	Trichloroethylene	4.996	425	0	5.421
21	108-05-4	Vinyl Acetate	6.710	88	1	6.799
21	1330-20-7	Xylene (Mixed Isomers)	245.280	2.668	1.332	249.281
21	7440-66-6	Zinc (Fume Or Dust)	2.386	199.138	766	202.290
21	N982	Zinc Compounds	8.388	57.947	54.452	120.787

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
22	71-55-6	1,1,1-Trichloroethane	157.117	1.367	0	158.485
22	95-63-6	1,2,4-Trimethylbenzene	2.053	203	0	2.256
22	78-93-3	2-Butanone (Methyl Ethyl Ketone)	81.686	1.059	0	82.745
22	110-80-5	2-Ethoxyethanol	209	0	0	209
22	109-86-4	2-Methoxyethanol	261	0	0	261
22	67-64-1	Acetone	31.441	648	0	32.089
22	7429-90-5	Aluminum (Fume Or Dust)	8	0	0	8
22	7664-41-7	Ammonia	4.561	15	0	4.577
22	7440-39-3	Barium	43	874	10	927
22	85-68-7	Butyl Benzyl Phthalate	700	0	0	700
22	1937-37-7	C.I. Direct Black 38	15	8	0	23
22	N230	Certain Glycol Ethers	59.354	465	717	60.536
22	18540-29-9	Chromium (VI)	23	1.201	39	1.263
22	7440-50-8	Copper	224	3.260	365	3.849
22	1319-77-3	Cresol (Mixed Isomers)	0	0	53	53
22	110-82-7	Cyclohexane	4.505	0	0	4.505
22	117-81-7	Di(2-Ethylhexyl) Phthalate	8	115	0	122
22	84-74-2	Dibutyl Phthalate	31	32	0	63
22	75-09-2	Dichloromethane	10.985	698	0	11.684
22	131-11-3	Dimethyl Phthalate	15	0	0	15
22	100-41-4	Ethylbenzene	1.114	0	0	1.114
22	107-21-1	Ethylene Glycol	5.598	60	0	5.658
22	76-13-1	Freon 113	1.084	0	0	1.084
22	7647-01-0	Hydrochloric Acid	38	8	0	46
22	123-31-9	Hydroquinone	95	0	0	95
22	67-63-0	Isopropyl Alcohol	34.153	101	0	34.254
22	7439-92-1	Lead	39	34	0	72
22	7439-96-5	Manganese	8	8	1	16
22	67-56-1	Methanol	28.045	391	1.816	30.252
22	108-10-1	Methyl Isobutyl Ketone	10.906	684	0	11.589
22	91-20-3	Naphthalene	1.769	15	0	1.784
22	71-36-3	N-Butyl Alcohol	4.809	8	0	4.816
22	117-84-0	N-Dioctyl Phthalate	8	0	0	8
22	7697-37-2	Nitric Acid	876	0	0	876
22	7664-38-2	Phosphoric Acid	77	8	0	85
22	7440-22-4	Silver	0	0	8	8
22	100-42-5	Styrene	855	0	0	855
22	7664-93-9	Sulfuric Acid	167	39	61.629	61.836
22	127-18-4	Tetrachloroethylene	21.221	791	0	22.012
22	108-88-3	Toluene	1.305.303	14.689	107	1.320.099
22	79-01-6	Trichloroethylene	4.745	61	0	4.806
22	1330-20-7	Xylene (Mixed Isomers)	55.174	206	37	55.417
22	7440-66-6	Zinc (Fume Or Dust)	2.152	8	0	2.159
22	N982	Zinc Compounds	24	316	16	356

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
23	71-55-6	1,1,1-Trichloroethane	37.334	536	51	37.921
23	95-63-6	1,2,4-Trimethylbenzene	189.489	17.448	1.684	208.621
23	106-88-7	1,2-Butylene Oxide	34	0	0	34
23	106-93-4	1,2-Dibromoethane	412	60	64	537
23	107-06-2	1,2-Dichloroethane	1.123	61	24	1.208
23	540-59-0	1,2-Dichloroethylene	52	0	0	52
23	78-87-5	1,2-Dichloropropane	364	0	20	384
23	106-99-0	1,3-Butadiene	34.078	59	202	34.338
23	542-75-6	1,3-Dichloropropylene	728	0	0	728
23	123-91-1	1,4-Dioxane	28	0	0	28
23	105-67-9	2,4-Dimethylphenol	6	6	130	141
23	78-93-3	2-Butanone (Methyl Ethyl Ketone)	1.150.768	432	3.472	1.154.672
23	110-80-5	2-Ethoxyethanol	28	0	0	28
23	109-86-4	2-Methoxyethanol	1.540	0	85	1.625
23	80-05-7	4,4'-Isopropylidenediphenol	8.545	81.023	0	89.569
23	67-64-1	Acetone	106.410	463	3.921	110.794
23	75-05-8	Acetonitrile	19.206	0	489	19.695
23	79-10-7	Acrylic Acid	29	0	0	29
23	107-05-1	Allyl Chloride	11.387	26	104	11.517
23	7429-90-5	Aluminum (Fume Or Dust)	69.189	302.944	504	372.637
23	7664-41-7	Ammonia	802.717	68.106	4.056.025	4.926.848
23	6484-52-2	Ammonium Nitrate (Solution)	26	0	0	26
23	7783-20-2	Ammonium Sulfate (Solution)	0	0	182	182
23	120-12-7	Anthracene	355	99	79	533
23	7440-36-0	Antimony	599	3.924	1.640	6.162
23	7440-38-2	Arsenic	0	1.761	58	1.820
23	1332-21-4	Asbestos (Friable)	521	115.629	0	116.151
23	7440-39-3	Barium	5.243	4.868	5.074	15.185
23	71-43-2	Benzene	738.813	11.775	15.439	766.027
23	7440-41-7	Beryllium	0	0	8	8
23	92-52-4	Biphenyl	1.660	117	52	1.830
23	103-23-1	Bis(2-Ethylhexyl) Adipate	26	432	0	458
23	85-68-7	Butyl Benzyl Phthalate	27	0	0	27
23	123-72-8	Butyraldehyde	11.861	6	0	11.868
23	7440-43-9	Cadmium	0	54	84	138
23	75-15-0	Carbon Disulfide	6.684	0	0	6.684
23	56-23-5	Carbon Tetrachloride	4.059	64	113	4.236
23	463-58-1	Carbonyl Sulfide	18.731	0	0	18.731
23	N230	Certain Glycol Ethers	10.951	1.018	364	12.333
23	7782-50-5	Chlorine	59.307	124	5.907	65.338
23	10049-04-4	Chlorine Dioxide	26	0	0	26
23	67-66-3	Chloroform	7	0	0	7
23	74-87-3	Chloromethane	306	0	0	306
23	18540-29-9	Chromium (VI)	19.289	62.755	15.933	97.978
23	7440-48-4	Cobalt	60	1.493	444	1.996
23	7440-50-8	Copper	274	5.986	702	6.962
23	1319-77-3	Cresol (Mixed Isomers)	4.951	245	5.754	10.950
23	98-82-8	Cumene	137.883	949	386	139.217
23	80-15-9	Cumene Hydroperoxide	5.966	0	0	5.966
23	N106	Cyanide Compounds	10	4	99	113

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
23	110-82-7	Cyclohexane	281.331	11.214	1.685	294.229
23	1163-19-5	Decabromodiphenyl Oxide	78	0	0	78
23	117-81-7	Di(2-Ethylhexyl) Phthalate	26	1.093	0	1.119
23	84-74-2	Dibutyl Phthalate	26	59	0	85
23	75-09-2	Dichloromethane	631	26	0	657
23	111-42-2	Diethanolamine	6.840	11.373	72.783	90.996
23	84-66-2	Diethyl Phthalate	2	0	0	2
23	106-89-8	Epichlorohydrin	18.949	26	20.511	39.486
23	140-88-5	Ethyl Acrylate	17	0	0	17
23	100-41-4	Ethylbenzene	226.879	17.218	2.667	246.764
23	74-85-1	Ethylene	613.090	7	19	613.117
23	107-21-1	Ethylene Glycol	14.033	1.611	12.767	28.411
23	75-21-8	Ethylene Oxide	14.270	0	0	14.270
23	50-00-0	Formaldehyde	8.888	125	186	9.199
23	76-13-1	Freon 113	1.290	608	0	1.898
23	302-01-2	Hydrazine	112	0	0	112
23	7647-01-0	Hydrochloric Acid	125.559	79	471	126.110
23	7664-39-3	Hydrogen Fluoride	130.845	138	99	131.082
23	78-84-2	Isobutyraldehyde	453	0	0	453
23	67-63-0	Isopropyl Alcohol	308	0	0	308
23	7439-92-1	Lead	1.456	36.323	2.437	40.216
23	108-31-6	Maleic Anhydride	52	0	0	52
23	7439-96-5	Manganese	760	888	18.742	20.391
23	7439-97-6	Mercury	10	2	0	12
23	67-56-1	Methanol	43.158	3.189	54.847	101.195
23	108-10-1	Methyl Isobutyl Ketone	65.382	86	641	66.109
23	80-62-6	Methyl Methacrylate	52	0	0	52
23	1634-04-4	Methyl Tert-Butyl Ether	203.559	339	2.727	206.625
23	1313-27-5	Molybdenum Trioxide	1.629	42.346	7	43.982
23	91-20-3	Naphthalene	46.096	15.300	1.822	63.218
23	71-36-3	N-Butyl Alcohol	49.523	55	10	49.588
23	117-84-0	N-Dioctyl Phthalate	0	114	0	114
23	7440-02-0	Nickel	2.564	72.972	7.389	82.924
23	7697-37-2	Nitric Acid	26	0	0	26
23	108-95-2	Phenol	74.127	829	159.142	234.098
23	7664-38-2	Phosphoric Acid	390	123.779	17.453	141.622
23	115-07-1	Propylene	941.275	33	15	941.324
23	7782-49-2	Selenium	2	110	129	241
23	100-42-5	Styrene	4.431	30	52	4.513
23	7664-93-9	Sulfuric Acid	89.635	4.365	21.971	115.971
23	127-18-4	Tetrachloroethylene	176	78	0	254
23	7440-28-0	Thallium	0	26	26	52
23	108-88-3	Toluene	1.784.627	48.973	17.027	1.850.627
23	584-84-9	Toluene-2,4-Diisocyanate	130	0	0	130
23	79-01-6	Trichloroethylene	8.106	0	0	8.106
23	N770	Vanadium (Except When Contained In An Alloy)	176	1.436	0	1.613
23	108-05-4	Vinyl Acetate	52	0	0	52
23	1330-20-7	Xylene (Mixed Isomers)	1.046.776	69.727	10.796	1.127.299
23	7440-66-6	Zinc (Fume Or Dust)	391	2.826	5.794	9.010

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
23	N982	Zinc Compounds	4.581	52.758	13.040	70.379

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
24	71-55-6	1,1,1-Trichloroethane	695.511	13.316	16.672	725.500
24	79-34-5	1,1,2,2-Tetrachloroethane	3.370	1.527	573	5.469
24	57-14-7	1,1-Dimethyl Hydrazine	81	127	25	233
24	120-82-1	1,2,4-Trichlorobenzene	81.589	8.234	1.187	91.011
24	95-63-6	1,2,4-Trimethylbenzene	40.792	16.819	1.304	58.914
24	106-88-7	1,2-Butylene Oxide	10.215	0	415	10.630
24	106-93-4	1,2-Dibromoethane	5.545	787	456	6.787
24	95-50-1	1,2-Dichlorobenzene	156.133	7.777	4.821	168.730
24	107-06-2	1,2-Dichloroethane	304.690	4.729	133.353	442.773
24	540-59-0	1,2-Dichloroethylene	10.569	1.104	78	11.751
24	78-87-5	1,2-Dichloropropane	65.837	145	520	66.502
24	106-99-0	1,3-Butadiene	547.818	2.539	14.108	564.464
24	541-73-1	1,3-Dichlorobenzene	1.143	0	2	1.145
24	542-75-6	1,3-Dichloropropylene	3.769	0	34	3.803
24	123-91-1	1,4-Dioxane	31.087	1.344	13.519	45.950
24	88-06-2	2,4,6-Trichlorophenol	12	0	2	13
24	94-75-7	2,4-D	468	685	409	1.562
24	95-80-7	2,4-Diaminotoluene	444	0	25	469
24	120-83-2	2,4-Dichlorophenol	136	0	668	804
24	105-67-9	2,4-Dimethylphenol	220	595	2.611	3.426
24	51-28-5	2,4-Dinitrophenol	187	564	46.290	47.042
24	121-14-2	2,4-Dinitrotoluene	1.224	19.500	1.269	21.993
24	606-20-2	2,6-Dinitrotoluene	8.412	5.840	1.913	16.166
24	87-62-7	2,6-Xylidine	4	0	191	195
24	78-93-3	2-Butanone (Methyl Ethyl Ketone)	912.885	57.195	95.165	1.065.245
24	110-80-5	2-Ethoxyethanol	17.778	90	9.628	27.496
24	109-86-4	2-Methoxyethanol	87.458	14.208	3.494	105.160
24	88-75-5	2-Nitrophenol	442	67	1	510
24	79-46-9	2-Nitropropane	10.032	0	23.880	33.912
24	90-43-7	2-Phenylphenol	807	150	38	996
24	91-94-1	3,3'-Dichlorobenzidine	25	734	24	784
24	119-90-4	3,3'-Dimethoxybenzidine	50	0	0	50
24	101-80-4	4,4'-Diaminodiphenyl Ether	63	25	60	148
24	80-05-7	4,4'-Isopropylidenediphenol	14.116	40.161	688	54.964
24	101-77-9	4,4'-Methylenedianiline	4.662	12.987	9.755	27.404
24	534-52-1	4,6-Dinitro-O-Cresol	27	26	4.525	4.578
24	60-09-3	4-Aminoazobenzene	0	0	35	35
24	92-67-1	4-Aminobiphenyl	0	0	1	1
24	100-02-7	4-Nitrophenol	777	4	180	961
24	99-59-2	5-Nitro-O-Anisidine	50	0	0	50
24	75-07-0	Acetaldehyde	670.650	3.120	200.814	874.584
24	60-35-5	Acetamide	0	0	25	25
24	67-64-1	Acetone	9.157.571	506.344	529.828	10.193.743
24	75-05-8	Acetonitrile	139.771	18.568	1.816.550	1.974.889
24	107-02-8	Acrolein	2.038	8	6.781	8.826
24	79-06-1	Acrylamide	2.524	12.585	444.950	460.059
24	79-10-7	Acrylic Acid	33.538	10.490	1.878.608	1.922.636
24	107-13-1	Acrylonitrile	471.027	6.509	581.832	1.059.368
24	107-05-1	Allyl Chloride	6.629	8	123	6.759
24	134-32-7	Alpha-Naphthylamine	67	0	0	67

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
24	7429-90-5	Aluminum (Fume Or Dust)	9.548	156.223	503	166.274
24	7664-41-7	Ammonia	19.624.938	399.687	6.473.292	26.497.918
24	6484-52-2	Ammonium Nitrate (Solution)	250.553	460.580	5.577.445	6.288.577
24	7783-20-2	Ammonium Sulfate (Solution)	6.617	602.714	51.621.164	52.230.494
24	62-53-3	Aniline	46.494	34.529	330.347	411.370
24	120-12-7	Anthracene	2.827	5.398	62	8.286
24	7440-36-0	Antimony	2.597	33.161	10.043	45.801
24	7440-38-2	Arsenic	664	229.229	17.185	247.079
24	1332-21-4	Asbestos (Friable)	367	121.269	55	121.691
24	7440-39-3	Barium	24.159	1.003.849	113.927	1.141.936
24	98-87-3	Benzal Chloride	547	0	0	547
24	55-21-0	Benzamide	50	75	50	175
24	71-43-2	Benzene	813.979	7.827	69.558	891.364
24	98-07-7	Benzoic Trichloride	2.534	262	0	2.796
24	98-88-4	Benzoyl Chloride	3.516	593	16.862	20.972
24	94-36-0	Benzoyl Peroxide	207	2.430	100	2.737
24	100-44-7	Benzyl Chloride	2.668	121	65	2.855
24	92-52-4	Biphenyl	76.003	15.948	8.827	100.778
24	108-60-1	Bis(2-Chloro-1-Methylethyl) Ether	1.094	0	1.203	2.297
24	111-44-4	Bis(2-Chloroethyl) Ether	490	0	156	646
24	103-23-1	Bis(2-Ethylhexyl) Adipate	2.664	9.725	196	12.586
24	542-88-1	Bis(Chloromethyl) Ether	0	0	0	0
24	74-83-9	Bromomethane	270.190	0	6.669	276.859
24	141-32-2	Butyl Acrylate	19.515	1.126	666	21.308
24	85-68-7	Butyl Benzyl Phthalate	1.591	8.307	103	10.000
24	123-72-8	Butyraldehyde	140.292	21.683	1.144	163.118
24	569-64-2	C.I. Basic Green 4	75	0	0	75
24	989-38-8	C.I. Basic Red 1	25	0	0	25
24	2832-40-8	C.I. Disperse Yellow 3	37	31	88	157
24	81-88-9	C.I. Food Red 15	25	0	0	25
24	842-07-9	C.I. Solvent Yellow 14	50	25	0	75
24	7440-43-9	Cadmium	2.341	19.166	540	22.047
24	156-62-7	Calcium Cyanamide	1.265	361	0	1.626
24	133-06-2	Captan	2.503	1.496	702	4.701
24	63-25-2	Carbaryl	1.011	4.107	151	5.269
24	75-15-0	Carbon Disulfide	8.676.364	26	2.053	8.678.443
24	56-23-5	Carbon Tetrachloride	338.440	2.303	13.997	354.741
24	463-58-1	Carbonyl Sulfide	2.294.261	0	0	2.294.261
24	120-80-9	Catechol	166	296	27	488
24	N230	Certain Glycol Ethers	200.708	52.829	59.438	312.975
24	57-74-9	Chlordane	376	0	0	377
24	7782-50-5	Chlorine	869.392	13.474	209.511	1.092.378
24	10049-04-4	Chlorine Dioxide	427	0	0	427
24	79-11-8	Chloroacetic Acid	2.466	361	51	2.877
24	108-90-7	Chlorobenzene	403.984	2.063	14.589	420.636
24	75-00-3	Chloroethane	348.964	382	7.208	356.554
24	67-66-3	Chloroform	337.333	4.831	12.645	354.809
24	74-87-3	Chloromethane	934.674	258	30.672	965.604
24	107-30-2	Chloromethyl Methyl Ether	324	0	0	324
24	N084	Chlorophenols	397	1	13.801	14.199

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
24	126-99-8	Chloroprene	179.260	1	15.859	195.120
24	1897-45-6	Chlorothalonil	2.957	30.194	974	34.125
24	18540-29-9	Chromium (VI)	16.441	150.997	2.159.637	2.327.076
24	7440-48-4	Cobalt	6.157	26.284	10.974	43.415
24	7440-50-8	Copper	13.319	399.770	62.233	475.322
24	1319-77-3	Cresol (Mixed Isomers)	49.207	76.256	209.396	334.860
24	98-82-8	Cumene	288.277	2.955	3.750	294.982
24	80-15-9	Cumene Hydroperoxide	3.237	171	47.893	51.300
24	135-20-6	Cupferron	150	0	3	154
24	N106	Cyanide Compounds	101.620	2.630	801.930	906.180
24	110-82-7	Cyclohexane	1.143.205	1.830	39.769	1.184.804
24	1163-19-5	Decabromodiphenyl Oxide	2.398	20.675	5	23.078
24	117-81-7	Di(2-Ethylhexyl) Phthalate	7.820	47.601	230	55.651
24	615-05-4	Diaminoanisole, 2,4- (Sulfate)	25	0	0	25
24	25376-45-8	Diaminotoluene (Mixed Isomers)	1.927	25.822	9.731	37.481
24	132-64-9	Dibenzofuran	2.632	2.806	26	5.464
24	84-74-2	Dibutyl Phthalate	2.840	6.998	31.153	40.991
24	25321-22-6	Dichlorobenzene (Mixed Isomers)	1.733	17	19	1.768
24	75-09-2	Dichloromethane	3.758.290	48.286	221.318	4.027.894
24	62-73-7	Dichlorvos	108	422	0	530
24	115-32-2	Dicofol	133	154	1.219	1.506
24	111-42-2	Diethanolamine	19.267	3.762	24.016	47.045
24	84-66-2	Diethyl Phthalate	2.222	275	894	3.391
24	64-67-5	Diethyl Sulfate	874	25	0	899
24	131-11-3	Dimethyl Phthalate	1.124	3.360	151	4.635
24	77-78-1	Dimethyl Sulfate	1.386	5	50	1.441
24	106-89-8	Epichlorohydrin	52.163	315	460	52.938
24	140-88-5	Ethyl Acrylate	18.661	1.287	122	20.070
24	541-41-3	Ethyl Chloroformate	866	0	0	866
24	100-41-4	Ethylbenzene	278.548	26.596	14.033	319.178
24	74-85-1	Ethylene	3.874.494	29	3.264	3.877.787
24	107-21-1	Ethylene Glycol	859.109	223.755	1.200.632	2.283.496
24	75-21-8	Ethylene Oxide	166.269	4.066	2.174	172.510
24	96-45-7	Ethylene Thiourea	50	540	0	591
24	2164-17-2	Fluometuron	54	32	75	161
24	50-00-0	Formaldehyde	394.507	11.574	896.545	1.302.626
24	76-13-1	Freon 113	314.470	7.072	1.845	323.387
24	76-44-8	Heptachlor	342	0	0	342
24	87-68-3	Hexachloro-1,3-Butadiene	464	2.641	95	3.200
24	118-74-1	Hexachlorobenzene	362	101.072	105	101.539
24	77-47-4	Hexachlorocyclopentadiene	8.897	121	26	9.043
24	67-72-1	Hexachloroethane	397	110	119	626
24	302-01-2	Hydrazine	2.954	247	927	4.128
24	10034-93-2	Hydrazine Sulfate	0	0	7.715	7.715
24	7647-01-0	Hydrochloric Acid	2.378.842	1.137.612	26.371.966	29.888.420
24	7664-39-3	Hydrogen Fluoride	159.920	642	8.474	169.037
24	123-31-9	Hydroquinone	441	849	35.789	37.079
24	78-84-2	Isobutyraldehyde	58.121	0	205	58.325
24	67-63-0	Isopropyl Alcohol	26.347	3.358	340	30.045
24	7439-92-1	Lead	18.113	165.878	12.486	196.477

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
24	58-89-9	Lindane	79	57	0	135
24	108-31-6	Maleic Anhydride	45.313	22.620	357	68.290
24	12427-38-2	Maneb	153	1.528	75	1.756
24	7439-96-5	Manganese	41.596	1.280.712	1.262.002	2.584.310
24	7439-97-6	Mercury	1.962	13.639	263	15.865
24	67-56-1	Methanol	7.434.188	332.738	3.039.026	10.805.952
24	72-43-5	Methoxychlor	54	50	25	129
24	96-33-3	Methyl Acrylate	19.054	645	137	19.836
24	60-34-4	Methyl Hydrazine	7	50	0	57
24	74-88-4	Methyl Iodide	2.554	25	510	3.089
24	108-10-1	Methyl Isobutyl Ketone	593.071	17.625	51.491	662.186
24	624-83-9	Methyl Isocyanate	1.418	6	0	1.425
24	80-62-6	Methyl Methacrylate	204.055	11.979	22.587	238.621
24	1634-04-4	Methyl Tert-Butyl Ether	119.924	0	1.924	121.847
24	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	3.334	33.428	26	36.788
24	74-95-3	Methylene Bromide	3.646	0	0	3.646
24	NA	Mixture	11.574	6.802	283	18.659
24	1313-27-5	Molybdenum Trioxide	1.826	41.999	18.917	62.742
24	121-69-7	N,N-Dimethylaniline	9.098	401	715	10.214
24	91-20-3	Naphthalene	78.470	74.126	4.412	157.008
24	71-36-3	N-Butyl Alcohol	563.290	27.598	351.727	942.615
24	117-84-0	N-Dioctyl Phthalate	1.468	1.528	67	3.063
24	7440-02-0	Nickel	3.314	93.638	158.066	255.018
24	7697-37-2	Nitric Acid	197.629	6.741	3.183.304	3.387.674
24	139-13-9	Nitrilotriacetic Acid	251	511	511	1.273
24	98-95-3	Nitrobenzene	3.937	2.795	55.754	62.486
24	55-63-0	Nitroglycerin	2.774	0	897	3.672
24	86-30-6	N-Nitrosodiphenylamine	2	19	4.262	4.283
24	90-04-0	O-Anisidine	205	125	729	1.059
24	95-53-4	O-Toluidine	2.566	100	483	3.149
24	104-94-9	P-Anisidine	0	0	25	25
24	56-38-2	Parathion	160	167	32	358
24	120-71-8	P-Cresidine	222	757	25	1.004
24	87-86-5	Pentachlorophenol	76	110	0	187
24	79-21-0	Peracetic Acid	901	0	4	905
24	108-95-2	Phenol	174.177	80.595	295.366	550.137
24	75-44-5	Phosgene	828	0	50	879
24	7664-38-2	Phosphoric Acid	98.022	3.004.255	4.594.590	7.696.867
24	7723-14-0	Phosphorus (Yellow Or White)	296	329.722	2	330.019
24	85-44-9	Phthalic Anhydride	60.879	145.104	82	206.065
24	88-89-1	Picric Acid	25	28	126.889	126.942
24	1336-36-3	Polychlorinated Biphenyls	0	9.554	0	9.554
24	106-50-3	P-Phenylenediamine	409	531	311	1.251
24	123-38-6	Propionaldehyde	109.521	0	494	110.016
24	114-26-1	Propoxur	25	152	0	178
24	115-07-1	Propylene	1.960.782	11	4	1.960.797
24	75-56-9	Propylene Oxide	207.009	1.014	35.373	243.396
24	75-55-8	Propyleneimine	54	0	0	54
24	110-86-1	Pyridine	12.020	770	66.291	79.081
24	91-22-5	Quinoline	1.236	490	1	1.727

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
24	106-51-4	Quinone	176	0	1	178
24	82-68-8	Quintozene	205	29	0	233
24	81-07-2	Saccharin	58	410	0	468
24	7782-49-2	Selenium	380	609	115	1.104
24	7440-22-4	Silver	429	829	92	1.350
24	100-42-5	Styrene	911.930	97.970	7.016	1.016.915
24	96-09-3	Styrene Oxide	203	0	0	203
24	7664-93-9	Sulfuric Acid	517.402	734.004	12.808.410	14.059.816
24	100-21-0	Terephthalic Acid	63.265	202.444	5.006	270.715
24	127-18-4	Tetrachloroethylene	138.981	4.518	5.988	149.487
24	961-11-5	Tetrachlorvinphos	25	821	0	846
24	62-56-6	Thiourea	251	279	25	555
24	1314-20-1	Thorium Dioxide	61	0	0	61
24	7550-45-0	Titanium Tetrachloride	5.630	691	0	6.321
24	108-88-3	Toluene	3.589.897	270.830	182.997	4.043.724
24	584-84-9	Toluene-2,4-Diisocyanate	5.393	632	0	6.026
24	52-68-6	Trichlorfon	26	96	0	123
24	79-01-6	Trichloroethylene	92.296	5.699	833	98.828
24	1582-09-8	Trifluralin	309	3.391	107	3.807
24	51-79-6	Urethane	25	0	0	25
24	108-05-4	Vinyl Acetate	548.388	2.438	130.511	681.338
24	593-60-2	Vinyl Bromide	77	0	27	104
24	75-01-4	Vinyl Chloride	134.324	835	566	135.726
24	75-35-4	Vinylidene Chloride	21.339	686	339	22.365
24	1330-20-7	Xylene (Mixed Isomers)	1.905.724	181.972	54.964	2.142.660
24	7440-66-6	Zinc (Fume Or Dust)	4.315	5.685	24.893	34.892
24	N982	Zinc Compounds	82.092	651.486	307.582	1.041.160

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
25	71-55-6	1,1,1-Trichloroethane	1.628.390	14.251	61	1.642.703
25	79-34-5	1,1,2,2-Tetrachloroethane	157	0	0	157
25	120-82-1	1,2,4-Trichlorobenzene	0	2.733	0	2.733
25	95-63-6	1,2,4-Trimethylbenzene	2.761	26	0	2.788
25	107-06-2	1,2-Dichloroethane	6.407	0	0	6.407
25	106-99-0	1,3-Butadiene	158	405	157	720
25	123-91-1	1,4-Dioxane	5.167	2.220	0	7.387
25	78-93-3	2-Butanone (Methyl Ethyl Ketone)	2.139.900	29.176	2.996	2.172.072
25	110-80-5	2-Ethoxyethanol	7.422	1.663	0	9.084
25	109-86-4	2-Methoxyethanol	111.526	4.428	420	116.374
25	79-46-9	2-Nitropropane	1.076	0	0	1.076
25	80-05-7	4,4'-Isopropylidenediphenol	4	0	0	4
25	101-14-4	4,4'-Methylenebis(2-Chloroaniline)	54	0	0	54
25	101-77-9	4,4'-Methylenedianiline	61	304	0	365
25	75-07-0	Acetaldehyde	3.321	0	0	3.321
25	67-64-1	Acetone	3.325.626	50.791	446	3.376.863
25	75-05-8	Acetonitrile	1	0	0	1
25	79-10-7	Acrylic Acid	599	60	0	659
25	107-13-1	Acrylonitrile	624	52	52	729
25	7429-90-5	Aluminum (Fume Or Dust)	5.659	27.850	79	33.588
25	7664-41-7	Ammonia	246.831	19	12.314	259.164
25	7783-20-2	Ammonium Sulfate (Solution)	0	26	45.545	45.572
25	62-53-3	Aniline	52	0	0	52
25	7440-36-0	Antimony	2.093	28.779	1.489	32.361
25	1332-21-4	Asbestos (Friable)	26	1.700	0	1.726
25	7440-39-3	Barium	14.185	120.152	386	134.723
25	94-36-0	Benzoyl Peroxide	5	277	0	282
25	103-23-1	Bis(2-Ethylhexyl) Adipate	2.091	5.426	52	7.570
25	141-32-2	Butyl Acrylate	2.700	0	0	2.700
25	85-68-7	Butyl Benzyl Phthalate	4.584	375	26	4.985
25	123-72-8	Butyraldehyde	9.959	0	68	10.027
25	7440-43-9	Cadmium	1.486	3.799	162	5.447
25	75-15-0	Carbon Disulfide	1.380.174	68	181	1.380.423
25	56-23-5	Carbon Tetrachloride	26	0	0	26
25	N230	Certain Glycol Ethers	151.779	3.967	0	155.745
25	7782-50-5	Chlorine	11.412	105	396	11.913
25	75-00-3	Chloroethane	169.705	0	0	169.705
25	67-66-3	Chloroform	2.099	0	0	2.099
25	74-87-3	Chloromethane	47.018	0	0	47.018
25	126-99-8	Chloroprene	52	3.507	0	3.560
25	18540-29-9	Chromium (VI)	2.103	37.392	1.593	41.087
25	7440-48-4	Cobalt	236	2.741	89	3.066
25	7440-50-8	Copper	2.820	38.215	2.135	43.171
25	1319-77-3	Cresol (Mixed Isomers)	657	0	0	657
25	98-82-8	Cumene	4.605	0	0	4.605
25	80-15-9	Cumene Hydroperoxide	180	0	0	180
25	N106	Cyanide Compounds	89	27	0	116
25	110-82-7	Cyclohexane	67.952	16	0	67.968
25	1163-19-5	Decabromodiphenyl Oxide	1.995	42.997	362	45.353
25	117-81-7	Di(2-Ethylhexyl) Phthalate	51.746	83.945	137	135.829

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
25	84-74-2	Dibutyl Phthalate	4.792	4.667	0	9.459
25	75-09-2	Dichloromethane	4.319.612	14.823	2	4.334.437
25	111-42-2	Diethanolamine	520	79	0	599
25	84-66-2	Diethyl Phthalate	921	813	26	1.761
25	131-11-3	Dimethyl Phthalate	930	50	38	1.017
25	106-89-8	Epichlorohydrin	52	0	0	52
25	140-88-5	Ethyl Acrylate	505	0	0	505
25	100-41-4	Ethylbenzene	51.768	0	0	51.768
25	74-85-1	Ethylene	0	0	26	26
25	107-21-1	Ethylene Glycol	70.186	11.958	52	82.196
25	75-21-8	Ethylene Oxide	27.147	2.311	0	29.458
25	96-45-7	Ethylene Thiourea	1	1.738	0	1.739
25	50-00-0	Formaldehyde	16.232	6.073	60	22.365
25	76-13-1	Freon 113	289.642	1.367	0	291.010
25	7647-01-0	Hydrochloric Acid	11.391	58	0	11.449
25	123-31-9	Hydroquinone	52	0	0	52
25	67-63-0	Isopropyl Alcohol	44.153	336	0	44.489
25	7439-92-1	Lead	3.481	66.557	676	70.715
25	108-31-6	Maleic Anhydride	990	252	1	1.242
25	7439-96-5	Manganese	315	2.965	105	3.385
25	7439-97-6	Mercury	52	79	0	131
25	67-56-1	Methanol	1.907.156	8.357	26	1.915.540
25	96-33-3	Methyl Acrylate	225	0	0	225
25	108-10-1	Methyl Isobutyl Ketone	306.382	3.174	0	309.556
25	80-62-6	Methyl Methacrylate	96.322	5.798	79	102.199
25	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	3.004	4.387	0	7.391
25	90-94-8	Michler's Ketone	15	0	0	15
25	NA	Mixture	299.302	52	26	299.380
25	91-20-3	Naphthalene	30.570	0	0	30.570
25	71-36-3	N-Butyl Alcohol	115.734	153	0	115.888
25	117-84-0	N-Dioctyl Phthalate	8.951	2.070	213	11.234
25	7440-02-0	Nickel	471	5.640	1.401	7.512
25	7697-37-2	Nitric Acid	3.920	1.285	0	5.205
25	108-95-2	Phenol	76.455	10.481	58	86.994
25	7664-38-2	Phosphoric Acid	290	31	0	322
25	85-44-9	Phthalic Anhydride	3.048	829	0	3.877
25	1336-36-3	Polychlorinated Biphenyls	0	26	26	52
25	75-56-9	Propylene Oxide	292	0	0	292
25	7782-49-2	Selenium	105	262	26	394
25	100-42-5	Styrene	1.097.460	106.174	53	1.203.686
25	7664-93-9	Sulfuric Acid	2.243	1.278	8.246	11.766
25	100-21-0	Terephthalic Acid	79	35	0	113
25	127-18-4	Tetrachloroethylene	142.574	1.758	26	144.358
25	108-88-3	Toluene	2.607.080	18.633	322	2.626.035
25	584-84-9	Toluene-2,4-Diisocyanate	6.693	3.170	0	9.863
25	79-01-6	Trichloroethylene	202.533	5.856	3	208.393
25	51-79-6	Urethane	52	0	0	52
25	108-05-4	Vinyl Acetate	6.108	0	0	6.108
25	75-01-4	Vinyl Chloride	1	0	0	1
25	75-35-4	Vinylidene Chloride	1.015	0	0	1.015

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
25	1330-20-7	Xylene (Mixed Isomers)	865.173	4.001	0	869.175
25	7440-66-6	Zinc (Fume Or Dust)	683	6.609	315	7.606
25	N982	Zinc Compounds	15.607	488.393	21.082	525.082

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
26	71-55-6	1,1,1-Trichloroethane	132.518	778	4	133.299
26	79-34-5	1,1,2,2-Tetrachloroethane	41	0	0	41
26	95-63-6	1,2,4-Trimethylbenzene	28.618	0	0	28.618
26	106-88-7	1,2-Butylene Oxide	0	0	0	0
26	95-50-1	1,2-Dichlorobenzene	32.084	21	0	32.105
26	107-06-2	1,2-Dichloroethane	11	0	0	11
26	123-91-1	1,4-Dioxane	61	0	0	61
26	120-83-2	2,4-Dichlorophenol	16	0	0	16
26	78-93-3	2-Butanone (Methyl Ethyl Ketone)	98.486	2.607	0	101.093
26	110-80-5	2-Ethoxyethanol	32.155	1	0	32.156
26	109-86-4	2-Methoxyethanol	5.751	0	0	5.751
26	79-46-9	2-Nitropropane	4	0	0	4
26	80-05-7	4,4'-Isopropylidenediphenol	5	7	2	14
26	101-77-9	4,4'-Methylenedianiline	21	0	0	21
26	67-64-1	Acetone	63.089	2.716	21	65.825
26	75-05-8	Acetonitrile	0	0	0	0
26	7429-90-5	Aluminum (Fume Or Dust)	12.379	612.770	877	626.026
26	7664-41-7	Ammonia	331.923	5.496	643	338.062
26	6484-52-2	Ammonium Nitrate (Solution)	70.731	0	0	70.731
26	7783-20-2	Ammonium Sulfate (Solution)	4.211	11.527	2.270	18.009
26	120-12-7	Anthracene	1	21	0	22
26	7440-36-0	Antimony	3.735	28.396	96	32.227
26	7440-38-2	Arsenic	1.333	7.833	57	9.223
26	1332-21-4	Asbestos (Friable)	1.501	210.641	124	212.266
26	7440-39-3	Barium	16.035	91.238	7.042	114.314
26	71-43-2	Benzene	122	0	0	122
26	103-23-1	Bis(2-Ethylhexyl) Adipate	23	0	0	23
26	141-32-2	Butyl Acrylate	2	0	0	2
26	85-68-7	Butyl Benzyl Phthalate	0	146	0	146
26	7440-43-9	Cadmium	63	1.603	1	1.667
26	75-15-0	Carbon Disulfide	6.645	0	0	6.645
26	56-23-5	Carbon Tetrachloride	64	0	0	64
26	N230	Certain Glycol Ethers	31.402	1.909	34	33.345
26	7782-50-5	Chlorine	826	0	253	1.079
26	108-90-7	Chlorobenzene	39	0	0	39
26	75-00-3	Chloroethane	0	0	0	0
26	67-66-3	Chloroform	42	0	0	42
26	74-87-3	Chloromethane	42	0	0	42
26	N084	Chlorophenols	41	0	21	62
26	18540-29-9	Chromium (VI)	4.612	180.476	3.996	189.084
26	7440-48-4	Cobalt	218	1.514	39	1.771
26	7440-50-8	Copper	1.718	5.435	388	7.541
26	1319-77-3	Cresol (Mixed Isomers)	189	133	0	322
26	98-82-8	Cumene	3.495	0	0	3.495
26	110-82-7	Cyclohexane	48	0	0	48
26	1163-19-5	Decabromodiphenyl Oxide	0	575	0	575
26	117-81-7	Di(2-Ethylhexyl) Phthalate	23	712	0	735
26	84-74-2	Dibutyl Phthalate	104	116	0	220
26	25321-22-6	Dichlorobenzene (Mixed Isomers)	4	0	0	4
26	75-09-2	Dichloromethane	161.937	36	0	161.972

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
26	111-42-2	Diethanolamine	1.591	0	3	1.594
26	140-88-5	Ethyl Acrylate	1	0	0	1
26	100-41-4	Ethylbenzene	8.823	21	0	8.844
26	74-85-1	Ethylene	24	1.341	0	1.365
26	107-21-1	Ethylene Glycol	27.677	6.444	1.340	35.460
26	151-56-4	Ethyleneimine	41	0	0	41
26	50-00-0	Formaldehyde	171.595	11.065	2.800	185.461
26	76-13-1	Freon 113	21.955	718	0	22.673
26	118-74-1	Hexachlorobenzene	83	0	0	83
26	77-47-4	Hexachlorocyclopentadiene	41	0	0	41
26	7647-01-0	Hydrochloric Acid	245.061	11.428	74.334	330.823
26	7664-39-3	Hydrogen Fluoride	157.435	13.187	667	171.288
26	67-63-0	Isopropyl Alcohol	2.687	0	0	2.687
26	7439-92-1	Lead	20.938	430.732	1.039	452.709
26	108-31-6	Maleic Anhydride	335	0	0	335
26	7439-96-5	Manganese	10.725	70.577	1.752	83.054
26	7439-97-6	Mercury	0	0	0	0
26	67-56-1	Methanol	136.435	12.151	6	148.592
26	108-10-1	Methyl Isobutyl Ketone	39.369	128	21	39.518
26	80-62-6	Methyl Methacrylate	123	21	0	143
26	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	63	11.391	0	11.453
26	NA	Mixture	2.804	233.122	21	235.947
26	91-20-3	Naphthalene	6.769	627	0	7.396
26	71-36-3	N-Butyl Alcohol	9.581	43	3.125	12.749
26	117-84-0	N-Dioctyl Phthalate	41	0	0	41
26	7440-02-0	Nickel	475	16.409	3.465	20.349
26	7697-37-2	Nitric Acid	6.533	0	21	6.554
26	98-95-3	Nitrobenzene	0	0	0	0
26	55-63-0	Nitroglycerin	538	0	0	538
26	87-86-5	Pentachlorophenol	62	0	0	62
26	108-95-2	Phenol	93.724	6.484	1.600	101.807
26	7664-38-2	Phosphoric Acid	553	13.239	2.354	16.146
26	7723-14-0	Phosphorus (Yellow Or White)	41	21	0	62
26	85-44-9	Phthalic Anhydride	21	62	0	83
26	1336-36-3	Polychlorinated Biphenyls	0	1.852	0	1.852
26	115-07-1	Propylene	21	0	0	21
26	7782-49-2	Selenium	216	0	21	237
26	100-42-5	Styrene	74.533	1.871	124	76.528
26	7664-93-9	Sulfuric Acid	17.350	6.610	566.066	590.026
26	100-21-0	Terephthalic Acid	41	21	0	62
26	127-18-4	Tetrachloroethylene	12.879	1.148	0	14.026
26	7440-28-0	Thallium	21	0	0	21
26	7550-45-0	Titanium Tetrachloride	21	0	0	21
26	108-88-3	Toluene	279.936	12.418	0	292.353
26	584-84-9	Toluene-2,4-Diisocyanate	1	0	0	1
26	79-01-6	Trichloroethylene	23.956	6	4	23.966
26	N770	Vanadium (Except When Contained In An Alloy)	0	0	0	0
26	108-05-4	Vinyl Acetate	25	1.617	0	1.642
26	1330-20-7	Xylene (Mixed Isomers)	121.195	234	62	121.491

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
26	7440-66-6	Zinc (Fume Or Dust)	250	3.627	1.816	5.693
26	N982	Zinc Compounds	12.308	57.117	3.172	72.597

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
27	71-55-6	1,1,1-Trichloroethane	1.612.453	22.364	544	1.635.361
27	120-82-1	1,2,4-Trichlorobenzene	49	1.348	0	1.397
27	95-63-6	1,2,4-Trimethylbenzene	74.702	538	16	75.257
27	106-88-7	1,2-Butylene Oxide	1.016	0	0	1.016
27	123-91-1	1,4-Dioxane	2.929	0	0	2.929
27	105-67-9	2,4-Dimethylphenol	16	0	1.967	1.983
27	51-28-5	2,4-Dinitrophenol	772	0	0	772
27	78-93-3	2-Butanone (Methyl Ethyl Ketone)	470.402	815	33	471.250
27	110-80-5	2-Ethoxyethanol	59	0	0	59
27	109-86-4	2-Methoxyethanol	7.457	0	0	7.457
27	67-64-1	Acetone	107.960	743	16	108.720
27	107-13-1	Acrylonitrile	0	16	0	16
27	7429-90-5	Aluminum (Fume Or Dust)	182.055	3.741.817	402.242	4.326.113
27	7664-41-7	Ammonia	1.225.147	78.143	587.145	1.890.435
27	6484-52-2	Ammonium Nitrate (Solution)	1.223	11.188	15.196	27.607
27	7783-20-2	Ammonium Sulfate (Solution)	308	0	550.231	550.539
27	120-12-7	Anthracene	2.102	72	17	2.190
27	7440-36-0	Antimony	3.404	119.559	2.059	125.022
27	7440-38-2	Arsenic	11.634	77.997	211.239	300.870
27	1332-21-4	Asbestos (Friable)	0	852	0	852
27	7440-39-3	Barium	11.801	304.989	107.927	424.716
27	71-43-2	Benzene	773.150	1.161	8.741	783.052
27	7440-41-7	Beryllium	154	4.191	366	4.712
27	92-52-4	Biphenyl	148	22	0	170
27	103-23-1	Bis(2-Ethylhexyl) Adipate	379	6.501	0	6.880
27	141-32-2	Butyl Acrylate	557	0	0	557
27	85-68-7	Butyl Benzyl Phthalate	114	2.244	0	2.358
27	7440-43-9	Cadmium	4.153	10.978	15.743	30.875
27	463-58-1	Carbonyl Sulfide	62.792	0	0	62.792
27	N230	Certain Glycol Ethers	73.178	3.966	0	77.145
27	7782-50-5	Chlorine	7.357.995	62.506	14.973	7.435.475
27	108-90-7	Chlorobenzene	591	0	16	608
27	75-00-3	Chloroethane	6.834	0	0	6.834
27	74-87-3	Chloromethane	656	0	0	656
27	18540-29-9	Chromium (VI)	59.226	1.273.184	294.045	1.626.456
27	7440-48-4	Cobalt	481	7.530	190	8.201
27	7440-50-8	Copper	151.499	2,370.614	382.048	2.904.161
27	1319-77-3	Cresol (Mixed Isomers)	32.357	1.587	68	34.012
27	98-82-8	Cumene	9.790	0	0	9.790
27	80-15-9	Cumene Hydroperoxide	1.054	16	0	1.070
27	N106	Cyanide Compounds	49.689	32.415	14.321	96.426
27	1163-19-5	Decabromodiphenyl Oxide	16	2.840	0	2.857
27	117-81-7	Di(2-Ethylhexyl) Phthalate	33	699	0	732
27	132-64-9	Dibenzofuran	641	24	3	667
27	84-74-2	Dibutyl Phthalate	4.327	16	0	4.343
27	75-09-2	Dichloromethane	126.835	2.354	33	129.222
27	111-42-2	Diethanolamine	12.190	1.259	1	13.449
27	131-11-3	Dimethyl Phthalate	741	670	0	1.411
27	100-41-4	Ethylbenzene	14.865	839	3	15.707
27	74-85-1	Ethylene	79.684	0	0	79.684

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
27	107-21-1	Ethylene Glycol	63.496	80.197	171.954	315.647
27	75-21-8	Ethylene Oxide	33	0	0	33
27	50-00-0	Formaldehyde	24.685	7.176	10	31.871
27	76-13-1	Freon 113	103.980	1.091	0	105.071
27	67-72-1	Hexachloroethane	1.193	0	0	1.193
27	302-01-2	Hydrazine	174	0	0	174
27	7647-01-0	Hydrochloric Acid	1.031.744	430.468	961.666	2.423.878
27	7664-39-3	Hydrogen Fluoride	507.406	42.891	485	550.782
27	67-63-0	Isopropyl Alcohol	12.982	0	0	12.982
27	7439-92-1	Lead	104.263	2.029.452	178.878	2.312.593
27	7439-96-5	Manganese	115.474	6.961.520	595.067	7.672.061
27	7439-97-6	Mercury	82	0	0	82
27	67-56-1	Methanol	237.718	1.309	101	239.128
27	108-10-1	Methyl Isobutyl Ketone	103.566	180	3.879	107.626
27	624-83-9	Methyl Isocyanate	4	718	0	722
27	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	6.736	25.954	16	32.706
27	NA	Mixture	44.018	16.499	66	60.583
27	1313-27-5	Molybdenum Trioxide	5.243	5.641	7.900	18.785
27	91-20-3	Naphthalene	62.940	148	10.237	73.325
27	71-36-3	N-Butyl Alcohol	32.536	37	16	32.590
27	7440-02-0	Nickel	7.008	175.922	74.483	257.414
27	7697-37-2	Nitric Acid	85.770	219.262	926	305.959
27	55-63-0	Nitroglycerin	0	0	16	16
27	108-95-2	Phenol	172.244	28.089	20.797	221.129
27	7664-38-2	Phosphoric Acid	20.020	164.210	5.475	189.705
27	7723-14-0	Phosphorus (Yellow Or White)	268	303	50	620
27	1336-36-3	Polychlorinated Biphenyls	0	852	0	852
27	115-07-1	Propylene	13.151	0	0	13.151
27	110-86-1	Pyridine	2.386	0	0	2.386
27	91-22-5	Quinoline	1.218	7	0	1.225
27	7782-49-2	Selenium	797	1.178	14.689	16.664
27	7440-22-4	Silver	185	826	123	1.134
27	100-42-5	Styrene	12.569	330	4	12.903
27	7664-93-9	Sulfuric Acid	239.988	783.261	2.232.077	3.255.326
27	127-18-4	Tetrachloroethylene	237.033	5.921	105	243.059
27	7440-28-0	Thallium	66	33	33	132
27	62-56-6	Thiourea	16	16	47	80
27	1314-20-1	Thorium Dioxide	16	5.705	0	5.722
27	7550-45-0	Titanium Tetrachloride	57	0	0	57
27	108-88-3	Toluene	426.422	922	275	427.619
27	584-84-9	Toluene-2,4-Diisocyanate	301	0	0	301
27	79-01-6	Trichloroethylene	344.362	2.372	33	346.768
27	N770	Vanadium (Except When Contained In An Alloy)	491	476	260	1.227
27	75-01-4	Vinyl Chloride	16	49	0	66
27	1330-20-7	Xylene (Mixed Isomers)	416.511	9.410	184	426.105
27	7440-66-6	Zinc (Fume Or Dust)	175.998	2.923.537	156.301	3.255.836
27	N982	Zinc Compounds	194.078	8.364.050	300.702	8.858.830

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
28	71-55-6	1,1,1-Trichloroethane	1.051.390	54.842	79	1.106.311
28	95-63-6	1,2,4-Trimethylbenzene	3.209	140	0	3.350
28	106-88-7	1,2-Butylene Oxide	56	3	0	60
28	95-50-1	1,2-Dichlorobenzene	394	10	10	413
28	107-06-2	1,2-Dichloroethane	4.007	0	0	4.007
28	123-91-1	1,4-Dioxane	2.092	5	0	2.097
28	94-75-7	2,4-D	19	0	10.092	10.112
28	121-14-2	2,4-Dinitrotoluene	19	0	0	19
28	78-93-3	2-Butanone (Methyl Ethyl Ketone)	404.077	21.450	19	425.546
28	110-80-5	2-Ethoxyethanol	3.015	0	0	3.015
28	109-86-4	2-Methoxyethanol	297	19	0	317
28	80-05-7	4,4'-Isopropylidenediphenol	193	0	0	193
28	67-64-1	Acetone	178.834	2.936	42	181.813
28	75-05-8	Acetonitrile	153	0	0	153
28	79-06-1	Acrylamide	10	0	0	10
28	107-13-1	Acrylonitrile	10	0	0	10
28	7429-90-5	Aluminum (Fume Or Dust)	5.050	105.389	128	110.567
28	7664-41-7	Ammonia	30.687	19	291	30.997
28	7783-20-2	Ammonium Sulfate (Solution)	49	0	0	49
28	7440-36-0	Antimony	14	360	11	385
28	7440-38-2	Arsenic	0	10	0	10
28	1332-21-4	Asbestos (Friable)	10	0	0	10
28	7440-39-3	Barium	1.839	7.908	428	10.175
28	71-43-2	Benzene	9	0	0	9
28	94-36-0	Benzoyl Peroxide	0	73	0	73
28	7440-41-7	Beryllium	0	0	0	0
28	103-23-1	Bis(2-Ethylhexyl) Adipate	497	10	0	507
28	85-68-7	Butyl Benzyl Phthalate	78	0	0	78
28	7440-43-9	Cadmium	265	8.523	442	9.230
28	56-23-5	Carbon Tetrachloride	1.861	0	0	1.861
28	N230	Certain Glycol Ethers	815.716	8.341	0	824.056
28	7782-50-5	Chlorine	2.075	11	989	3.075
28	18540-29-9	Chromium (VI)	22.225	117.265	29.968	169.458
28	7440-48-4	Cobalt	26	13	39	78
28	7440-50-8	Copper	7.262	186.266	10.894	204.422
28	1319-77-3	Cresol (Mixed Isomers)	980	0	0	980
28	98-82-8	Cumene	10	0	0	10
28	N106	Cyanide Compounds	2.217	5.389	206	7.812
28	110-82-7	Cyclohexane	37.850	0	0	37.850
28	1163-19-5	Decabromodiphenyl Oxide	10	69	0	78
28	117-81-7	Di(2-Ethylhexyl) Phthalate	2.348	380	0	2.728
28	84-74-2	Dibutyl Phthalate	29	10	0	39
28	75-09-2	Dichloromethane	181.316	97	29	181.443
28	111-42-2	Diethanolamine	29	35	0	64
28	84-66-2	Diethyl Phthalate	714	0	0	714
28	131-11-3	Dimethyl Phthalate	9.222	0	0	9.222
28	106-89-8	Epichlorohydrin	8	0	0	8
28	140-88-5	Ethyl Acrylate	10	0	0	10
28	100-41-4	Ethylbenzene	11.472	772	10	12.253
28	107-21-1	Ethylene Glycol	18.913	5.596	860	25.369

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
28	50-00-0	Formaldehyde	2.018	102	39	2.159
28	76-13-1	Freon 113	229.343	8.542	37	237.923
28	302-01-2	Hydrazine	0	0	29	29
28	7647-01-0	Hydrochloric Acid	46.010	58.871	159.361	264.242
28	7664-39-3	Hydrogen Fluoride	7.842	97	339	8.277
28	67-63-0	Isopropyl Alcohol	15.687	1.146	0	16.832
28	7439-92-1	Lead	3.818	69.592	1.573	74.983
28	7439-96-5	Manganese	51.122	59.233	1.779	112.134
28	67-56-1	Methanol	38.030	4.079	18	42.127
28	96-33-3	Methyl Acrylate	10	0	0	10
28	108-10-1	Methyl Isobutyl Ketone	88.023	9.531	0	97.555
28	624-83-9	Methyl Isocyanate	10	10	0	19
28	80-62-6	Methyl Methacrylate	10	0	0	10
28	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	133	112	0	245
28	NA	Mixture	1.738	706	10	2.454
28	1313-27-5	Molybdenum Trioxide	10	413	0	423
28	91-20-3	Naphthalene	7.746	10	0	7.756
28	71-36-3	N-Butyl Alcohol	517.260	7.191	10	524.461
28	117-84-0	N-Dioctyl Phthalate	29	0	0	29
28	7440-02-0	Nickel	2.725	99.947	5.277	107.949
28	7697-37-2	Nitric Acid	30.684	7.026	8.687	46.397
28	98-95-3	Nitrobenzene	19	0	0	19
28	55-63-0	Nitroglycerin	62	0	0	62
28	95-53-4	O-Toluidine	10	0	0	10
28	87-86-5	Pentachlorophenol	0	0	0	0
28	108-95-2	Phenol	2.625	1.088	10	3.723
28	7664-38-2	Phosphoric Acid	8.054	13.670	6.159	27.883
28	7723-14-0	Phosphorus (Yellow Or White)	29	28	77	135
28	85-44-9	Phthalic Anhydride	8	0	0	8
28	1336-36-3	Polychlorinated Biphenyls	0	59	0	59
28	115-07-1	Propylene	4.679	0	0	4.679
28	7782-49-2	Selenium	10	29	0	39
28	7440-22-4	Silver	39	0	29	68
28	100-42-5	Styrene	7.596	759	0	8.354
28	7664-93-9	Sulfuric Acid	53.170	51.678	226.331	331.178
28	127-18-4	Tetrachloroethylene	150.283	8.861	14	159.157
28	108-88-3	Toluene	424.878	10.615	379	435.872
28	584-84-9	Toluene-2,4-Diisocyanate	87	0	0	87
28	79-01-6	Trichloroethylene	493.399	19.126	46	512.572
28	N770	Vanadium (Except When Contained In An Alloy)	10	29	0	38
28	1330-20-7	Xylene (Mixed Isomers)	754.766	19.770	29	774.565
28	7440-66-6	Zinc (Fume Or Dust)	15.565	94.142	21.360	131.067
28	N982	Zinc Compounds	10.655	312.699	15.857	339.212

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
29	71-55-6	1,1,1-Trichloroethane	950.535	29.052	82	979.668
29	95-63-6	1,2,4-Trimethylbenzene	16.861	13	0	16.875
29	106-88-7	1,2-Butylene Oxide	27	0	0	27
29	107-06-2	1,2-Dichloroethane	52.338	0	0	52.338
29	123-91-1	1,4-Dioxane	2.883	23	0	2.906
29	78-93-3	2-Butanone (Methyl Ethyl Ketone)	126.115	8.745	0	134.860
29	110-80-5	2-Ethoxyethanol	5.362	0	0	5.362
29	109-86-4	2-Methoxyethanol	1.088	0	0	1.088
29	67-64-1	Acetone	73.764	1.386	73	75.223
29	79-10-7	Acrylic Acid	13	0	0	13
29	7429-90-5	Aluminum (Fume Or Dust)	15.390	242.087	2.384	259.860
29	7664-41-7	Ammonia	19.817	637	2.096	22.549
29	7440-36-0	Antimony	0	278	0	278
29	1332-21-4	Asbestos (Friable)	27	623	570	1.220
29	7440-39-3	Barium	1.516	18.878	456	20.850
29	71-43-2	Benzene	54	0	0	54
29	103-23-1	Bis(2-Ethylhexyl) Adipate	0	40	0	40
29	74-83-9	Bromomethane	27	0	0	27
29	85-68-7	Butyl Benzyl Phthalate	659	0	0	659
29	7440-43-9	Cadmium	27	53	13	93
29	N230	Certain Glycol Ethers	94.149	1.094	952	96.195
29	7782-50-5	Chlorine	143	106	697	946
29	18540-29-9	Chromium (VI)	4.118	154.687	16.285	175.091
29	7440-48-4	Cobalt	13	0	112	125
29	7440-50-8	Copper	6.950	32.651	1.110	40.711
29	98-82-8	Cumene	1.434	0	0	1.434
29	N106	Cyanide Compounds	159	93	0	252
29	110-82-7	Cyclohexane	186	0	0	186
29	117-81-7	Di(2-Ethylhexyl) Phthalate	13	40	0	53
29	75-09-2	Dichloromethane	98.195	3.888	13	102.096
29	111-42-2	Diethanolamine	85	10.444	71	10.601
29	100-41-4	Ethylbenzene	17.066	0	6	17.072
29	107-21-1	Ethylene Glycol	3.192	1.661	1.169	6.022
29	75-21-8	Ethylene Oxide	9.166	0	0	9.166
29	50-00-0	Formaldehyde	4.722	64	0	4.786
29	76-13-1	Freon 113	469.301	4.353	11	473.665
29	7647-01-0	Hydrochloric Acid	9.255	814	3.668	13.738
29	7664-39-3	Hydrogen Fluoride	148	107	0	254
29	123-31-9	Hydroquinone	40	13	27	80
29	67-63-0	Isopropyl Alcohol	7.084	0	0	7.084
29	7439-92-1	Lead	718	8.479	389	9.586
29	7439-96-5	Manganese	7.355	95.559	432	103.345
29	67-56-1	Methanol	88.930	20	0	88.951
29	108-10-1	Methyl Isobutyl Ketone	24.474	430	0	24.904
29	1634-04-4	Methyl Tert-Butyl Ether	42	0	0	42
29	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	590	271	0	861
29	NA	Mixture	3.199	0	0	3.199
29	1313-27-5	Molybdenum Trioxide	27	0	0	27
29	91-20-3	Naphthalene	371	0	0	371
29	71-36-3	N-Butyl Alcohol	40.363	339	0	40.702

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
29	7440-02-0	Nickel	290	6.577	531	7.398
29	7697-37-2	Nitric Acid	1.462	12.351	9.112	22.924
29	87-86-5	Pentachlorophenol	13	0	0	13
29	108-95-2	Phenol	444	736	0	1.180
29	7664-38-2	Phosphoric Acid	2.957	1.188	553	4.698
29	7723-14-0	Phosphorus (Yellow Or White)	194	485	0	679
29	1336-36-3	Polychlorinated Biphenyls	0	11	0	11
29	115-07-1	Propylene	2.814	0	0	2.814
29	7782-49-2	Selenium	0	13	0	13
29	7440-22-4	Silver	0	13	0	13
29	100-42-5	Styrene	14.622	1.900	0	16.522
29	7664-93-9	Sulfuric Acid	3.530	1.978	36.164	41.671
29	127-18-4	Tetrachloroethylene	90.246	826	0	91.073
29	108-88-3	Toluene	260.119	7.501	2	267.622
29	584-84-9	Toluene-2,4-Diisocyanate	80	85	0	164
29	79-01-6	Trichloroethylene	405.533	6.947	30	412.511
29	N770	Vanadium (Except When Contained In An Alloy)	16	1.345	13	1.375
29	1330-20-7	Xylene (Mixed Isomers)	523.697	6.369	1.928	531.994
29	7440-66-6	Zinc (Fume Or Dust)	407	8.130	99	8.636
29	N982	Zinc Compounds	299	17.928	3.228	21.454

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
31	71-55-6	1,1,1-Trichloroethane	542.645	18.969	159	561.773
31	120-82-1	1,2,4-Trichlorobenzene	2.053	0	49	2.102
31	95-63-6	1,2,4-Trimethylbenzene	385	7	0	392
31	95-50-1	1,2-Dichlorobenzene	2.058	0	19	2.077
31	540-59-0	1,2-Dichloroethylene	2.588	0	0	2.588
31	106-99-0	1,3-Butadiene	7	0	0	7
31	123-91-1	1,4-Dioxane	515	0	0	515
31	78-93-3	2-Butanone (Methyl Ethyl Ketone)	87.140	817	0	87.957
31	110-80-5	2-Ethoxyethanol	2.409	287	0	2.696
31	109-86-4	2-Methoxyethanol	9.307	10	0	9.317
31	101-77-9	4,4'-Methylenedianiline	0	219	0	219
31	67-64-1	Acetone	223.198	2.682	203	226.083
31	75-05-8	Acetonitrile	9	18	0	27
31	7429-90-5	Aluminum (Fume Or Dust)	1.729	53.540	22.327	77.595
31	7664-41-7	Ammonia	26.538	1.750	4.450	32.739
31	6484-52-2	Ammonium Nitrate (Solution)	7	2.043	264	2.313
31	7783-20-2	Ammonium Sulfate (Solution)	20	28.063	4.678	32.761
31	120-12-7	Anthracene	216	47	0	263
31	7440-36-0	Antimony	109	1.411	74	1.594
31	7440-38-2	Arsenic	14	130	0	143
31	7440-39-3	Barium	784	34.805	1.055	36.644
31	7440-41-7	Beryllium	7	117	0	124
31	92-52-4	Biphenyl	33	0	0	33
31	85-68-7	Butyl Benzyl Phthalate	0	7	0	7
31	7440-43-9	Cadmium	28	4.146	355	4.528
31	56-23-5	Carbon Tetrachloride	14	0	0	14
31	N230	Certain Glycol Ethers	96.273	6.888	170	103.331
31	7782-50-5	Chlorine	666	197	177	1.040
31	67-66-3	Chloroform	14	0	0	14
31	18540-29-9	Chromium (VI)	4.828	10.607	489	15.924
31	7440-48-4	Cobalt	27	605	7	639
31	7440-50-8	Copper	13.760	62.455	28.948	105.163
31	1319-77-3	Cresol (Mixed Isomers)	4.102	21	8	4.131
31	N106	Cyanide Compounds	1.610	27	34	1.671
31	1163-19-5	Decabromodiphenyl Oxide	0	42	0	42
31	117-81-7	Di(2-Ethylhexyl) Phthalate	249	5.758	0	6.007
31	84-74-2	Dibutyl Phthalate	14	7	0	20
31	25321-22-6	Dichlorobenzene (Mixed Isomers)	1.702	101	7	1.810
31	75-09-2	Dichloromethane	234.769	3.632	49	238.450
31	111-42-2	Diethanolamine	111	9	353	473
31	106-89-8	Epichlorohydrin	0	0	0	0
31	100-41-4	Ethylbenzene	10.568	103	0	10.671
31	107-21-1	Ethylene Glycol	6.582	4.535	2.774	13.891
31	75-21-8	Ethylene Oxide	3	0	0	3
31	50-00-0	Formaldehyde	4.396	33	9	4.438
31	76-13-1	Freon 113	531.508	10.335	91	541.935
31	7647-01-0	Hydrochloric Acid	11.297	2.014	2.408	15.719
31	7664-39-3	Hydrogen Fluoride	4.086	3.667	9.895	17.647
31	67-63-0	Isopropyl Alcohol	7.407	684	498	8.588
31	7439-92-1	Lead	4.554	129.711	2.180	136.445

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
31	7439-96-5	Manganese	1.927	30.448	379	32.754
31	7439-97-6	Mercury	111	1.022	21	1.154
31	67-56-1	Methanol	49.158	4.539	211	53.908
31	108-10-1	Methyl Isobutyl Ketone	13.567	1	0	13.567
31	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	70	95	0	164
31	NA	Mixture	1.423	12.225	0	13.649
31	91-20-3	Naphthalene	406	0	0	406
31	71-36-3	N-Butyl Alcohol	38.295	92	4	38.390
31	7440-02-0	Nickel	352	16.676	470	17.498
31	7697-37-2	Nitric Acid	7.657	7.329	3.074	18.060
31	108-95-2	Phenol	13.126	297	22	13.445
31	7664-38-2	Phosphoric Acid	2.254	1.841	5.659	9.754
31	1336-36-3	Polychlorinated Biphenyls	0	4.906	0	4.906
31	115-07-1	Propylene	8	0	0	8
31	7440-22-4	Silver	27	20	20	68
31	100-42-5	Styrene	13.256	307	0	13.563
31	7664-93-9	Sulfuric Acid	18.237	17.541	41.575	77.354
31	127-18-4	Tetrachloroethylene	95.684	579	14	96.277
31	62-56-6	Thiourea	14	3	0	17
31	108-88-3	Toluene	140.155	697	20	140.872
31	584-84-9	Toluene-2,4-Diisocyanate	112	14	0	126
31	79-01-6	Trichloroethylene	137.900	7.204	42	145.146
31	N770	Vanadium (Except When Contained In An Alloy)	7	0	0	7
31	1330-20-7	Xylene (Mixed Isomers)	413.953	4.322	36	418.311
31	7440-66-6	Zinc (Fume Or Dust)	1.068	9.009	1.118	11.196
31	N982	Zinc Compounds	1.438	47.744	3.615	52.797

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
32	71-55-6	1,1,1-Trichloroethane	323.003	9.872	28	332.903
32	95-63-6	1,2,4-Trimethylbenzene	5.730	5	0	5.734
32	106-88-7	1,2-Butylene Oxide	9	0	0	9
32	107-06-2	1,2-Dichloroethane	17.785	0	0	17.785
32	123-91-1	1,4-Dioxane	980	8	0	987
32	78-93-3	2-Butanone (Methyl Ethyl Ketone)	42.856	2.971	0	45.827
32	110-80-5	2-Ethoxyethanol	1.822	0	0	1.822
32	109-86-4	2-Methoxyethanol	370	0	0	370
32	67-64-1	Acetone	25.066	471	25	25.562
32	79-10-7	Acrylic Acid	5	0	0	5
32	7429-90-5	Aluminum (Fume Or Dust)	5.230	82.264	810	88.304
32	7664-41-7	Ammonia	6.734	216	712	7.663
32	7440-36-0	Antimony	0	94	0	94
32	1332-21-4	Asbestos (Friable)	9	212	194	415
32	7440-39-3	Barium	515	6.415	155	7.085
32	71-43-2	Benzene	18	0	0	18
32	103-23-1	Bis(2-Ethylhexyl) Adipate	0	14	0	14
32	74-83-9	Bromomethane	9	0	0	9
32	85-68-7	Butyl Benzyl Phthalate	224	0	0	224
32	7440-43-9	Cadmium	9	18	5	32
32	N230	Certain Glycol Ethers	31.993	372	324	32.688
32	7782-50-5	Chlorine	48	36	237	321
32	18540-29-9	Chromium (VI)	1.399	52.565	5.534	59.498
32	7440-48-4	Cobalt	5	0	38	42
32	7440-50-8	Copper	2.362	11.095	377	13.834
32	98-82-8	Cumene	487	0	0	487
32	N106	Cyanide Compounds	54	32	0	86
32	110-82-7	Cyclohexane	63	0	0	63
32	117-81-7	Di(2-Ethylhexyl) Phthalate	5	14	0	18
32	75-09-2	Dichloromethane	33.368	1.321	5	34.694
32	111-42-2	Diethanolamine	29	3.549	24	3.602
32	100-41-4	Ethylbenzene	5.799	0	2	5.801
32	107-21-1	Ethylene Glycol	1.085	564	397	2.046
32	75-21-8	Ethylene Oxide	3.115	0	0	3.115
32	50-00-0	Formaldehyde	1.605	22	0	1.626
32	76-13-1	Freon 113	159.474	1.479	4	160.957
32	7647-01-0	Hydrochloric Acid	3.145	277	1.246	4.668
32	7664-39-3	Hydrogen Fluoride	50	36	0	86
32	123-31-9	Hydroquinone	14	5	9	27
32	67-63-0	Isopropyl Alcohol	2.407	0	0	2.407
32	7439-92-1	Lead	244	2.881	132	3.257
32	7439-96-5	Manganese	2.499	32.472	147	35.118
32	67-56-1	Methanol	30.220	7	0	30.227
32	108-10-1	Methyl Isobutyl Ketone	8.317	146	0	8.463
32	1634-04-4	Methyl Tert-Butyl Ether	14	0	0	14
32	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	200	92	0	293
32	NA	Mixture	1.087	0	0	1.087
32	1313-27-5	Molybdenum Trioxide	9	0	0	9
32	91-20-3	Naphthalene	126	0	0	126
32	71-36-3	N-Butyl Alcohol	13.716	115	0	13.831

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
32	7440-02-0	Nickel	99	2.235	181	2.514
32	7697-37-2	Nitric Acid	497	4.197	3.096	7.790
32	87-86-5	Pentachlorophenol	5	0	0	5
32	108-95-2	Phenol	151	250	0	401
32	7664-38-2	Phosphoric Acid	1.005	404	188	1.596
32	7723-14-0	Phosphorus (Yellow Or White)	66	165	0	231
32	1336-36-3	Polychlorinated Biphenyls	0	4	0	4
32	115-07-1	Propylene	956	0	0	956
32	7782-49-2	Selenium	0	5	0	5
32	7440-22-4	Silver	0	5	0	5
32	100-42-5	Styrene	4.969	646	0	5.614
32	7664-93-9	Sulfuric Acid	1.200	672	12.289	14.160
32	127-18-4	Tetrachloroethylene	30.667	281	0	30.948
32	108-88-3	Toluene	88.392	2.549	1	90.941
32	584-84-9	Toluene-2,4-Diisocyanate	27	29	0	56
32	79-01-6	Trichloroethylene	137.805	2.361	10	140.176
32	N770	Vanadium (Except When Contained In An Alloy)	6	457	5	467
32	1330-20-7	Xylene (Mixed Isomers)	177.958	2.164	655	180.778
32	7440-66-6	Zinc (Fume Or Dust)	138	2.763	34	2.935
32	N982	Zinc Compounds	102	6.092	1.097	7.290

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
33	71-55-6	1,1,1-Trichloroethane	56.453	2.686	16	59.155
33	95-63-6	1,2,4-Trimethylbenzene	7	5	0	13
33	95-50-1	1,2-Dichlorobenzene	25	0	0	25
33	107-06-2	1,2-Dichloroethane	283	0	42	326
33	78-87-5	1,2-Dichloropropane	6.924	0	69	6.993
33	106-99-0	1,3-Butadiene	44	0	0	44
33	123-91-1	1,4-Dioxane	626	0	1.563	2.189
33	78-93-3	2-Butanone (Methyl Ethyl Ketone)	22.517	5.567	15	28.099
33	110-80-5	2-Ethoxyethanol	110	0	0	110
33	109-86-4	2-Methoxyethanol	1.609	418	123	2.150
33	75-07-0	Acetaldehyde	1.464	0	0	1.464
33	67-64-1	Acetone	92.821	6.829	458	100.107
33	75-05-8	Acetonitrile	584	121	37	742
33	79-06-1	Acrylamide	1	0	0	1
33	107-13-1	Acrylonitrile	36	0	0	36
33	7429-90-5	Aluminum (Fume Or Dust)	377	1.340	6	1.723
33	7664-41-7	Ammonia	3.246	46	31	3.324
33	6484-52-2	Ammonium Nitrate (Solution)	156	0	0	156
33	7783-20-2	Ammonium Sulfate (Solution)	0	0	0	0
33	62-53-3	Aniline	4	0	0	4
33	7440-36-0	Antimony	58	24	42	125
33	7440-39-3	Barium	20	642	198	860
33	92-52-4	Biphenyl	134	1	0	136
33	103-23-1	Bis(2-Ethylhexyl) Adipate	6	0	0	6
33	141-32-2	Butyl Acrylate	96	0	0	96
33	120-80-9	Catechol	1	0	0	1
33	N230	Certain Glycol Ethers	1.421	0	108	1.530
33	7782-50-5	Chlorine	555	0	2	557
33	108-90-7	Chlorobenzene	79	409	0	488
33	N084	Chlorophenols	1	0	0	1
33	18540-29-9	Chromium (VI)	40	1.306	114	1.459
33	7440-48-4	Cobalt	1	12	3	16
33	7440-50-8	Copper	70	3.772	238	4.080
33	1319-77-3	Cresol (Mixed Isomers)	40	0	1	41
33	N106	Cyanide Compounds	11	0	0	11
33	110-82-7	Cyclohexane	4.367	0	0	4.367
33	117-81-7	Di(2-Ethylhexyl) Phthalate	102	563	0	665
33	84-74-2	Dibutyl Phthalate	65	0	18	83
33	75-09-2	Dichloromethane	161.650	832	1.531	164.014
33	111-42-2	Diethanolamine	14	0	12	26
33	84-66-2	Diethyl Phthalate	0	0	0	0
33	140-88-5	Ethyl Acrylate	39	0	0	39
33	100-41-4	Ethylbenzene	210	0	0	210
33	107-21-1	Ethylene Glycol	1.033	110	157	1.301
33	75-21-8	Ethylene Oxide	7.161	0	0	7.161
33	50-00-0	Formaldehyde	488	0	0	488
33	76-13-1	Freon 113	102.539	1.679	0	104.218
33	7647-01-0	Hydrochloric Acid	29.174	14	2	29.189
33	7664-39-3	Hydrogen Fluoride	1.932	0	8	1.940
33	123-31-9	Hydroquinone	43	4	5	52

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
33	67-63-0	Isopropyl Alcohol	246	0	0	246
33	7439-92-1	Lead	122	2.226	106	2.453
33	7439-96-5	Manganese	16	1.983	931	2.929
33	7439-97-6	Mercury	1	0	0	1
33	67-56-1	Methanol	74.876	3.938	274	79.088
33	96-33-3	Methyl Acrylate	5	0	0	5
33	108-10-1	Methyl Isobutyl Ketone	3.789	10	0	3.800
33	624-83-9	Methyl Isocyanate	1	0	0	1
33	80-62-6	Methyl Methacrylate	145	30	0	175
33	121-69-7	N,N-Dimethylaniline	17	0	82	98
33	71-36-3	N-Butyl Alcohol	4.547	280	3	4.830
33	7440-02-0	Nickel	12	135	27	174
33	7697-37-2	Nitric Acid	1.624	181	8	1.813
33	98-95-3	Nitrobenzene	1	0	0	1
33	108-95-2	Phenol	9	361	1	371
33	7664-38-2	Phosphoric Acid	306	269	0	574
33	85-44-9	Phthalic Anhydride	160	0	15	175
33	115-07-1	Propylene	162	0	0	162
33	75-56-9	Propylene Oxide	401	0	0	401
33	110-86-1	Pyridine	255	0	16	271
33	7782-49-2	Selenium	12	314	108	434
33	7440-22-4	Silver	112	4	150	266
33	100-42-5	Styrene	640	0	0	640
33	7664-93-9	Sulfuric Acid	353	5.577	0	5.931
33	127-18-4	Tetrachloroethylene	7.044	35	0	7.079
33	62-56-6	Thiourea	0	25	0	25
33	108-88-3	Toluene	34.130	559	10	34.700
33	584-84-9	Toluene-2,4-Diisocyanate	1	0	0	1
33	79-01-6	Trichloroethylene	16.048	29	8	16.085
33	108-05-4	Vinyl Acetate	79	0	0	79
33	75-35-4	Vinylidene Chloride	2	0	0	3
33	1330-20-7	Xylene (Mixed Isomers)	9.554	290	16	9.860
33	7440-66-6	Zinc (Fume Or Dust)	14	33	1	48
33	N982	Zinc Compounds	384	3.197	437	4.018

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
34	71-55-6	1,1,1-Trichloroethane	2.108.502	62.336	643	2.171.481
34	120-82-1	1,2,4-Trichlorobenzene	0	15	0	15
34	95-63-6	1,2,4-Trimethylbenzene	5.281	121	0	5.403
34	107-06-2	1,2-Dichloroethane	1.500	79	0	1.579
34	123-91-1	1,4-Dioxane	9.793	46	0	9.839
34	78-93-3	2-Butanone (Methyl Ethyl Ketone)	992.693	37.690	119	1.030.502
34	110-80-5	2-Ethoxyethanol	17.656	404	0	18.060
34	109-86-4	2-Methoxyethanol	1.099	0	0	1.099
34	67-64-1	Acetone	1.427.946	87.866	166	1.515.978
34	107-13-1	Acrylonitrile	61	0	0	61
34	7429-90-5	Aluminum (Fume Or Dust)	5.892	69.194	200	75.286
34	7664-41-7	Ammonia	30.599	1.221	54	31.873
34	6484-52-2	Ammonium Nitrate (Solution)	30	0	0	30
34	62-53-3	Aniline	30	0	117	147
34	7440-36-0	Antimony	15	30	18	63
34	7440-38-2	Arsenic	0	0	15	15
34	1332-21-4	Asbestos (Friable)	414	158.396	0	158.810
34	7440-39-3	Barium	7.793	157.645	5.634	171.073
34	71-43-2	Benzene	6.664	316	17	6.997
34	141-32-2	Butyl Acrylate	868	61	0	929
34	85-68-7	Butyl Benzyl Phthalate	1.678	1.211	0	2.889
34	7440-43-9	Cadmium	310	1.121	298	1.730
34	N230	Certain Glycol Ethers	647.707	25.668	2.347	675.722
34	7782-50-5	Chlorine	2.457	1.410	1.739	5.605
34	108-90-7	Chlorobenzene	15	0	0	15
34	67-66-3	Chloroform	799	0	0	799
34	18540-29-9	Chromium (VI)	6.337	83.990	27.552	117.879
34	7440-48-4	Cobalt	104	254	198	556
34	7440-50-8	Copper	3.004	41.000	2.584	46.588
34	98-82-8	Cumene	30	0	0	30
34	80-15-9	Cumene Hydroperoxide	50	0	0	50
34	N106	Cyanide Compounds	144	1.194	7	1.346
34	110-82-7	Cyclohexane	745	108	0	852
34	117-81-7	Di(2-Ethylhexyl) Phthalate	4.815	3.052	0	7.867
34	84-74-2	Dibutyl Phthalate	2.988	550	0	3.538
34	75-09-2	Dichloromethane	435.381	10.150	1.667	447.198
34	111-42-2	Diethanolamine	892	2.456	1.658	5.006
34	84-66-2	Diethyl Phthalate	844	0	0	844
34	131-11-3	Dimethyl Phthalate	4.128	15	0	4.143
34	100-41-4	Ethylbenzene	131.409	6.733	24	138.166
34	74-85-1	Ethylene	1	0	0	1
34	107-21-1	Ethylene Glycol	13.571	16.463	1.075	31.109
34	50-00-0	Formaldehyde	2.184	30	0	2.214
34	76-13-1	Freon 113	699.980	14.395	30	714.405
34	302-01-2	Hydrazine	31	1	0	32
34	7647-01-0	Hydrochloric Acid	134.061	576	2.920	137.557
34	7664-39-3	Hydrogen Fluoride	2.980	4	0	2.984
34	67-63-0	Isopropyl Alcohol	42.433	2.241	0	44.674
34	7439-92-1	Lead	2.380	53.382	4.374	60.136
34	7439-96-5	Manganese	7.012	33.486	3.676	44.174

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
34	7439-97-6	Mercury	0	0	15	15
34	67-56-1	Methanol	299.291	5.819	191	305.301
34	108-10-1	Methyl Isobutyl Ketone	512.428	12.676	249	525.353
34	624-83-9	Methyl Isocyanate	30	243	0	273
34	80-62-6	Methyl Methacrylate	6.346	46	0	6.391
34	1634-04-4	Methyl Tert-Butyl Ether	2.619	124	0	2.743
34	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	6.196	14.273	0	20.468
34	NA	Mixture	1.528	3.133	0	4.661
34	91-20-3	Naphthalene	11.604	323	5	11.932
34	71-36-3	N-Butyl Alcohol	610.621	14.880	222	625.722
34	117-84-0	N-Dioctyl Phthalate	24.995	0	0	24.995
34	7440-02-0	Nickel	901	10.963	2.181	14.044
34	7697-37-2	Nitric Acid	14.054	8.094	8.861	31.009
34	55-63-0	Nitroglycerin	2	1.306	0	1.307
34	108-95-2	Phenol	8.165	4.530	18	12.712
34	7664-38-2	Phosphoric Acid	1.772	3.438	1.193	6.403
34	7723-14-0	Phosphorus (Yellow Or White)	0	3.978	0	3.978
34	1336-36-3	Polychlorinated Biphenyls	0	16	0	16
34	115-07-1	Propylene	233	0	0	233
34	75-56-9	Propylene Oxide	24	0	0	24
34	7440-22-4	Silver	30	0	15	46
34	100-42-5	Styrene	788.199	22.479	15	810.694
34	7664-93-9	Sulfuric Acid	10.593	7.551	46.041	64.185
34	127-18-4	Tetrachloroethylene	511.591	23.820	118	535.529
34	108-88-3	Toluene	1.170.358	34.584	616	1.205.558
34	584-84-9	Toluene-2,4-Diisocyanate	322	923	0	1.244
34	79-01-6	Trichloroethylene	625.935	9.519	88	635.542
34	51-79-6	Urethane	194	628	0	823
34	108-05-4	Vinyl Acetate	112	0	0	112
34	75-01-4	Vinyl Chloride	47	500	0	547
34	1330-20-7	Xylene (Mixed Isomers)	2.605.066	69.535	325	2.674.926
34	7440-66-6	Zinc (Fume Or Dust)	5.008	3.656	322	8.986
34	N982	Zinc Compounds	7.587	102.040	15.936	125.564

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
35	71-55-6	1,1,1-Trichloroethane	378.102	11.178	115	389.396
35	120-82-1	1,2,4-Trichlorobenzene	0	3	0	3
35	95-63-6	1,2,4-Trimethylbenzene	947	22	0	969
35	107-06-2	1,2-Dichloroethane	269	14	0	283
35	123-91-1	1,4-Dioxane	1.756	8	0	1.764
35	78-93-3	2-Butanone (Methyl Ethyl Ketone)	178.012	6.759	21	184.792
35	110-80-5	2-Ethoxyethanol	3.166	72	0	3.239
35	109-86-4	2-Methoxyethanol	197	0	0	197
35	67-64-1	Acetone	256.063	15.756	30	271.849
35	107-13-1	Acrylonitrile	11	0	0	11
35	7429-90-5	Aluminum (Fume Or Dust)	1.057	12.408	36	13.500
35	7664-41-7	Ammonia	5.487	219	10	5.716
35	6484-52-2	Ammonium Nitrate (Solution)	5	0	0	5
35	62-53-3	Aniline	5	0	21	26
35	7440-36-0	Antimony	3	5	3	11
35	7440-38-2	Arsenic	0	0	3	3
35	1332-21-4	Asbestos (Friable)	74	28.404	0	28.478
35	7440-39-3	Barium	1.398	28.269	1.010	30.677
35	71-43-2	Benzene	1.195	57	3	1.255
35	141-32-2	Butyl Acrylate	156	11	0	167
35	85-68-7	Butyl Benzyl Phthalate	301	217	0	518
35	7440-43-9	Cadmium	56	201	53	310
35	N230	Certain Glycol Ethers	116.149	4.603	421	121.172
35	7782-50-5	Chlorine	441	253	312	1.005
35	108-90-7	Chlorobenzene	3	0	0	3
35	67-66-3	Chloroform	143	0	0	143
35	18540-29-9	Chromium (VI)	1.136	15.061	4.941	21.138
35	7440-48-4	Cobalt	19	45	35	100
35	7440-50-8	Copper	539	7.352	463	8.354
35	98-82-8	Cumene	5	0	0	5
35	80-15-9	Cumene Hydroperoxide	9	0	0	9
35	N106	Cyanide Compounds	26	214	1	241
35	110-82-7	Cyclohexane	134	19	0	153
35	117-81-7	Di(2-Ethylhexyl) Phthalate	863	547	0	1.411
35	84-74-2	Dibutyl Phthalate	536	99	0	634
35	75-09-2	Dichloromethane	78.074	1.820	299	80.193
35	111-42-2	Diethanolamine	160	440	297	898
35	84-66-2	Diethyl Phthalate	151	0	0	151
35	131-11-3	Dimethyl Phthalate	740	3	0	743
35	100-41-4	Ethylbenzene	23.565	1.207	4	24.776
35	74-85-1	Ethylene	0	0	0	0
35	107-21-1	Ethylene Glycol	2.434	2.952	193	5.579
35	50-00-0	Formaldehyde	392	5	0	397
35	76-13-1	Freon 113	125.522	2.581	5	128.109
35	302-01-2	Hydrazine	6	0	0	6
35	7647-01-0	Hydrochloric Acid	24.040	103	524	24.667
35	7664-39-3	Hydrogen Fluoride	534	1	0	535
35	67-63-0	Isopropyl Alcohol	7.609	402	0	8.011
35	7439-92-1	Lead	427	9.573	784	10.784
35	7439-96-5	Manganese	1.257	6.005	659	7.921

CNAE Code	CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
			Air	Land	Water	Total
35	7439-97-6	Mercury	0	0	3	3
35	67-56-1	Methanol	53.670	1.043	34	54.747
35	108-10-1	Methyl Isobutyl Ketone	91.890	2.273	45	94.208
35	624-83-9	Methyl Isocyanate	5	44	0	49
35	80-62-6	Methyl Methacrylate	1.138	8	0	1.146
35	1634-04-4	Methyl Tert-Butyl Ether	470	22	0	492
35	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	1.111	2.559	0	3.670
35	NA	Mixture	274	562	0	836
35	91-20-3	Naphthalene	2.081	58	1	2.140
35	71-36-3	N-Butyl Alcohol	109.498	2.668	40	112.206
35	117-84-0	N-Dioctyl Phthalate	4.482	0	0	4.482
35	7440-02-0	Nickel	162	1.966	391	2.518
35	7697-37-2	Nitric Acid	2.520	1.451	1.589	5.561
35	55-63-0	Nitroglycerin	0	234	0	234
35	108-95-2	Phenol	1.464	812	3	2.280
35	7664-38-2	Phosphoric Acid	318	617	214	1.148
35	7723-14-0	Phosphorus (Yellow Or White)	0	713	0	713
35	1336-36-3	Polychlorinated Biphenyls	0	3	0	3
35	115-07-1	Propylene	42	0	0	42
35	75-56-9	Propylene Oxide	4	0	0	4
35	7440-22-4	Silver	5	0	3	8
35	100-42-5	Styrene	141.342	4.031	3	145.376
35	7664-93-9	Sulfuric Acid	1.899	1.354	8.256	11.510
35	127-18-4	Tetrachloroethylene	91.740	4.271	21	96.033
35	108-88-3	Toluene	209.872	6.202	110	216.184
35	584-84-9	Toluene-2,4-Diisocyanate	58	165	0	223
35	79-01-6	Trichloroethylene	112.244	1.707	16	113.967
35	51-79-6	Urethane	35	113	0	148
35	108-05-4	Vinyl Acetate	20	0	0	20
35	75-01-4	Vinyl Chloride	8	90	0	98
35	1330-20-7	Xylene (Mixed Isomers)	467.147	12.469	58	479.675
35	7440-66-6	Zinc (Fume Or Dust)	898	656	58	1.611
35	N982	Zinc Compounds	1.361	18.298	2.858	22.516

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
36	71-55-6	1,1,1-Trichloroethane	242.402	2.888	17	245.308
36	95-63-6	1,2,4-Trimethylbenzene	11.660	0	0	11.660
36	542-75-6	1,3-Dichloropropylene	435	231	0	665
36	78-93-3	2-Butanone (Methyl Ethyl Ketone)	410.033	8.766	17	418.816
36	110-80-5	2-Ethoxyethanol	1.117	0	0	1.117
36	67-64-1	Acetone	367.288	11.828	0	379.116
36	7429-90-5	Aluminum (Fume Or Dust)	18	0	0	18
36	7664-41-7	Ammonia	1.341	0	0	1.341
36	7440-39-3	Barium	34	52	52	137
36	71-43-2	Benzene	34	0	0	34
36	85-68-7	Butyl Benzyl Phthalate	39	17	0	56
36	N230	Certain Glycol Ethers	96.255	804	93	97.152
36	126-99-8	Chloroprene	17	0	0	17
36	18540-29-9	Chromium (VI)	103	18	52	173
36	7440-48-4	Cobalt	34	17	0	52
36	7440-50-8	Copper	825	69	86	980
36	98-82-8	Cumene	17	0	0	17
36	N106	Cyanide Compounds	17	17	0	34
36	110-82-7	Cyclohexane	2.465	0	0	2.465
36	117-81-7	Di(2-Ethylhexyl) Phthalate	20.362	258	0	20.620
36	84-74-2	Dibutyl Phthalate	34	17	0	52
36	75-09-2	Dichloromethane	31.363	2.328	0	33.691
36	111-42-2	Diethanolamine	69	17	0	86
36	100-41-4	Ethylbenzene	16.914	830	0	17.744
36	107-21-1	Ethylene Glycol	1.179	911	0	2.091
36	50-00-0	Formaldehyde	7.902	10.477	0	18.379
36	76-13-1	Freon 113	52	17	0	69
36	7647-01-0	Hydrochloric Acid	323	0	0	323
36	67-63-0	Isopropyl Alcohol	32.187	705	0	32.892
36	7439-92-1	Lead	40	18	17	75
36	108-31-6	Maleic Anhydride	1	288	0	289
36	7439-96-5	Manganese	194	25	17	237
36	67-56-1	Methanol	744.517	9.069	17	753.603
36	108-10-1	Methyl Isobutyl Ketone	167.436	1.198	0	168.635
36	101-68-8	Methylene Bisphenyl Isocyanate (MDI).	69	34	0	103
36	NA	Mixture	3.523	0	0	3.523
36	91-20-3	Naphthalene	5.730	103	0	5.833
36	71-36-3	N-Butyl Alcohol	194.070	659	0	194.729
36	7440-02-0	Nickel	86	2.576	768	3.430
36	7697-37-2	Nitric Acid	1.461	88	0	1.549
36	108-95-2	Phenol	0	91	0	91
36	7664-38-2	Phosphoric Acid	438	182	0	620
36	7723-14-0	Phosphorus (Yellow Or White)	17	0	0	17
36	115-07-1	Propylene	223	0	0	223
36	75-56-9	Propylene Oxide	19	0	0	19
36	100-42-5	Styrene	11.308	0	0	11.308
36	7664-93-9	Sulfuric Acid	351	0	0	351
36	127-18-4	Tetrachloroethylene	5.418	0	0	5.418
36	108-88-3	Toluene	1.325.016	28.126	17	1.353.159
36	584-84-9	Toluene-2,4-Diisocyanate	256	0	0	256

CNAE Code	CAS Number	Analyte	São Paulo Releases (lb/yr)			
			Air	Land	Water	Total
36	79-01-6	Trichloroethylene	20.713	204	0	20.917
36	N770	Vanadium (Except When Contained In An Alloy)	17	0	0	17
36	108-05-4	Vinyl Acetate	4	0	0	4
36	1330-20-7	Xylene (Mixed Isomers)	869.311	6.926	17	876.254
36	7440-66-6	Zinc (Fume Or Dust)	54	17	120	191
36	N982	Zinc Compounds	781	86	565	1.433

Table 2-6 - Estimated São Paulo Industrial Releases

CAS Number	Analyte	São Paulo Releases (lb/yr)			
		Air	Land	Water	Total
71-55-6	1,1,1-Trichloroethane	10.850.711	254.796	18.717	11.124.223
79-34-5	1,1,2,2-Tetrachloroethane	3.568	1.527	573	5.668
57-14-7	1,1-Dimethyl Hydrazine	81	127	25	233
120-82-1	1,2,4-Trichlorobenzene	110.786	15.305	1.643	127.734
95-63-6	1,2,4-Trimethylbenzene	436.885	35.463	3.061	475.409
106-88-7	1,2-Butylene Oxide	11.357	3	415	11.775
106-93-4	1,2-Dibromoethane	5.957	847	520	7.325
95-50-1	1,2-Dichlorobenzene	191.601	7.807	4.849	204.257
107-06-2	1,2-Dichloroethane	388.412	4.883	133.420	526.715
540-59-0	1,2-Dichloroethylene	13.209	1.104	78	14.391
78-87-5	1,2-Dichloropropane	73.125	145	609	73.879
106-99-0	1,3-Butadiene	582.507	3.003	14.524	600.033
541-73-1	1,3-Dichlorobenzene	1.143	0	2	1.145
542-75-6	1,3-Dichloropropylene	4.932	231	34	5.196
123-91-1	1,4-Dioxane	63.413	3.653	15.082	82.148
95-95-4	2,4,5-Trichlorophenol	18	18	0	37
88-06-2	2,4,6-Trichlorophenol	12	0	263	274
94-75-7	2,4-D	514	685	10.502	11.701
95-80-7	2,4-Diaminotoluene	444	0	25	469
120-83-2	2,4-Dichlorophenol	152	0	668	821
105-67-9	2,4-Dimethylphenol	242	601	4.707	5.550
51-28-5	2,4-Dinitrophenol	960	564	46.290	47.814
121-14-2	2,4-Dinitrotoluene	1.244	19.500	1.269	22.012
606-20-2	2,6-Dinitrotoluene	8.412	5.840	1.913	16.166
87-62-7	2,6-Xylidine	4	0	191	195
78-93-3	2-Butanone (Methyl Ethyl Ketone)	10.416.607	270.360	103.333	10.790.299
110-80-5	2-Ethoxyethanol	142.693	2.517	9.628	154.838
109-86-4	2-Methoxyethanol	240.013	19.084	4.122	263.220
88-75-5	2-Nitrophenol	442	67	1	510
79-46-9	2-Nitropropane	15.908	0	23.991	39.899
90-43-7	2-Phenylphenol	807	150	38	996
91-94-1	3,3'-Dichlorobenzidine	25	734	24	784
119-90-4	3,3'-Dimethoxybenzidine	50	0	0	50
101-80-4	4,4'-Diaminodiphenyl Ether	63	25	60	148
80-05-7	4,4'-Isopropylidenediphenol	22.863	121.260	689	144.812
101-14-4	4,4'-Methylenebis(2-Chloroaniline)	54	0	0	54
101-77-9	4,4'-Methylenedianiline	4.744	13.509	9.755	28.009
534-52-1	4,6-Dinitro-O-Cresol	27	26	4.525	4.578
60-09-3	4-Aminoazobenzene	0	0	35	35
92-67-1	4-Aminobiphenyl	0	0	1	1
100-02-7	4-Nitrophenol	777	4	180	961
99-59-2	5-Nitro-O-Anisidine	50	0	0	50
75-07-0	Acetaldehyde	741.872	3.139	202.907	947.917
60-35-5	Acetamide	0	0	25	25
67-64-1	Acetone	17.664.457	720.686	581.629	18.966.772
75-05-8	Acetonitrile	159.724	18.708	1.817.076	1.995.508
107-02-8	Acrolein	2.038	8	6.781	8.826
79-06-1	Acrylamide	2.534	12.585	444.950	460.070

CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
		Air	Land	Water	Total
79-10-7	Acrylic Acid	35.342	10.550	1.878.625	1.924.517
107-13-1	Acrylonitrile	471.769	6.578	581.884	1.060.231
107-05-1	Allyl Chloride	18.016	34	227	18.276
134-32-7	Alpha-Naphthylamine	67	0	0	67
7429-90-5	Aluminum (Fume Or Dust)	314.235	5.422.478	430.817	6.167.529
7664-41-7	Ammonia	23.986.481	726.127	11.512.013	36.224.621
6484-52-2	Ammonium Nitrate (Solution)	323.929	473.935	5.686.558	6.484.423
7783-20-2	Ammonium Sulfate (Solution)	60.763	750.982	53.306.439	54.118.184
62-53-3	Aniline	46.586	34.529	330.485	411.600
120-12-7	Anthracene	5.735	7.565	166	13.466
7440-36-0	Antimony	12.935	227.031	16.933	256.899
7440-38-2	Arsenic	14.205	323.260	228.575	566.039
1332-21-4	Asbestos (Friable)	3.036	641.018	944	644.998
7440-39-3	Barium	87.439	1.805.706	255.904	2.149.049
98-87-3	Benzal Chloride	547	0	0	547
55-21-0	Benzamide	50	75	50	175
71-43-2	Benzene	2.338.700	21.159	93.843	2.453.701
98-07-7	Benzoic Trichloride	2.534	262	0	2.796
98-88-4	Benzoyl Chloride	3.516	593	16.862	20.972
94-36-0	Benzoyl Peroxide	212	2.779	100	3.092
100-44-7	Benzyl Chloride	2.668	121	65	2.855
7440-41-7	Beryllium	161	4.309	375	4.845
92-52-4	Biphenyl	108.158	17.833	12.680	138.671
108-60-1	Bis(2-Chloro-1-Methylethyl) Ether	1.094	0	1.203	2.297
111-44-4	Bis(2-Chloroethyl) Ether	490	0	156	646
103-23-1	Bis(2-Ethylhexyl) Adipate	6.520	22.179	248	28.946
74-83-9	Bromomethane	293.736	0	6.669	300.405
141-32-2	Butyl Acrylate	23.910	1.198	666	25.774
85-68-7	Butyl Benzyl Phthalate	17.215	42.027	178	59.420
123-72-8	Butyraldehyde	162.112	21.689	1.212	185.013
569-64-2	C.I. Basic Green 4	75	17	17	110
989-38-8	C.I. Basic Red 1	25	0	0	25
1937-37-7	C.I. Direct Black 38	15	8	0	23
2832-40-8	C.I. Disperse Yellow 3	37	31	88	157
81-88-9	C.I. Food Red 15	25	0	0	25
842-07-9	C.I. Solvent Yellow 14	50	25	0	75
7440-43-9	Cadmium	8.738	50.173	17.751	76.661
156-62-7	Calcium Cyanamide	1.265	361	0	1.626
133-06-2	Captan	2.503	1.496	702	4.701
63-25-2	Carbaryl	1.011	4.107	151	5.269
75-15-0	Carbon Disulfide	10.083.666	112	2.309	10.086.087
56-23-5	Carbon Tetrachloride	344.464	2.367	14.110	360.941
463-58-1	Carbonyl Sulfide	2.375.785	0	0	2.375.785
120-80-9	Catechol	349	6.125	23.476	29.950
N230	Certain Glycol Ethers	2.810.372	113.336	71.097	2.994.806
57-74-9	Chlordane	376	0	0	377
7782-50-5	Chlorine	9.087.421	98.904	262.297	9.448.623
10049-04-4	Chlorine Dioxide	417.656	0	88	417.744
79-11-8	Chloroacetic Acid	2.466	361	51	2.877
108-90-7	Chlorobenzene	404.711	2.472	14.605	421.788

CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
		Air	Land	Water	Total
75-00-3	Chloroethane	525.503	382	7.208	533.093
67-66-3	Chloroform	1.917.181	8.621	93.977	2.019.780
74-87-3	Chloromethane	984.894	258	30.672	1.015.824
107-30-2	Chloromethyl Methyl Ether	324	0	0	324
N084	Chlorophenols	440	1	13.822	14.263
126-99-8	Chloroprene	179.330	3.508	15.859	198.697
1897-45-6	Chlorothalonil	2.957	30.194	974	34.125
18540-29-9	Chromium (VI)	145.845	2.362.199	2.714.603	5.222.646
7440-48-4	Cobalt	7.437	40.509	12.176	60.121
7440-50-8	Copper	208.450	3.191.943	495.987	3.896.379
1319-77-3	Cresol (Mixed Isomers)	93.221	78.243	215.280	386.744
98-82-8	Cumene	455.989	3.957	4.136	464.082
80-15-9	Cumene Hydroperoxide	10.495	187	47.893	58.575
135-20-6	Cupferron	150	0	3	154
N106	Cyanide Compounds	155.649	42.076	816.622	1.014.346
110-82-7	Cyclohexane	1.713.555	13.280	41.566	1.768.401
1163-19-5	Decabromodiphenyl Oxide	4.672	75.093	367	80.132
117-81-7	Di(2-Ethylhexyl) Phthalate	93.276	153.610	368	247.253
615-05-4	Diaminoanisole, 2,4- (Sulfate)	25	0	0	25
25376-45-8	Diaminotoluene (Mixed Isomers)	1.927	25.822	9.731	37.481
132-64-9	Dibenzofuran	3.582	4.240	31	7.852
84-74-2	Dibutyl Phthalate	18.295	12.573	31.173	62.041
25321-22-6	Dichlorobenzene (Mixed Isomers)	9.638	118	25	9.781
75-09-2	Dichloromethane	9.837.899	94.155	226.367	10.158.421
62-73-7	Dichlorvos	108	422	0	530
115-32-2	Dicofol	133	154	1.219	1.506
111-42-2	Diethanolamine	41.868	33.426	102.450	177.744
84-66-2	Diethyl Phthalate	6.874	1.089	920	8.883
64-67-5	Diethyl Sulfate	874	25	0	899
131-11-3	Dimethyl Phthalate	16.900	4.098	189	21.188
77-78-1	Dimethyl Sulfate	1.386	5	50	1.441
106-89-8	Epichlorohydrin	71.210	341	20.970	92.521
140-88-5	Ethyl Acrylate	19.232	1.287	122	20.641
541-41-3	Ethyl Chloroformate	866	0	0	866
100-41-4	Ethylbenzene	814.173	54.320	16.760	885.253
74-85-1	Ethylene	4.569.346	1.377	3.367	4.574.090
107-21-1	Ethylene Glycol	1.143.146	360.312	1.405.203	2.908.660
75-21-8	Ethylene Oxide	235.318	6.377	2.174	243.869
96-45-7	Ethylene Thiourea	69	2.278	0	2.347
151-56-4	Ethyleneimine	41	0	0	41
2164-17-2	Fluometuron	54	32	75	161
50-00-0	Formaldehyde	830.211	48.901	919.470	1.798.582
76-13-1	Freon 113	3.092.970	54.239	2.023	3.149.233
76-44-8	Heptachlor	342	0	0	342
87-68-3	Hexachloro-1,3-Butadiene	464	2.641	95	3.200
118-74-1	Hexachlorobenzene	445	101.072	105	101.622
77-47-4	Hexachlorocyclopentadiene	8.938	121	26	9.085
67-72-1	Hexachloroethane	1.590	110	119	1.819
302-01-2	Hydrazine	3.277	249	955	4.481
10034-93-2	Hydrazine Sulfate	0	0	7.715	7.715

CAS Number	Analyte	São Paulo Releases (lb/yr)			
		Air	Land	Water	Total
7647-01-0	Hydrochloric Acid	5.995.337	1.682.227	27.794.309	35.471.873
7664-39-3	Hydrogen Fluoride	974.756	60.769	19.967	1.055.492
123-31-9	Hydroquinone	685	871	35.829	37.385
78-84-2	Isobutyraldehyde	58.574	0	205	58.779
67-63-0	Isopropyl Alcohol	298.369	9.546	1.570	309.485
7439-92-1	Lead	160.703	3.009.845	205.432	3.375.980
58-89-9	Lindane	79	57	0	135
108-31-6	Maleic Anhydride	46.693	23.187	358	70.238
12427-38-2	Maneb	153	1.528	75	1.756
7439-96-5	Manganese	242.934	8.608.613	1.995.244	10.846.791
7439-97-6	Mercury	2.306	15.090	320	17.716
67-56-1	Methanol	17.790.397	948.403	4.091.321	22.830.120
72-43-5	Methoxychlor	54	50	25	129
96-33-3	Methyl Acrylate	19.294	645	137	20.076
60-34-4	Methyl Hydrazine	7	50	0	57
74-88-4	Methyl Iodide	2.554	25	510	3.089
108-10-1	Methyl Isobutyl Ketone	2.409.947	65.762	56.330	2.532.038
624-83-9	Methyl Isocyanate	1.468	1.020	0	2.489
80-62-6	Methyl Methacrylate	309.901	17.882	22.666	350.449
1634-04-4	Methyl Tert-Butyl Ether	327.862	485	5.533	333.880
101-68-8	Methylene Bisphenyl Isocyanate (MDI)	22.030	100.537	42	122.610
74-95-3	Methylene Bromide	3.646	0	0	3.646
90-94-8	Michler's Ketone	15	0	0	15
NA	Mixture	401.177	275.446	3.710	680.333
1313-27-5	Molybdenum Trioxide	8.770	90.562	26.825	126.157
121-69-7	N,N-Dimethylaniline	9.115	401	797	10.313
91-20-3	Naphthalene	269.279	93.630	17.205	380.114
71-36-3	N-Butyl Alcohol	2.443.168	54.459	355.406	2.853.033
117-84-0	N-Dioctyl Phthalate	40.186	4.599	279	45.065
7440-02-0	Nickel	18.466	527.708	255.223	801.397
7697-37-2	Nitric Acid	356.841	283.298	3.223.060	3.863.200
139-13-9	Nitrilotriacetic Acid	251	511	511	1.273
98-95-3	Nitrobenzene	3.957	2.795	55.811	62.564
55-63-0	Nitroglycerin	3.377	1.540	913	5.830
86-30-6	N-Nitrosodiphenylamine	2	19	4.262	4.283
90-04-0	O-Anisidine	205	125	729	1.059
95-53-4	O-Toluidine	2.576	100	483	3.159
104-94-9	P-Anisidine	0	0	25	25
56-38-2	Parathion	160	167	32	358
120-71-8	P-Cresidine	222	757	25	1.004
87-86-5	Pentachlorophenol	272	264	59	595
79-21-0	Peracetic Acid	938	0	4	942
108-95-2	Phenol	666.201	147.979	480.405	1.294.586
75-44-5	Phosgene	828	0	50	879
7664-38-2	Phosphoric Acid	152.689	3.417.026	4.664.503	8.234.217
7723-14-0	Phosphorus (Yellow Or White)	1.041	335.415	129	336.586
85-44-9	Phthalic Anhydride	64.115	145.995	97	210.207
88-89-1	Picric Acid	25	28	126.889	126.942
1336-36-3	Polychlorinated Biphenyls	0	26.203	27	26.229
106-50-3	P-Phenylenediamine	409	531	311	1.251

CAS Number	Analyte	Sao Paulo Releases (lb/yr)			
		Air	Land	Water	Total
123-38-6	Propionaldehyde	109.521	0	494	110.016
114-26-1	Propoxur	25	152	0	178
115-07-1	Propylene	2.933.426	44	76	2.933.546
75-56-9	Propylene Oxide	236.088	1.062	35.410	272.560
75-55-8	Propyleneimine	54	0	0	54
110-86-1	Pyridine	14.662	770	66.306	81.738
91-22-5	Quinoline	2.865	601	1	3.467
106-51-4	Quinone	176	0	1	178
82-68-8	Quintozene	205	29	0	233
81-07-2	Saccharin	95	428	0	523
7782-49-2	Selenium	1.707	2.581	15.088	19.376
7440-22-4	Silver	827	1.731	441	2.998
100-42-5	Styrene	3.094.054	236.496	7.329	3.337.879
96-09-3	Styrene Oxide	203	0	0	203
7664-93-9	Sulfuric Acid	1.979.011	1.645.791	16.864.996	20.489.798
100-21-0	Terephthalic Acid	63.397	258.299	5.010	326.706
127-18-4	Tetrachloroethylene	1.708.332	54.855	10.598	1.773.785
961-11-5	Tetrachlorvinphos	44	821	0	864
7440-28-0	Thallium	87	59	59	204
62-56-6	Thiourea	281	324	72	677
1314-20-1	Thorium Dioxide	78	5.705	0	5.783
7550-45-0	Titanium Tetrachloride	5.708	691	0	6.399
108-88-3	Toluene	18.912.566	571.928	203.085	19.687.580
584-84-9	Toluene-2,4-Diisocyanate	13.649	5.018	0	18.667
52-68-6	Trichlorfon	26	96	0	123
79-01-6	Trichloroethylene	2.754.545	61.532	1.286	2.817.363
1582-09-8	Trifluralin	309	3.391	107	3.807
51-79-6	Urethane	307	741	0	1.048
N770	Vanadium (Except When Contained In An Alloy)	723	3.743	278	4.744
108-05-4	Vinyl Acetate	561.791	4.143	130.512	696.446
593-60-2	Vinyl Bromide	77	0	27	104
75-01-4	Vinyl Chloride	136.634	1.474	566	138.674
75-35-4	Vinylidene Chloride	22.357	686	340	23.383
1330-20-7	Xylene (Mixed Isomers)	10.951.665	403.229	79.641	11.434.534
7440-66-6	Zinc (Fume Or Dust)	210.238	3.260.496	213.429	3.684.163
N982	Zinc Compounds	343.795	10.196.674	750.250	11.290.720

Table 2-7 - CAS Number Cross Reference

CASNumber	Analyte
100-02-7	4-Nitrophenol
100-21-0	Terephthalic Acid
10034-93-2	Hydrazine Sulfate
100-41-4	Ethylbenzene
100-42-5	Styrene
100-44-7	Benzyl Chloride
10049-04-4	Chlorine Dioxide
101-14-4	4,4'-Methylenebis(2-Chloroaniline)
101-68-8	Methylene Bisphenyl Isocyanate (MDI).
101-77-9	4,4'-Methylenedianiline
101-80-4	4,4'-Diaminodiphenyl Ether
103-23-1	Bis(2-Ethylhexyl) Adipate
104-94-9	P-Anisidine
105-67-9	2,4-Dimethylphenol
106-50-3	P-Phenylenediamine
106-51-4	Quinone
106-88-7	1,2-Butylene Oxide
106-89-8	Epichlorohydrin
106-93-4	1,2-Dibromoethane
106-99-0	1,3-Butadiene
107-02-8	Acrolein
107-05-1	Allyl Chloride
107-06-2	1,2-Dichloroethane
107-13-1	Acrylonitrile
107-21-1	Ethylene Glycol
107-30-2	Chloromethyl Methyl Ether
108-05-4	Vinyl Acetate
108-10-1	Methyl Isobutyl Ketone
108-31-6	Maleic Anhydride
108-60-1	Bis(2-Chloro-1-Methylethyl) Ether
108-88-3	Toluene
108-90-7	Chlorobenzene
108-95-2	Phenol
109-86-4	2-Methoxyethanol
110-80-5	2-Ethoxyethanol
110-82-7	Cyclohexane
110-86-1	Pyridine
111-42-2	Diethanolamine
111-44-4	Bis(2-Chloroethyl) Ether
114-26-1	Propoxur
115-07-1	Propylene
115-32-2	Dicofol
1163-19-5	Decabromodiphenyl Oxide
117-81-7	Di(2-Ethylhexyl) Phthalate
117-84-0	N-Dioctyl Phthalate
118-74-1	Hexachlorobenzene
119-90-4	3,3'-Dimethoxybenzidine
119-93-7	3,3'-Dimethylbenzidine
120-12-7	Anthracene

CASNumber	Analyte
120-71-8	P-Cresidine
120-80-9	Catechol
120-82-1	1,2,4-Trichlorobenzene
120-83-2	2,4-Dichlorophenol
121-14-2	2,4-Dinitrotoluene
121-69-7	N,N-Dimethylaniline
123-31-9	Hydroquinone
123-38-6	Propionaldehyde
123-72-8	Butyraldehyde
123-91-1	1,4-Dioxane
12427-38-2	Maneb
126-99-8	Chloroprene
127-18-4	Tetrachloroethylene
131-11-3	Dimethyl Phthalate
1313-27-5	Molybdenum Trioxide
1314-20-1	Thorium Dioxide
1319-77-3	Cresol (Mixed Isomers)
132-64-9	Dibenzofuran
1330-20-7	Xylene (Mixed Isomers)
133-06-2	Captan
1332-21-4	Asbestos (Friable)
1336-36-3	Polychlorinated Biphenyls
134-32-7	Alpha-Naphthylamine
135-20-6	Cupferron
139-13-9	Nitrilotriacetic Acid
140-88-5	Ethyl Acrylate
141-32-2	Butyl Acrylate
151-56-4	Ethyleneimine
156-62-7	Calcium Cyanamide
1582-09-8	Trifluralin
1634-04-4	Methyl Tert-Butyl Ether
18540-29-9	Chromium (VI)
1897-45-6	Chlorothalonil
1937-37-7	C.I. Direct Black 38
2164-17-2	Fluometuron
25321-22-6	Dichlorobenzene (Mixed Isomers)
25376-45-8	Diaminotoluene (Mixed Isomers)
2832-40-8	C.I. Disperse Yellow 3
302-01-2	Hydrazine
3118-97-6	C.I. Solvent Orange 7
39156-41-7	2,4-Diaminoanisole Sulfate
463-58-1	Carbonyl Sulfide
50-00-0	Formaldehyde
51-28-5	2,4-Dinitrophenol
51-79-6	Urethane
52-68-6	Trichlorfon
534-52-1	4,6-Dinitro-O-Cresol
540-59-0	1,2-Dichloroethylene
541-41-3	Ethyl Chloroformate
541-73-1	1,3-Dichlorobenzene
542-75-6	1,3-Dichloropropylene

CASNumber	Analyte
542-88-1	Bis(Chloromethyl) Ether
55-21-0	Benzamide
55-63-0	Nitroglycerin
56-23-5	Carbon Tetrachloride
56-38-2	Parathion
569-64-2	C.I. Basic Green 4
57-14-7	1,1-Dimethyl Hydrazine
57-74-9	Chlordane
584-84-9	Toluene-2,4-Diisocyanate
58-89-9	Lindane
593-60-2	Vinyl Bromide
60-09-3	4-Aminoazobenzene
60-34-4	Methyl Hydrazine
60-35-5	Acetamide
606-20-2	2,6-Dinitrotoluene
615-05-4	Diaminoanisole, 2,4- (Sulfate)
624-83-9	Methyl Isocyanate
62-53-3	Aniline
62-56-6	Thiourea
62-73-7	Dichlorvos
62-75-9	Nitrosodimethylamine, N-
63-25-2	Carbaryl
64-67-5	Diethyl Sulfate
6484-52-2	Ammonium Nitrate (Solution)
67-56-1	Methanol
67-63-0	Isopropyl Alcohol
67-64-1	Acetone
67-66-3	Chloroform
67-72-1	Hexachloroethane
71-36-3	N-Butyl Alcohol
71-43-2	Benzene
71-55-6	1,1,1-Trichloroethane
72-43-5	Methoxychlor
7429-90-5	Aluminum (Fume Or Dust)
7439-92-1	Lead
7439-96-5	Manganese
7439-97-6	Mercury
7440-02-0	Nickel
7440-22-4	Silver
7440-28-0	Thallium
7440-36-0	Antimony
7440-38-2	Arsenic
7440-39-3	Barium
7440-41-7	Beryllium
7440-43-9	Cadmium
7440-48-4	Cobalt
7440-50-8	Copper
7440-66-6	Zinc (Fume Or Dust)
74-83-9	Bromomethane
74-85-1	Ethylene
74-87-3	Chloromethane

CASNumber	Analyte
74-88-4	Methyl Iodide
74-95-3	Methylene Bromide
75-00-3	Chloroethane
75-01-4	Vinyl Chloride
75-05-8	Acetonitrile
75-07-0	Acetaldehyde
75-09-2	Dichloromethane
75-15-0	Carbon Disulfide
75-21-8	Ethylene Oxide
75-25-2	Bromoform
75-35-4	Vinylidene Chloride
75-44-5	Phosgene
7550-45-0	Titanium Tetrachloride
75-55-8	Propyleneimine
75-56-9	Propylene Oxide
76-13-1	Freon 113
76-44-8	Heptachlor
7647-01-0	Hydrochloric Acid
7664-38-2	Phosphoric Acid
7664-39-3	Hydrogen Fluoride
7664-41-7	Ammonia
7664-93-9	Sulfuric Acid
7697-37-2	Nitric Acid
7723-14-0	Phosphorus (Yellow Or White)
77-47-4	Hexachlorocyclopentadiene
77-78-1	Dimethyl Sulfate
7782-49-2	Selenium
7782-50-5	Chlorine
7783-20-2	Ammonium Sulfate (Solution)
78-84-2	Isobutyraldehyde
78-87-5	1,2-Dichloropropane
78-93-3	2-Butanone (Methyl Ethyl Ketone)
79-01-6	Trichloroethylene
79-06-1	Acrylamide
79-10-7	Acrylic Acid
79-11-8	Chloroacetic Acid
79-21-0	Peracetic Acid
79-34-5	1,1,2,2-Tetrachloroethane
79-46-9	2-Nitropropane
80-05-7	4,4'-Isopropylidenediphenol
80-15-9	Cumene Hydroperoxide
80-62-6	Methyl Methacrylate
81-07-2	Saccharin
81-88-9	C.I. Food Red 15
82-68-8	Quintozene
842-07-9	C.I. Solvent Yellow 14
84-66-2	Diethyl Phthalate
84-74-2	Dibutyl Phthalate
85-44-9	Phthalic Anhydride
85-68-7	Butyl Benzyl Phthalate
86-30-6	N-Nitrosodiphenylamine

CASNumber	Analyte
87-62-7	2,6-Xylidine
87-68-3	Hexachloro-1,3-Butadiene
87-86-5	Pentachlorophenol
88-06-2	2,4,6-Trichlorophenol
88-75-5	2-Nitrophenol
88-89-1	Picric Acid
90-04-0	O-Anisidine
90-43-7	2-Phenylphenol
90-94-8	Michler's Ketone
91-20-3	Naphthalene
91-22-5	Quinoline
91-94-1	3,3'-Dichlorobenzidine
92-52-4	Biphenyl
92-67-1	4-Aminobiphenyl
94-36-0	Benzoyl Peroxide
94-59-7	Safrole
94-75-7	2,4-D
95-50-1	1,2-Dichlorobenzene
95-53-4	O-Toluidine
95-63-6	1,2,4-Trimethylbenzene
95-80-7	2,4-Diaminotoluene
95-95-4	2,4,5-Trichlorophenol
96-09-3	Styrene Oxide
961-11-5	Tetrachlorvinphos
96-33-3	Methyl Acrylate
96-45-7	Ethylene Thiourea
97-56-3	C.I. Solvent Yellow 3
98-07-7	Benzoic Trichloride
98-82-8	Cumene
98-87-3	Benzal Chloride
98-88-4	Benzoyl Chloride
989-38-8	C.I. Basic Red 1
98-95-3	Nitrobenzene
99-59-2	5-Nitro-O-Anisidine
N084	Chlorophenols
N106	Cyanide Compounds
N230	Certain Glycol Ethers
N770	Vanadium (Except When Contained In An Alloy)
N982	Zinc Compounds

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL	Soil Prevention	CONAMA Class 1	Cancer Inhalation	Cancer Oral
		(mg/m^3)	(mg/kg)	(ug/l)	(mg/kg-day)$^{-1}$	
76-11-9	1,1,1,2-Tetrachloro-2, 2-Difluoroethane.	4170				
71-55-6	1,1,1-Trichloroethane	45				
76-12-0	1,1,2,2-Tetrachloro-1, 2-Difluoroethane.	4170				
79-34-5	1,1,2,2-Tetrachloroethane	35			0,2	0,27
79-00-5	1,1,2-Trichloroethane				0,057	0,072
594-72-9	1,1-Dichloro-1- Nitroethane	60				
57-14-7	1,1-Dimethyl Hydrazine	1				
37871-00-4	1,2,3,4,6,7,8-Heptachlorodibenzo-P-Dioxin				1300	13
634-66-2	1,2,3,4-Tetrachloro-Benzene		0,16			
634-90-2	1,2,3,5-Tetrachloro-Benzene		0,0065			
87-61-6	1,2,3-Trichloro-Benzene		0,01			
96-18-4	1,2,3-Trichloropropane	300				
95-94-3	1,2,4,5-Tetrachloro-Benzene		0,01			
120-82-1	1,2,4-Trichlorobenzene		0,011	20		0,0036
96-12-8	1,2-Dibromo-3-Chloropropane	0,0097			7	7
106-93-4	1,2-Dibromoethane	154			0,25	3,6
95-50-1	1,2-Dichlorobenzene	300	0,39			
107-06-2	1,2-Dichloroethane	202,5	0,075	10	0,072	0,047
540-59-0	1,2-Dichloroethylene	790				
78-87-5	1,2-Dichloropropane	350			0,036	0,036
540-73-8	1,2-Dimethylhydrazine				550	550
122-66-7	1,2-Diphenylhydrazine				0,87	0,87
108-70-3	1,3,5-Trichloro-Benzene		0,5			
106-99-0	1,3-Butadiene	2,21			0,6	3,4
118-52-5	1,3-Dichloro-5, 5-Dimethyl Hydantoin.	0,2				
541-73-1	1,3-Dichlorobenzene		0,39			
542-75-6	1,3-Dichloropropylene				0,055	0,091
106-46-7	1,4-Dichlorobenzene				0,04	0,0054
123-91-1	1,4-Dioxane	360			0,027	0,027
555-84-0	1-[(5-Nitrofurfurylidene)-Amino]-2-Imidazolidinone				1,8	1,8
82-28-0	1-Amino-2-Methylanthraquinone				0,15	0,15
600-25-9	1-Chloro-1-Nitropropane	100				
108-03-2	1-Nitropropane.	90				
3570-75-0	2-(2-Formylhydrazino)-4-(5-Nitro-2-Furyl)Thiazole				2,3	2,3
93-76-5	2,4,5-T (2,4,5-Tri- Chlorophenoxyacetic Acid)	10		2		
95-95-4	2,4,5-Trichlorophenol		0,11			
93-72-1	2,4,5-Trichlorophenoxypropionic Acid			10		
88-06-2	2,4,6-Trichlorophenol		1,5	10	0,07	0,07
118-96-7	2,4,6-Trinitrotoluene (Tnt)	1,5				
94-75-7	2,4-D	10		4		
39156-41-7	2,4-Diaminoanisole Sulfate				0,013	0,013
95-80-7	2,4-Diaminotoluene				4	3,8
120-83-2	2,4-Dichlorophenol		0,031	0,3		
121-14-2	2,4-Dinitrotoluene				0,31	0,31
53-96-3	2-Acetylaminofluorene				3,8	3,8
712-68-5	2-Amino-5-(5-Nitro-2-Furyl)-1,3,4-Thiadiazol				16	16
504-29-0	2-Aminopyridine	2				

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m^3)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)$^{-1}$	Cancer Oral (mg/kg-day)$^{-1}$
78-93-3	2-Butanone (Methyl Ethyl Ketone)	590				
111-76-2	2-Butoxyethanol	240				
95-57-8	2-Chlorophenol		0,055			
100-37-8	2-Diethylaminoethanol	50				
110-80-5	2-Ethoxyethanol	740				
111-15-9	2-Ethoxyethyl Acetate (Cellosolve Acetate).	540				
591-78-6	2-Hexanone (Methyl N-Butyl Ketone)	410				
109-86-4	2-Methoxyethanol	80				
110-49-6	2-Methoxyethyl Acetate (Methyl Cellosolve Acetate)	120				
129-15-7	2-Methyl-1-Nitroanthraquinone (Of Uncertain Purity)				4,3	4,3
79-46-9	2-Nitropropane	90				
107-87-9	2-Pentanone (Methyl	700				
32598-13-3	3,3',4,4'-Tcb				13	13
91-94-1	3,3'-Dichlorobenzidine			0,028	1,2	1,2
6109-97-3	3-Amino-9-Ethylcarbazolehydrochloride				0,078	0,078
563-47-3	3-Chloro-2-Methyl-1-Propene				0,14	0,14
101-80-4	4,4'-Diaminodiphenyl Ether				0,14	0,14
838-88-0	4,4-Methylene Bis(2-Methylaniline)				0,92	0,92
101-61-1	4,4-Methylene Bis(N,N'-Dimethyl)Aniline				0,046	0,046
101-14-4	4,4'-Methylenebis(2-Chloroaniline)				1,5	1,5
101-77-9	4,4'-Methylenedianiline	0,081			1,6	1,6
13552-44-8	4,4-Methylenedianiline Dihydrochloride				1,2	1,2
96-69-5	4,4'-Thiobis(6-Tert, Butyl-M-Cresol)	5				
139-65-1	4,4-Thiodianiline				15	15
534-52-1	4,6-Dinitro-O-Cresol	0,2				
92-67-1	4-Aminobiphenyl				21	21
60-11-7	4-Dimethylaminoazobenzene				4,6	4,6
99-59-2	5-Nitro-O-Anisidine				0,049	0,049
26148-68-5	A-Alpha-C(2-Amino-9H-Pyrido[2,3-B]Indole)				0,4	0,4
75-07-0	Acetaldehyde	360			0,01	
60-35-5	Acetamide				0,07	0,07
64-19-7	Acetic Acid	25				
108-24-7	Acetic Anhydride.	20				
67-64-1	Acetone	2400				
75-05-8	Acetonitrile	70				
79-27-6	Acetylene Tetrabromide.	14				
532-27-4	A-Chloroacetophenone (Phenacyl Chloride)	0,3				
107-02-8	Acrolein	0,25				
79-06-1	Acrylamide	0,3		0,5	4,5	4,5
107-13-1	Acrylonitrile	4,34			1	1
50-76-0	Actinomycin D				8700	8700
3688-53-7	AF-2;[2-(2-Furyl)-3(5-Nitro-2-Furyl)]Acrylamide				0,24	0,24
15972-60-8	Alachlor			20		0,056
309-00-2	Aldrin	0,25	0,0015	0,005	17	17
107-18-6	Allyl Alcohol	5				
107-05-1	Allyl Chloride	3			0,021	0,021
106-92-3	Allyl Glycidyl Ether.	45				

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m^3)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)$^{-1}$	Cancer Oral (mg/kg-day)$^{-1}$
2179-59-1	Allyl Propyl Disulfide.	12				
98-83-9	Alpha-Methyl Styrene.	480				
7429-90-5	Aluminum (Fume Or Dust)	5		100		
117-79-3	Aminoanthraquinone, 2-				0,033	0,033
61-82-5	Amitrole				0,94	0,94
7664-41-7	Ammonia	35				
7773-06-0	Ammonium Sulfamate. Respirable Fraction	5				
62-53-3	Aniline	19			0,0057	0,0057
29191-52-4	Anisidine (O-,P-Isomers).	0,5				
120-12-7	Anthracene		0,039			
7440-36-0	Antimony	0,5	2	5		
86-88-4	ANTU (Alpha Naphthylthiourea)	0,3				
140-57-8	Aramite				0,03	0,03
7440-38-2	Arsenic	0,5	15	10	12	9,45
7784-42-1	Arsine.	0,2				
1332-21-4	Asbestos (Friable)				220	
1912-24-9	Atrazine			2		0,23
115-02-6	Azaserine				11	11
446-86-6	Azathioprine				1,8	1,8
86-50-0	Azinphos-Methyl	0,2				
103-33-3	Azobenzene				0,11	0,11
7440-39-3	Barium	0,5	150	700		
7727-43-7	Barium Sulfate. Respirable Fraction	5				
17804-35-2	Benomyl	5				
56-55-3	Benz[A]Anthracene		0,025	0,018	0,39	1,2
71-43-2	Benzene	3,19	0,03	5	0,1	0,1
92-87-5	Benzidine			0,0002	500	500
191-24-2	Benzo(G,H,I)Perylene		0,57			
50-32-8	Benzo[A]Pyrene 0.0007b		0,052	0,018	3,9	12
205-99-2	Benzo[B]Fluoranthene				0,39	1,2
205-82-3	Benzo[J]Fluoranthene				0,39	1,2
207-08-9	Benzo[K]Fluoranthene				0,39	1,2
94-36-0	Benzoyl Peroxide	5				
100-44-7	Benzyl Chloride	5			0,17	0,17
1694-09-3	Benzyl Violet 4B				0,02	0,02
7440-41-7	Beryllium	0,002		40	8,4	
1304-56-9	Beryllium Oxide				8,4	7
13510-49-1	Beryllium Sulfate				3000	3000
3068-88-0	Beta-Butyrolactone				1	1
91-59-8	Beta-Naphthylamine				1,8	1,8
57-57-8	Beta-Propiolactone				14	14
92-52-4	Biphenyl	1				
111-44-4	Bis(2-Chloroethyl) Ether	90			2,5	2,5
542-88-1	Bis(Chloromethyl) Ether				46	46
1304-82-1	Bismuth Telluride, Respirable Fraction	5				
7440-42-8	Boron 0.5 (T)			500		
1303-86-2	Boron Oxide	15				
7637-07-2	Boron Trifluoride	3				
7726-95-6	Bromine	0,7				
75-25-2	Bromoform	5				

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m^3)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)$^{-1}$	Cancer Oral (mg/kg-day)$^{-1}$
74-83-9	Bromomethane	80				
75-63-8	Bromotrifluoromethane	6100				
109-79-5	Butyl Mercaptan	35				
109-73-9	Butylamine.	15				
25013-16-5	Butylated Hydroxyanisole				0,0002	0,0002
569-61-9	C.I. Basic Red 9 Monohydrochloride				0,25	240
1937-37-7	C.I. Direct Black 38				7,4	7,4
97-56-3	C.I. Solvent Yellow 3				3,8	3,8
492-80-8	C.I. Solvent Yellow 34				0,88	0,88
7440-43-9	Cadmium	0,005	1,3	1	15	0,38
1305-62-0	Calcium Hydroxide Respirable Fraction	5				
1305-78-8	Calcium Oxide	5				
1344-95-2	Calcium Silicate.	5				
7778-18-9	Calcium Sulfate	5				
76-22-2	Camphor, Synthetic.	2				
2425-06-1	Captafol				0,15	0,15
133-06-2	Captan				0,0023	0,0023
63-25-2	Carbaryl	5		0,02		
1333-86-4	Carbon Black.	3,5				
124-38-9	Carbon Dioxide.	9000				
75-15-0	Carbon Disulfide	62				
630-08-0	Carbon Monoxide	55				
56-23-5	Carbon Tetrachloride	63	0,17	2	0,15	0,15
9004-34-6	Cellulose	5				
305-03-3	Chlorambucil				440	0,0023
57-74-9	Chlordane	0,5		0,04	1,2	1,3
143-50-0	Chlordecone (Kepone)				16	16
115-28-6	Chlorendic Acid				0,091	0,091
55720-99-5	Chlorinated Diphenyl Oxide	0,5				
7782-50-5	Chlorine	3		10		
10049-04-4	Chlorine Dioxide	0,3				
7790-91-2	Chlorine Trifluoride.	0,4				
107-20-0	Chloroacetaldehyde.	3				
108-90-7	Chlorobenzene	350	0,41			
510-15-6	Chlorobenzilate				0,11	0,11
74-97-5	Chlorobromomethane.	1050				
53469-21-9	Chlorodiphenyl (42% Chlorine)(Pcb)	1				
11097-69-1	Chlorodiphenyl (54% Chlorine)(Pcb)	0,5				
75-00-3	Chloroethane	2600				
67-66-3	Chloroform	240	1,75		0,019	0,031
74-87-3	Chloromethane	210				
107-30-2	Chloromethyl Methyl Ether				2,4	2,4
95-83-0	Chloro-O-Phenylenediamine, 4-				0,016	0,016
95-69-2	Chloro-O-Toluidine, P-				0,27	0,27
N084	Chlorophenols			0,1		
76-06-2	Chloropicrin	0,7				
126-99-8	Chloroprene	90				
1897-45-6	Chlorothalonil				0,0031	0,0031
54749-90-5	Chlorozotocin				240	240
18540-29-9	Chromium (VI)	1	75	50	510	

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m³)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)⁻¹	Cancer Oral (mg/kg-day)⁻¹
218-01-9	Chrysene		8,1	0,018	0,039	0,12
87-29-6	Cinnamyl Anthranilate				0,0046	0,0046
2971-90-6	Clopidol.	5				
65966-93-2	Coal Tar Pitch Volatiles (Benzene Soluble Fraction), Anthracene, Bap, Phenanthrene, Acridine, Chrysene, Pyrene	0,2				
7440-48-4	Cobalt	0,1	25	50		
7440-50-8	Copper	0,1	60	9		
136-78-7	Crag Herbicide (Sesone)	5				
1319-77-3	Cresol (Mixed Isomers)	22	0,16			
123-73-9	Crotonaldehyde.	6				
98-82-8	Cumene	245				
135-20-6	Cupferron				0,22	0,22
N106	Cyanide Compounds	5		5		
110-82-7	Cyclohexane	1050				
319-85-7	Cyclohexane, 1,2,3,4,5,6-Hexachloro-, (1α,2β,3α,4β,5α,6β)-		0,011		1,5	1,5
108-93-0	Cyclohexanol	200				
108-94-1	Cyclohexanone	200				
110-83-8	Cyclohexene	1015				
542-92-7	Cyclopentadiene	200				
50-18-0	Cyclophosphamide (Anhydrous)				0,61	0,61
6055-19-2	Cyclophosphamide (Hydrated)				0,57	0,57
5160-02-1	D & C Red No. 9				0,0053	0,0053
4342-03-4	Dacarbazine.				49	49
1596-84-5	Daminozide				0,018	0,018
117-10-2	Dantron				0,076	0,076
17702-41-9	Decaborane.	0,3				
8065-48-3	Demeton (Systox).	0,1				
117-81-7	Di(2-Ethylhexyl) Phthalate	5	0,6		0,0084	0,003
123-42-2	Diacetone Alcohol (4-Hydroxy-4-Methyl- 2-Pentanone).	240				
615-05-4	Diaminoanisole, 2,4- (Sulfate)				0,023	0,023
334-88-3	Diazomethane.	0,4				
226-36-8	Dibenz[A,H,]Acridine				0,39	1,2
53-70-3	Dibenz[A,H]Anthracene		0,08	0,018	4,1	4,1
224-42-0	Dibenz[A,J]Acridine				0,39	1,2
192-65-4	Dibenzo[A,E]Pyrene				3,9	12
189-64-0	Dibenzo[A,H]Pyrene				39	120
189-55-9	Dibenzo[A,I]Pyrene				39	120
191-30-0	Dibenzo[A,L]Pyrene				39	120
194-59-2	Dibenzo[C,G]Carbazole, 7H-				3,9	12
19287-45-7	Diborane.	0,1				
124-48-1	Dibromochloromethane 0.1				0,094	0,094
107-66-4	Dibutyl Phosphate	5				
84-74-2	Dibutyl Phthalate	5	0,7			
75-27-4	Dichlorobromomethane				0,13	0,13
75-71-8	Dichlorodifluoromethane	4950				
50-29-3	Dichlorodiphenyltri- Chloroethane (DDT).	1	0,01	0,002	0,34	0,34
75-43-4	Dichlorofluoromethane	4200				

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m^3)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation ($(mg/kg\text{-}day)^{-1}$)	Cancer Oral ($(mg/kg\text{-}day)^{-1}$)
75-09-2	Dichloromethane	87	0,018	20	0,0035	0,014
76-14-2	Dichlorotetrafluoroethane (FC-114)	7000				
62-73-7	Dichlorvos	1			0,29	0,41
102-54-5	Dicyclopentadienyl Iron	5				
60-57-1	Dieldrin.	0,25	0,043		16	16
109-89-7	Diethylamine.	75				
56-53-1	Diethylstilbestrol				350	350
75-61-6	Difluorodibromomethane.	860				
2238-07-5	Diglycidyl Ether (DGE).	2,8				
101-90-6	Diglycidyl Resorcinol Ether				1,7	1,7
94-58-6	Dihydrosafrole				0,044	0,044
108-83-8	Diisobutyl Ketone	290				
108-18-9	Diisopropylamine.	20				
127-19-5	Dimethyl Acetamide.	35				
131-11-3	Dimethyl Phthalate	5	0,25			
77-78-1	Dimethyl Sulfate	5				
124-40-3	Dimethylamine	18				
57-97-6	Dimethylbenz[A]Anthracene, 7,12-				250	250
79-44-7	Dimethylcarbamyl Chloride				13	13
513-37-1	Dimethylvinylchloride				0,045	0,045
42397-64-8	Dinitropyrene, 1,6-				39	120
42397-65-9	Dinitropyrene, 1,8-				3,9	12
25321-14-6	Dinitrotoluene (Mixed Isomers)	1,5				
34590-94-8	Dipropylene Glycol Methyl Ether.	600				
2602-46-2	Direct Blue 6 (Technical Grade)				7,4	7,4
16071-86-6	Direct Brown 95 (Technical Grade)				6,7	6,7
2475-45-8	Disperse Blue 1 (Technical Grade)				0,0045	0,0045
12415-34-8	Emery	5				
72-20-8	Endrin.	0,1	0,001	0,004		
106-89-8	Epichlorohydrin	19			0,08	0,08
2104-64-5	Epn	0,5				
50-28-2	Estradiol 17B				39	39
72-54-8	Ethane, 1,1-Dichloro-2,2-Bis(4-Chlorophenyl)-		0,013		0,24	0,24
141-43-5	Ethanolamine.	6				
141-78-6	Ethyl Acetate	1400				
140-88-5	Ethyl Acrylate	100				
64-17-5	Ethyl Alcohol (Ethanol)	1900				
541-85-5	Ethyl Amyl Ketone (5-Methyl-3- Heptanone).	130				
74-96-4	Ethyl Bromide	890				
106-35-4	Ethyl Butyl Ketone (3-Heptanone)	230				
60-29-7	Ethyl Ether	1200				
109-94-4	Ethyl Formate	300				
75-08-1	Ethyl Mercaptan	25				
78-10-4	Ethyl Silicate.	850				
75-04-7	Ethylamine.	18				
100-41-4	Ethylbenzene	435	6,2	90		
107-07-3	Ethylene Chlorohydrin	16				
628-96-6	Ethylene Glycol Dinitrate	1				
75-21-8	Ethylene Oxide	1,8			0,31	0,31
96-45-7	Ethylene Thiourea				0,045	0,045

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m³)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)	Cancer Oral (mg/kg-day)
107-15-3	Ethylenediamine	25				
151-56-4	Ethyleneimine				65	65
75-34-3	Ethylidene Dichloride	400			0,0057	0,0057
14484-64-1	Ferbam	15				
12604-58-9	Ferrovanadium Dust.	1				
7782-41-4	Fluorine	0,2		1400		
50-00-0	Formaldehyde	0,923			0,021	
64-18-6	Formic Acid	9				
76-13-1	Freon 113	7600				
98-01-1	Furfural.	20				
98-00-0	Furfuryl Alcohol.	200				
60568-05-0	Furmecyclox				0,03	0,03
67730-11-4	Glu-P-1 (2-Amino-6-Methyldipyrido[1,2-A:3',2'-D]Imidazole)				4,8	4,8
67730-10-3	Glu-P-2 (2-Aminodipyrido[1,2-A:3',2'-D]Indole)				1,4	1,4
56-81-5	Glycerin (Mist)	5				
556-52-5	Glycidol.	150				
7782-42-5	Graphite	5				
13397-24-5	Gypsum.	5				
16568-02-8	Gyromitrin				10	10
7440-58-6	Hafnium	0,5				
2784-94-3	Hc Blue 1				0,051	0,051
76-44-8	Heptachlor	0,5			4,1	4,1
1024-57-3	Heptachlor Epoxide				5,5	5,5
39635-31-9	Heptachlorobiphenyl, 2,3,3',4,4',5,5'- (PCB 189)				13	13
67562-39-4	Heptachlorodibenzofuran, 1,2,3,4,6,7,8-				1300	13
55673-89-7	Heptachlorodibenzofuran, 1,2,3,4,7,8,9-				1300	13
142-82-5	Heptane (N-Heptane)	2000				
118-74-1	Hexachlorobenzene		0,003		1,8	1,8
38380-08-4	Hexachlorobiphenyl, 2,3,3',4,4',5- (PCB 156)				650	650
69782-90-7	Hexachlorobiphenyl, 2,3,3',4,4',5'- (PCB 157)				650	650
52663-72-6	Hexachlorobiphenyl, 2,3',4,4',5,5'- (PCB 167)				13	13
32774-16-6	Hexachlorobiphenyl, 3,3',4,4',5,5'- (PCB 169)				13	13
608-73-1	Hexachlorocyclohexane (Technical Grade)				4	4
319-84-6	Hexachlorocyclohexane, Alpha Isomer				2,7	2,7
70648-26-9	Hexachlorodibenzofuran, 1,2,3,4,7,8-				13000	13
72918-21-9	Hexachlorodibenzofuran, 1,2,3,7,8,9-				13000	13
60851-34-5	Hexachlorodibenzofuran, 2,3,4,6,7,8-				13000	13000
34465-46-8	Hexachlorodibenzo-P-Dioxin				13000	13000
39227-28-6	Hexachlorodibenzo-P-Dioxin, 1,2,3,4,7,8-				13000	13
57653-85-7	Hexachlorodibenzo-P-Dioxin, 1,2,3,6,7,8-				13000	13
67-72-1	Hexachloroethane	10			0,039	0,039
1335-87-1	Hexachloronaphthalene	0,2				
302-01-2	Hydrazine	1,3			17	3
10034-93-2	Hydrazine Sulfate				3	3
7647-01-0	Hydrochloric Acid	7				
10035-10-6	Hydrogen Bromide.	10				
7664-39-3	Hydrogen Fluoride	2,46				

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL	Soil Prevention	CONAMA Class 1	Cancer Inhalation	Cancer Oral
		(mg/m^3)	(mg/kg)	(ug/l)	(mg/kg-day)$^{-1}$	
7722-84-1	Hydrogen Peroxide	1,4				
7785-07-5	Hydrogen Selenide	0,2				
7783-06-4	Hydrogen Sulfide (Z37.2-1966)	28				
123-31-9	Hydroquinone	2				
193-39-5	Indeno(1,2,3-C,D)Pyrene		0,031		0,39	1,2
7553-56-2	Iodine.	1				
76180-96-6	IQ (2-Amino-3-Methylimidazo-[4,5-F]Quinoline)				1,4	1,4
7439-89-6	Iron			300		
1309-37-1	Iron Oxide Fume	10				
110-19-0	Isobutyl Acetate.	700				
78-83-1	Isobutyl Alcohol.	300				
123-92-2	Isomyl Acetate.	525				
123-51-3	Isomyl Alcohol	360				
78-59-1	Isophorone.	140				
108-21-4	Isopropyl Acetate	950				
67-63-0	Isopropyl Alcohol	980				
108-20-3	Isopropyl Ether	2100				
4016-14-2	Isopropyl Glycidyl Ether (IGE)	240				
75-31-0	Isopropylamine.	12				
1332-58-7	Kaolin.	5				
463-51-4	Ketene.	0,9				
42615-29-2	Las			500		
303-34-4	Lasiocarpine				7,8	7,8
7439-92-1	Lead	0,05	72	10	0,042	0,0085
301-04-2	Lead Acetate				0,28	0,28
1335-32-6	Lead Subacetate				0,038	0,038
1317-65-3	Limestone	5				
58-89-9	Lindane	0,5	0,001	0,02	1,1	1,1
7439-93-2	Lithium			2500		
7580-67-8	Lithium Hydride	0,025				
68476-85-7	Lpg	1800				
546-93-0	Magnesite	5				
1309-48-4	Magnesium Oxide Fume.	15				
121-75-5	Malathion	15		0,1		
108-31-6	Maleic Anhydride	1				
7439-96-5	Manganese	5		100		
68006-83-7	Me-A-Alpha-C (2-Amino-3-Methyl-9H-Pyrido[2,3-B]Indole)				1,2	1,2
3223-07-2	Melphalan				130	130
7439-97-6	Mercury	0,01	0,5	0,2		
141-79-7	Mesityl Oxide	100				
67-56-1	Methanol	260				
72-43-5	Methoxychlor	15				
79-20-9	Methyl Acetate.	610				
74-99-7	Methyl Acetylene (Propyne)	1650				
96-33-3	Methyl Acrylate	35				
107-31-3	Methyl Formate.	250				
60-34-4	Methyl Hydrazine	0,35				
74-88-4	Methyl Iodide	28				

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m^3)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)[1]	Cancer Oral (mg/kg-day)[1]
110-12-3	Methyl Isoamyl Ketone	475				
108-11-2	Methyl Isobutyl Carbinol.	100				
108-10-1	Methyl Isobutyl Ketone	410				
624-83-9	Methyl Isocyanate	0,05				
74-93-1	Methyl Mercaptan.	20				
80-62-6	Methyl Methacrylate	410				
66-27-3	Methyl Methanesulfonate				0,099	0,099
110-43-0	Methyl N-Amyl Ketone.	465				
1634-04-4	Methyl Tert-Butyl Ether				0,00091	0,0018
109-87-5	Methylal (Dimethoxy-Methane)	3100				
74-89-5	Methylamine	12				
56-49-5	Methylcholanthrene, 3-				22	22
3697-24-3	Methylchrysene, 5-				3,9	12
108-87-2	Methylcyclohexane	2000				
25639-42-3	Methylcyclohexanol.	470				
101-68-8	Methylene Bisphenyl Isocyanate (MDI).	0,2				
56-04-2	Methylthiouracil				0,4	0,4
7786-34-7	Mevinphos	0,1				
90-94-8	Michler's Ketone				0,86	0,86
2385-85-5	Mirex				18	18
50-07-7	Mitomycin C				8200	8200
7439-98-7	Molybdenum (As Mo).	5	30			
315-22-0	Monocrotaline				10	10
100-61-8	Monomethyl Aniline.	9				
110-91-8	Morpholine.	70				
121-69-7	N,N-Dimethylaniline	25				
68-12-2	N,N-Dimethylformamide	30				
531-82-8	N-[4-(5-Nitro-2-Furyl)-2-Thiazolyl]-Acetamide				1,5	1,5
300-76-5	Naled	3				
628-63-7	N-Amyl Acetate.	525				
8030-30-6	Naphtha (Coal Tar).	400				
91-20-3	Naphthalene	50	0,12		0,12	
71-36-3	N-Butyl Alcohol	300				
2426-08-6	N-Butyl Glycidyl Ether (BGE)	270				
123-86-4	N-Butyl-Acetate	710				
100-74-3	N-Ethylmorpholine	94				
110-54-3	N-Hexane	1800				
7440-02-0	Nickel	1	30	25	0,91	
13463-39-3	Nickel Carbonyl (As Ni)	0,007				
12035-72-2	Nickel Subsulfide				1,7	1,7
54-11-5	Nicotine.	0,5				
1929-82-4	Nitrapyrin	5				
N511	Nitrate Compounds			10000		
7697-37-2	Nitric Acid	5				
10102-43-9	Nitric Oxide.	30				
139-13-9	Nitrilotriacetic Acid				0,0053	0,0053
18662-53-8	Nitrilotriacetic Acid, Trisodium Salt Monohydrate				0,01	0,01
NA E	Nitrite (As NO2			1000		
602-87-9	Nitroacenaphthene, 5-				0,13	0,13

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m^3)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)$^{-1}$	Cancer Oral (mg/kg-day)$^{-1}$
98-95-3	Nitrobenzene	5				
7496-02-8	Nitrochrysene, 6-				39	120
79-24-3	Nitroethane	310				
1836-75-5	Nitrofen (Technical Grade)				0,082	0,082
607-57-8	Nitrofluorene, 2-				0,039	0,12
59-87-0	Nitrofurazone				1,3	1,3
10102-44-0	Nitrogen Dioxide.	9				
7783-54-2	Nitrogen Trifluoride.	29				
55-63-0	Nitroglycerin	2				
75-52-5	Nitromethane.	250				
5522-43-0	Nitropyrene, 1-				0,39	1,2
57835-92-4	Nitropyrene, 4-				0,39	1,2
62-75-9	Nitrosodimethylamine, N-				16	16
10595-95-6	Nitrosomethylethylamine, N-				22	22
59-89-2	Nitrosomorpholine, N-				6,7	6,7
930-55-2	Nitrosopyrrolidine, N-				2,1	2,1
88-72-2	Nitrotoluene	30				
70-25-7	N-Methyl-N-Nitro-N-Nitrosoguanidine				8,3	8,3
1116-54-7	N-Nitrosodiethanolamine				2,8	2,8
55-18-5	N-Nitrosodiethylamine				36	36
924-16-3	N-Nitrosodi-N-Butylamine				11	11
621-64-7	N-Nitrosodi-N-Propylamine				7	7
86-30-6	N-Nitrosodiphenylamine				0,009	0,009
759-73-9	N-Nitroso-N-Ethylurea				27	27
684-93-5	N-Nitroso-N-Methylurea				120	120
615-53-2	N-Nitroso-N-Methylurethane				110	110
16543-55-8	N-Nitrosonornicotine				1,4	1,4
100-75-4	N-Nitrosopiperidine				9,4	9,4
109-60-4	N-Propyl Acetate.	840				
71-23-8	N-Propyl Alcohol.	500				
627-13-4	N-Propyl Nitrate.	110				
90-04-0	O-Anisidine				0,14	0,14
2698-41-1	O-Chlorobenzylidene Malononitrile	0,4				
39001-02-0	Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-				13	13
3268-87-9	Octachlorodibenzo-P-Dioxin, 1,2,3,4,6,7,8,9-				13	13
2234-13-1	Octachloronaphthalene	0,1				
111-65-9	Octane.	2350				
528-29-0	O-Dinitrobenzene	1				
8012-95-1	Oil Mist, Mineral	5				
583-60-8	O-Methylcyclohexanone	460				
134-29-2	Ortho-Anisidine Hydrochloride				0,11	0,11
20816-12-0	Osmium Tetroxide	0,002				
95-53-4	O-Toluidine	22			0,18	0,18
636-21-5	O-Toluidine Hydrochloride				0,13	0,13
144-62-7	Oxalic Acid	1				
7783-41-7	Oxygen Difluoride	0,1				
10028-15-6	Ozone	0,2				
72-55-9	P,P'-DDE		0,021		0,34	0,34
108171-26-2	Paraffins, Chlorinated				0,089	0,089

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m^3)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)$^{-1}$	Cancer Oral (mg/kg-day)$^{-1}$
4685-14-7	Paraquat, Respirable	0,5				
56-38-2	Parathion	0,1		0,04		
120-71-8	P-Cresidine				0,15	0,15
19624-22-7	Pentaborane	0,01				
32598-14-4	Pentachlorobiphenyl, 2,3,3',4,4'- (PCB 105)				13	13
74472-37-0	Pentachlorobiphenyl, 2,3,4,4',5- (PCB 114)				650	650
31508-00-6	Pentachlorobiphenyl, 2,3',4,4',5- (PCB 118)				13	13
65510-44-3	Pentachlorobiphenyl, 2',3,4,4',5'- (PCB 123)				13	13
57465-28-8	Pentachlorobiphenyl, 3,3',4,4',5- (PCB 126)				13000	13000
57117-41-6	Pentachlorodibenzofuran, 1,2,3,7,8-				6500	650
57117-31-4	Pentachlorodibenzofuran, 2,3,4,7,8-				65000	65000
40321-76-4	Pentachlorodibenzo-P-Dioxin, 1,2,3,7,8-				130000	130000
1321-64-8	Pentachloronaphthalene.	0,5				
87-86-5	Pentachlorophenol	0,5	0,16	9	0,018	0,081
115-77-5	Pentaerythritol	5				
109-66-0	Pentane	2950				
594-42-3	Perchloromethyl Mercaptan	0,8				
7616-94-6	Perchloryl Fluoride	13,5				
62-44-2	Phenacetin				0,0022	0,0022
85-01-8	Phenanthrene		3,3			
94-78-0	Phenazopyridine				0,17	0,17
136-40-3	Phenazopyridine Hydrochloride				0,15	0,15
3546-10-9	Phenesterin				150	150
50-06-6	Phenobarbital				0,46	0,46
108-95-2	Phenol	19	0,2	3		
4901-51-3	Phenol, 2,3,4,5-Tetrachloro-		0,092			
58-90-2	Phenol, 2,3,4,6-Tetrachloro-		0,011			
95-77-2	Phenol, 3,4-Dichloro-		0,051			
59-96-1	Phenoxybenzamine				3,1	3,1
63-92-3	Phenoxybenzamine Hydrochloride				2,7	2,7
101-84-8	Phenyl Ether, Vapor	7				
122-60-1	Phenyl Glycidyl Ether	60				
100-63-0	Phenylhydrazine	22				
75-44-5	Phosgene	0,4				
7803-51-2	Phosphine	0,4				
7664-38-2	Phosphoric Acid	1				
7723-14-0	Phosphorus (Yellow Or White)	0,1		20		
10026-13-8	Phosphorus Pentachloride	1				
1314-80-3	Phosphorus Pentasulfide	1				
7719-12-2	Phosphorus Trichloride.	3				
85-44-9	Phthalic Anhydride	12				
1918-02-1	Picloram	5				
88-89-1	Picric Acid	0,1				
83-26-1	Pindone (2-Pivalyl-1, 3-Indandione)	0,1				
26499-65-0	Plaster Of Paris.	5				
7440-06-4	Platinum (As Pt).	0,002				
100-01-6	P-Nitroaniline	6				
100-00-5	P-Nitrochlorobenzene.	1				
156-10-5	P-Nitrosodiphenylamine				0,022	0,022
1336-36-3	Polychlorinated Biphenyls		0,0003	0,000064	2	5

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m^3)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)$^{-1}$	Cancer Oral (mg/kg-day)$^{-1}$
3564-09-8	Ponceau 3R				0,016	0,016
3761-53-3	Ponceau Mx (D&C Red No.5)				0,0045	0,0045
65997-15-1	Portland Cement	5				
7758-01-2	Potassium Bromate				0,49	0,49
106-50-3	P-Phenylenediamine	0,1				
671-16-9	Procarbazine				14	14
366-70-1	Procarbazine Hydrochloride				12	12
74-98-6	Propane	1800				
1120-71-4	Propane Sultone				2,4	2,4
75-56-9	Propylene Oxide	240			0,013	0,24
75-55-8	Propyleneimine	5				
51-52-5	Propylthiouracil				1	1
98-51-1	P-Tert-Butyltoluene	60				
8003-34-7	Pyrethrum	5				
110-86-1	Pyridine	15				
106-51-4	Quinone	0,4				
50-55-5	Reserpine				11	11
299-84-3	Ronnel.	15				
83-79-4	Rotenone.	5				
94-59-7	Safrole				0,22	0,22
626-38-0	Sec-Amyl Acetate.	650				
105-46-4	Sec-Butyl Acetate	950				
108-84-9	Sec-Hexyl Acetate	300				
7782-49-2	Selenium	0,2	5	10		
7783-79-1	Selenium Hexafluoride (As Se)	0,4				
7440-21-3	Silicon	5				
409-21-2	Silicon Carbide	5				
7440-22-4	Silver	0,01	2	10		
122-34-9	Simazine			2		
62-74-8	Sodium Fluoroacetate.	0,05				
1310-73-2	Sodium Hydroxide.	2				
132-27-4	Sodium O-Phenylphenoxide				0,003	0,003
9005-25-8	Starch.	5				
10048-13-2	Sterigmatocystin				35	0,22
7803-52-3	Stibine	0,5				
8052-41-3	Stoddard Solvent.	2900				
18883-66-4	Streptozotocin				110	110
57-24-9	Strychnine.	0,15				
100-42-5	Styrene	426	0,2	20		
96-09-3	Styrene Oxide				0,16	0,16
57-50-1	Sucrose	5				
95-06-7	Sulfallate				0,19	0,19
7704-34-9	Sulfur			2		
7446-09-5	Sulfur Dioxide.	13				
2551-62-4	Sulfur Hexafluoride	6000				
10025-67-9	Sulfur Monochloride	6				
5714-22-7	Sulfur Pentafluoride.	0,25				
7664-93-9	Sulfuric Acid	1				
2699-79-8	Sulfuryl Fluoride	20				
7440-25-7	Tantalum, Metal And Oxide Dust.	5				

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL (mg/m^3)	Soil Prevention (mg/kg)	CONAMA Class 1 (ug/l)	Cancer Inhalation (mg/kg-day)$^{-1}$	Cancer Oral (mg/kg-day)$^{-1}$
3689-24-5	Tedp (Sulfotep)	0,2				
13494-80-9	Tellurium And Compounds (As Te)	0,1				
7783-80-4	Tellurium Hexafluoride (As Te)	0,2				
3383-96-8	Temephos	5				
107-49-3	TEPP (Tetraethyl Pyrophosphaate)	0,05				
26140-60-3	Terphenylis	9				
540-88-5	Tert-Butyl-Acetate.	950				
70362-50-4	Tetrachlorobiphenyl, 3,4,4',5- (PCB 81)				13	13
51207-31-9	Tetrachlorodibenzofuran, 2,3,7,8-				13000	13000
1746-01-6	Tetrachlorodibenzo-P-Dioxin, 2,3,7,8-				130000	130000
127-18-4	Tetrachloroethylene	678	0,054	10	0,021	0,54
1335-88-2	Tetrachloronaphthalene.	2				
78-00-2	Tetraethyl Lead (As Pb)	0,075				
109-99-9	Tetrahydrofuran	590				
75-74-1	Tetramethyl Lead,	0,075				
3333-52-6	Tetramethyl Succinonitrile.	3				
509-14-8	Tetranitromethane	8				
479-45-8	Tetryl (2,4,6-Trinitro- Phenylmethyl-Nitramine).	1,5				
7440-28-0	Thallium	0,1				
62-55-5	Thioacetamide				6,1	6,1
62-56-6	Thiourea				0,072	0,072
137-26-8	Thiram	5				
7440-31-5	Tin, Organic Compounds	0,1				
13463-67-7	Titanium Dioxide.	15				
108-88-3	Toluene	752	0,14	2		
26471-62-5	Toluene Diisocyanate (Mixed Isomers)				0,039	0,039
584-84-9	Toluene-2,4-Diisocyanate	0,14				
8001-35-2	Toxaphene	0,5		0,00028	1,2	1,2
55738-54-0	Trans-2[(Dimethylamino)-Methylimino]-5-[2-(5-Nitro-2-Furyl)-Vinyl]-1,3,4-Oxadiazole				0,44	0,44
126-73-8	Tributyl Phosphate.	5				
688-73-3	Tributyltin			0,063		
79-01-6	Trichloroethylene	537	0,0078	30	0,007	0,013
75-69-4	Trichlorofluoromethane	5600				
1321-65-9	Trichloronaphthalene.	5				
121-44-8	Triethylamine	100				
1582-09-8	Trifluralin			0,2		
78-30-8	Triorthocresyl Phosphate	0,1				
115-86-6	Triphenyl Phosphate	3				
52-24-4	Tris-(1-Aziridinyl)Phosphine Sulfide				12	12
126-72-7	Tris(2,3-Dibromopropyl) Phosphate				2,3	2,3
62450-06-0	Trp-P-1 (Tryptophan-P-1)				26	26
62450-07-1	Trp-P-2 (Tryptophan-P-2)				3,2	3,2
8006-64-2	Turpentine.	560				
7440-61-1	Uranium (As U).	0,05		20		
51-79-6	Urethane				1	1
7440-62-2	Vanadium Compounds			100		
1314-62-1	Vanadium.	0,1				
75-01-4	Vinyl Chloride	2,56	0,003		0,27	0,27

Table 2-8 - Risk Factors

CAS Number	Analyte	OSHA PEL	Soil Prevention	CONAMA Class 1	Cancer Inhalation	Cancer Oral
		(mg/m^3)	(mg/kg)	(ug/l)	(mg/kg-day)$^{-1}$	
25013-15-4	Vinyl Toluene	480				
75-35-4	Vinylidene Chloride			3		
81-81-2	Warfarin.	0,1				
1330-20-7	Xylene (Mixed Isomers)	435	0,13	300		
1300-73-8	Xylidine.	25				
7440-65-5	Yttrium	1				
7440-66-6	Zinc (Fume Or Dust)		300	180		
7646-85-7	Zinc Chloride Fume.	1				
1314-13-2	Zinc Oxide.	5				
557-05-1	Zinc Stearate	5				
7440-67-7	Zirconium Compounds	5				

Table 2-9 - Toxic Impact Factors

		Toxic Impact Factor (Emissions * Normalized Risk)					
CAS Number	Analyte	OSHA PEL	Soil Prevention	CONAMA Water	Cancer Inhalation	Cancer Oral	Total Factor
71-55-6	1,1,1-Trichloroethane	1.206					1.206
79-34-5	1,1,2,2-Tetrachloroethane	1			1	30	31
120-82-1	1,2,4-Trichlorobenzene		4.174	8		3	4.186
106-93-4	1,2-Dibromoethane	0			1	260	262
95-50-1	1,2-Dichlorobenzene	3	60				63
107-06-2	1,2-Dichloroethane	10	195	1.334	27	344	1.910
78-87-5	1,2-Dichloropropane	1			3	1	5
106-99-0	1,3-Butadiene	1.318			343	3.153	4.813
542-75-6	1,3-Dichloropropylene				0	1	2
123-91-1	1,4-Dioxane	1			2	27	29
95-95-4	2,4,5-Trichlorophenol		1				1
88-06-2	2,4,6-Trichlorophenol		-	3	0	1	4
94-75-7	2,4-D	0		263			263
95-80-7	2,4-Diaminotoluene				2	5	7
120-83-2	2,4-Dichlorophenol		-	223			223
121-14-2	2,4-Dinitrotoluene				0	341	341
78-93-3	2-Butanone (Methyl Ethyl Ketone)	88					88
110-80-5	2-Ethoxyethanol	1					1
109-86-4	2-Methoxyethanol	15					15
79-46-9	2-Nitropropane	1					1
91-94-1	3,3'-Dichlorobenzidine			86	0	48	134
101-80-4	4,4'-Diaminodiphenyl Ether				0	1	1
101-77-9	4,4'-Methylenedianiline	293			7	1.969	2.270
534-52-1	4,6-Dinitro-O-Cresol	1					1
92-67-1	4-Aminobiphenyl				0	1	1
75-07-0	Acetaldehyde	10			7		18
67-64-1	Acetone	37					37
75-05-8	Acetonitrile	11					11
107-02-8	Acrolein	41					41
79-06-1	Acrylamide	42		88.990	11	108.937	197.981
107-13-1	Acrylonitrile	544			463	31.136	32.142
107-05-1	Allyl Chloride	30			0	0	31
7429-90-5	Aluminum (Fume Or Dust)	314		431			745
7664-41-7	Ammonia	3.427					3.427
62-53-3	Aniline	12			0	110	123
120-12-7	Anthracene		582				582
7440-36-0	Antimony	129	341	339			809
7440-38-2	Arsenic	142	65	2.286	167	275.917	278.577
1332-21-4	Asbestos (Friable)				655		655
7440-39-3	Barium	874	36	37			947
71-43-2	Benzene	3.666	2.116	1.877	229	608	8.496
100-44-7	Benzyl Chloride	3			0	2	5
7440-41-7	Beryllium	403		1	1		405
92-52-4	Biphenyl	541					541
111-44-4	Bis(2-Chloroethyl) Ether	0			1	21	22
74-83-9	Bromomethane	18					18
1937-37-7	C.I. Direct Black 38				0	3	3
7440-43-9	Cadmium	8.738	116	1.775	128	1.366	12.123
63-25-2	Carbaryl	1		755			756
75-15-0	Carbon Disulfide	813					813
56-23-5	Carbon Tetrachloride	27	42	706	51	131	956
57-74-9	Chlordane	4		1	0	0	5

Table 2-9 - Toxic Impact Factors

CAS Number	Analyte	Toxic Impact Factor (Emissions * Normalized Risk)					
		OSHA PEL	Soil Prevention	CONAMA Water	Cancer Inhalation	Cancer Oral	Total Factor
7782-50-5	Chlorine	15.146		2.623			17.769
10049-04-4	Chlorine Dioxide	6.961					6.961
108-90-7	Chlorobenzene	6	18				24
75-00-3	Chloroethane	1					1
67-66-3	Chloroform	40	15		36	168	259
74-87-3	Chloromethane	23					23
107-30-2	Chloromethyl Methyl Ether				1	-	1
N084	Chlorophenols			13.822			13.822
126-99-8	Chloroprene	10					10
1897-45-6	Chlorothalonil				0	5	5
18540-29-9	Chromium (VI)	729	94	5.429	72.922		79.175
7440-48-4	Cobalt	372	5	24			401
7440-50-8	Copper	10.422	160	5.511			16.093
1319-77-3	Cresol (Mixed Isomers)	21	1.467				1.488
98-82-8	Cumene	9					9
N106	Cyanide Compounds	156		16.332			16.488
110-82-7	Cyclohexane	8					8
117-81-7	Di(2-Ethylhexyl) Phthalate	93	768		1	24	887
84-74-2	Dibutyl Phthalate	18	54				72
75-09-2	Dichloromethane	565	15.693	1.132	34	237	17.661
62-73-7	Dichlorvos	1			0	9	10
131-11-3	Dimethyl Phthalate	17	49				66
77-78-1	Dimethyl Sulfate	1					1
106-89-8	Epichlorohydrin	19			6	90	115
140-88-5	Ethyl Acrylate	1					1
100-41-4	Ethylbenzene	9	26	19			54
75-21-8	Ethylene Oxide	654			72	140	865
96-45-7	Ethylene Thiourea				0	5	5
151-56-4	Ethyleneimine				3	-	3
50-00-0	Formaldehyde	4.497			17		4.514
76-13-1	Freon 113	2					2
76-44-8	Heptachlor	3			1	0	5
118-74-1	Hexachlorobenzene		101.072		1	9.636	110.709
67-72-1	Hexachloroethane	1			0	0	1
302-01-2	Hydrazine	13			55	191	258
10034-93-2	Hydrazine Sulfate				0	1.225	1.225
7647-01-0	Hydrochloric Acid	4.282					4.282
7664-39-3	Hydrogen Fluoride	1.981					1.981
123-31-9	Hydroquinone	2					2
67-63-0	Isopropyl Alcohol	2					2
7439-92-1	Lead	16.070	125	2.054	7	1.446	19.703
58-89-9	Lindane	1	170	-	0	3	174
108-31-6	Maleic Anhydride	233					233
7439-96-5	Manganese	243		1.995			2.238
7439-97-6	Mercury	1.153	91	160			1.404
67-56-1	Methanol	342					342
96-33-3	Methyl Acrylate	3					3
108-10-1	Methyl Isobutyl Ketone	29					29
624-83-9	Methyl Isocyanate	147					147
80-62-6	Methyl Methacrylate	4					4
1634-04-4	Methyl Tert-Butyl Ether				0	1	1
101-68-8	Methylene Bisphenyl Isocyanate	551					551

Table 2-9 - Toxic Impact Factors

		Toxic Impact Factor (Emissions * Normalized Risk)					
CAS Number	Analyte	OSHA PEL	Soil Prevention	CONAMA Water	Cancer Inhalation	Cancer Oral	Total Factor
121-69-7	N,N-Dimethylaniline	2					2
91-20-3	Naphthalene	27	2.341		32		2.399
71-36-3	N-Butyl Alcohol	41					41
7440-02-0	Nickel	92	53	1.021	16		1.182
7697-37-2	Nitric Acid	357					357
98-95-3	Nitrobenzene	4					4
55-63-0	Nitroglycerin	8					8
86-30-6	N-Nitrosodiphenylamine				0	2	2
90-04-0	O-Anisidine				0	6	6
95-53-4	O-Toluidine	1			0	6	7
56-38-2	Parathion	8		79			87
120-71-8	P-Cresidine				0	6	6
87-86-5	Pentachlorophenol	3	5	1	0	1	10
108-95-2	Phenol	175	2.220	16.014			18.409
75-44-5	Phosgene	10					10
7664-38-2	Phosphoric Acid	763					763
7723-14-0	Phosphorus (Yellow Or White)	52		1			53
85-44-9	Phthalic Anhydride	27					27
88-89-1	Picric Acid	1					1
1336-36-3	Polychlorinated Biphenyls		262.027	41.675		6.939	310.641
106-50-3	P-Phenylenediamine	20					20
75-56-9	Propylene Oxide	5			3	463	471
110-86-1	Pyridine	5					5
106-51-4	Quinone	2					2
7782-49-2	Selenium	43	2	151			195
7440-22-4	Silver	414	3	4			421
100-42-5	Styrene	36	3.547	37			3.620
7664-93-9	Sulfuric Acid	9.895					9.895
127-18-4	Tetrachloroethylene	13	3.048	106	35	1.870	5.071
7440-28-0	Thallium	4					4
62-56-6	Thiourea				0	2	2
108-88-3	Toluene	126	12.256	10.154			22.536
584-84-9	Toluene-2,4-Diisocyanate	487					487
79-01-6	Trichloroethylene	26	23.666	4	19	43	23.758
1582-09-8	Trifluralin			54			54
51-79-6	Urethane				0	39	40
75-01-4	Vinyl Chloride	267	1.474		36	29	1.806
75-35-4	Vinylidene Chloride			11			11
1330-20-7	Xylene (Mixed Isomers)	126	9.305	27			9.458
7440-66-6	Zinc (Fume Or Dust)		33	119			151

Table 2-10 - Adjusted Toxic Impact Factors

CASNumber	Analyte	Toxic Impact Factor	Persistence	Used Produced	High Use and Low Toxicity	Adjusted Toxic Impact Factor
71-55-6	1,1,1-Trichloroethane	1.206	0,5	1	1	603
79-34-5	1,1,2,2-Tetrachloroethane	31	0,5	1	1	16
120-82-1	1,2,4-Trichlorobenzene	4.186	0,5	1	1	2.093
106-93-4	1,2-Dibromoethane	262	0,5	0	1	-
95-50-1	1,2-Dichlorobenzene	63	0,5	1	1	32
107-06-2	1,2-Dichloroethane	1.910	0,5	1	1	955
78-87-5	1,2-Dichloropropane	5	0,5	1	1	3
106-99-0	1,3-Butadiene	4.813	0,1	1	0	-
542-75-6	1,3-Dichloropropylene	2	0,5	1	1	1
123-91-1	1,4-Dioxane	29	0,5	1	1	15
95-95-4	2,4,5-Trichlorophenol	1	0,5	1	1	0
88-06-2	2,4,6-Trichlorophenol	4	0,5	1	1	2
94-75-7	2,4-D	263	0,5	1	1	131
95-80-7	2,4-Diaminotoluene	7	0,5	1	1	3
120-83-2	2,4-Dichlorophenol	223	0,5	1	1	111
121-14-2	2,4-Dinitrotoluene	341	0,5	1	1	171
78-93-3	2-Butanone (Methyl Ethyl Ketone)	88	0,5	1	1	44
110-80-5	2-Ethoxyethanol	1	0,5	1	1	0
109-86-4	2-Methoxyethanol	15	0,5	1	1	8
79-46-9	2-Nitropropane	1	0,5	1	1	0
91-94-1	3,3'-Dichlorobenzidine	134	0,5	1	1	67
101-80-4	4,4'-Diaminodiphenyl Ether	1	0,5	1	1	0
101-77-9	4,4'-Methylenedianiline	2.270	0,5	1	1	1.135
534-52-1	4,6-Dinitro-O-Cresol	1	0,5	1	1	0
92-67-1	4-Aminobiphenyl	1	0,5	1	1	1
75-07-0	Acetaldehyde	18	0,5	1	1	9
67-64-1	Acetone	37	0,5	1	1	18
75-05-8	Acetonitrile	11	0,5	1	1	6
107-02-8	Acrolein	41	0,5	1	1	20
79-06-1	Acrylamide	197.981	0,1	1	1	19.798
107-13-1	Acrylonitrile	32.142	0,5	1	1	16.071
107-05-1	Allyl Chloride	31	0,5	1	1	15
7429-90-5	Aluminum (Fume Or Dust)	745	1	1	0	-
7664-41-7	Ammonia	3.427	0,1	1	1	343
62-53-3	Aniline	123	0,5	1	1	61
120-12-7	Anthracene	582	0,5	0	1	-
7440-36-0	Antimony	809	1	1	1	809
7440-38-2	Arsenic	278.577	1	1	1	278.577
1332-21-4	Asbestos (Friable)	655	1	0	1	-
7440-39-3	Barium	947	1	1	0	-
71-43-2	Benzene	8.496	0,5	1	1	4.248
100-44-7	Benzyl Chloride	5	0,5	1	1	2
7440-41-7	Beryllium	405	1	1	1	405
92-52-4	Biphenyl	541	0,5	1	1	270
111-44-4	Bis(2-Chloroethyl) Ether	22	0,5	1	1	11
74-83-9	Bromomethane	18	0,5	1	1	9
1937-37-7	C.I. Direct Black 38	3	0,5	1	1	2
7440-43-9	Cadmium	12.123	1	1	1	12.123

Table 2-10 - Adjusted Toxic Impact Factors

CASNumber	Analyte	Toxic Impact Factor	Persistence	Used Produced	High Use and Low Toxicity	Adjusted Toxic Impact Factor
63-25-2	Carbaryl	756	0,5	1	1	378
75-15-0	Carbon Disulfide	813	0,5	1	1	407
56-23-5	Carbon Tetrachloride	956	0,5	1	1	478
57-74-9	Chlordane	5	0,5	1	1	3
7782-50-5	Chlorine	17.769	0	1	1	-
10049-04-4	Chlorine Dioxide	6.961	0	1	1	-
108-90-7	Chlorobenzene	24	0,5	1	1	12
75-00-3	Chloroethane	1	0,5	1	1	1
67-66-3	Chloroform	259	0,5	1	1	129
74-87-3	Chloromethane	23	0,5	1	1	12
107-30-2	Chloromethyl Methyl Ether	1	0,5	1	1	0
N084	Chlorophenols	13.822	0,5	1	1	6.911
126-99-8	Chloroprene	10	0,5	1	1	5
1897-45-6	Chlorothalonil	5	0,5	1	1	3
18540-29-9	Chromium (VI)	79.175	1	1	1	79.175
7440-48-4	Cobalt	401	1	1	0	-
7440-50-8	Copper	16.093	1	1	0	-
1319-77-3	Cresol (Mixed Isomers)	1.488	0,5	1	1	744
98-82-8	Cumene	9	0,5	1	1	5
N106	Cyanide Compounds	16.488	0,5	1	1	8.244
110-82-7	Cyclohexane	8	0,5	1	1	4
117-81-7	Di(2-Ethylhexyl) Phthalate	887	0,1	1	1	89
84-74-2	Dibutyl Phthalate	72	0,5	1	1	36
75-09-2	Dichloromethane	17.661	0,5	1	1	8.830
62-73-7	Dichlorvos	10	0,5	1	1	5
131-11-3	Dimethyl Phthalate	66	0,5	1	1	33
77-78-1	Dimethyl Sulfate	1	0,5	1	1	1
106-89-8	Epichlorohydrin	115	0,1	1	1	11
140-88-5	Ethyl Acrylate	1	0,5	1	1	0
100-41-4	Ethylbenzene	54	0,5	1	1	27
75-21-8	Ethylene Oxide	865	0,5	1	1	433
96-45-7	Ethylene Thiourea	5	0,5	1	1	3
151-56-4	Ethyleneimine	3	0,5	1	1	1
50-00-0	Formaldehyde	4.514	0,5	1	1	2.257
76-13-1	Freon 113	2	1	1	1	2
76-44-8	Heptachlor	5	0,5	1	1	2
118-74-1	Hexachlorobenzene	110.709	0,5	1	1	55.354
67-72-1	Hexachloroethane	1	0,5	1	1	1
302-01-2	Hydrazine	258	0,1	1	1	26
10034-93-2	Hydrazine Sulfate	1.225	0,1	1	1	122
7647-01-0	Hydrochloric Acid	4.282	0	1	1	-
7664-39-3	Hydrogen Fluoride	1.981	0	1	1	-
123-31-9	Hydroquinone	2	0,5	1	1	1
67-63-0	Isopropyl Alcohol	2	0,5	1	1	1
7439-92-1	Lead	19.703	1	1	1	19.703
58-89-9	Lindane	174	0,5	1	1	87
108-31-6	Maleic Anhydride	233	0,5	1	1	117
7439-96-5	Manganese	2.238	1	1	0	-

Table 2-10 - Adjusted Toxic Impact Factors

CASNumber	Analyte	Toxic Impact Factor	Persistence	Used Produced	High Use and Low Toxicity	Adjusted Toxic Impact Factor
7439-97-6	Mercury	1.404	1	1	1	1.404
67-56-1	Methanol	342	0,1	1	1	34
96-33-3	Methyl Acrylate	3	0,5	1	1	1
108-10-1	Methyl Isobutyl Ketone	29	0,5	1	1	15
624-83-9	Methyl Isocyanate	147	0,5	1	1	73
80-62-6	Methyl Methacrylate	4	0,5	1	1	2
1634-04-4	Methyl Tert-Butyl Ether	1	0,5	1	1	0
101-68-8	Methylene Bisphenyl Isocyanate	551	0,5	1	1	275
121-69-7	N,N-Dimethylaniline	2	0,5	1	1	1
91-20-3	Naphthalene	2.399	0,5	1	1	1.200
71-36-3	N-Butyl Alcohol	41	0,5	1	1	20
7440-02-0	Nickel	1.182	1	1	0	-
7697-37-2	Nitric Acid	357	0	1	1	-
98-95-3	Nitrobenzene	4	0,5	1	1	2
55-63-0	Nitroglycerin	8	0,5	1	1	4
86-30-6	N-Nitrosodiphenylamine	2	0,5	1	1	1
90-04-0	O-Anisidine	6	0,5	1	1	3
95-53-4	O-Toluidine	7	0,5	1	1	3
56-38-2	Parathion	87	0,5	1	1	44
120-71-8	P-Cresidine	6	0,5	1	1	3
87-86-5	Pentachlorophenol	10	0,5	1	1	5
108-95-2	Phenol	18.409	0,5	1	1	9.204
75-44-5	Phosgene	10	0,5	1	1	5
7664-38-2	Phosphoric Acid	763	0	1	1	-
7723-14-0	Phosphorus (Yellow Or White)	53	0,1	1	1	5
85-44-9	Phthalic Anhydride	27	0,5	1	1	13
88-89-1	Picric Acid	1	0,1	1	1	0
1336-36-3	Polychlorinated Biphenyls	310.641	0,5	0	1	-
106-50-3	P-Phenylenediamine	20	0,5	1	1	10
75-56-9	Propylene Oxide	471	0,5	1	1	236
110-86-1	Pyridine	5	0,5	1	1	2
106-51-4	Quinone	2	0,5	1	1	1
7782-49-2	Selenium	195	1	1	1	195
7440-22-4	Silver	421	1	1	1	421
100-42-5	Styrene	3.620	0,1	1	1	362
7664-93-9	Sulfuric Acid	9.895	0	1	1	-
127-18-4	Tetrachloroethylene	5.071	0,5	1	1	2.536
7440-28-0	Thallium	4	1	1	1	4
62-56-6	Thiourea	2	0,5	1	1	1
108-88-3	Toluene	22.536	0,5	1	1	11.268
584-84-9	Toluene-2,4-Diisocyanate	487	0,5	1	1	244
79-01-6	Trichloroethylene	23.758	0,5	1	1	11.879
1582-09-8	Trifluralin	54	0,5	1	1	27
51-79-6	Urethane	40	0,5	1	1	20
75-01-4	Vinyl Chloride	1.806	0,1	1	1	181
75-35-4	Vinylidene Chloride	11	0,5	1	1	6
1330-20-7	Xylene (Mixed Isomers)	9.458	0,5	1	1	4.729
7440-66-6	Zinc (Fume Or Dust)	151	1	1	0	-

Appendix B - Report Contributors

The following companies and people were contracted to conduct work to prepare this report:

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