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**Sri Lanka - Minnesota Scoping Mission
on Institution Building for
Waste Minimization**

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EXECUTIVE SUMMARY

Programs in the United States that promote and support waste minimization face two principal challenges: motivation on the part of the industrial audience, and appropriate program design. The primary motivation for industry in the United States to consider waste minimization seems to be regulatory pressure, and economic concerns driven by that pressure. There is no evidence that promotion of waste minimization by public agencies has led to increased activity on the part of industry, only awareness. Some evidence exists to support the claim that about 20% of technical assistance activity (including information provision) leads to implementation. The reasons for these results seem to lie mostly in program design and implementation.

Waste minimization programs in the United States are usually some combination of promotion and technical assistance. Regulatory integration of waste minimization uses similar program elements, and also mandates waste minimization through permits, inspections or enforcement, or encourages it through rules. Promotion conducted by public agency staff is perforce limited to generalities, or heavily dependent on suppliers and consultants who may or may not be fully committed to waste minimization. Technical assistance recommendations cannot be made because of liability concerns, and because staff with sufficient expertise and experience cannot be hired because of pay restrictions. Advice and information is generally limited to discovering simple opportunities. This approach is beginning to struggle in the face of increasing industry sophistication in waste minimization. Promotion and technical assistance for "middle innovators" and "late innovators" has begun to engender some new program designs.

The scoping mission came to the following general conclusions about industry in Sri Lanka and possible institutional participants in a national waste minimization program and institute.

- Industries need more technical information, not limited to waste minimization, even at the level of trade journals and current textbooks.
- Industries either have a beginning awareness of waste minimization, or grasp the basics very quickly.
- Industries are willing to innovate, but lack support in terms of a diversified supplier base; applied research information; support from customers; and funding.
- Industries have great potential for implementation of waste minimization, primarily because so little has been tried and technology is one or two "generations" old.
- Institutions are heavily "invested" in pollution control approaches, both in terms of staff and understanding, and may not easily be swayed to integration of waste minimization.
- Institutions do not see their roles in the dissemination and implementation of waste minimization concepts.
- Institutions do not generally have active outreach to clients as regards process change in general or waste management in particular, and thus are not currently well-suited for either promotion or technical assistance.

Full recommendations for program elements will require further investigation in Sri Lanka, but some early indications of needed elements are already clear. The opportunity exists to "leapfrog" program experience in the United States rather than simply play "follow the leader". An early target should be to affect the beginning efforts to enforce regulations protecting water resources by stating and supporting a clear bias for source reduction approaches in all regulatory activities. Given the stated goal of rapid industrialization, a parallel effort to affect the process of specifying and financing new industrial plant and processes should also be undertaken by providing and supporting technical expertise that is well-versed in waste minimization. A third early target that could be undertaken in parallel is a "sweep" through key industrial sectors by process experts who can integrate environmental excellence with manufacturing excellence, with the goal of further affecting current acquisition activities. The key to the success of any of these activities will be their integration with business realities and their sophistication as regards technical expertise, industrial experience and waste minimization understanding. The National Waste Minimization Program would have a broad mission to direct and support these activities; the National Waste Minimization Institute would focus at least initially on industrial sources.

INTRODUCTION

Project overview

The World Environment Center (WEC), under the auspices of the US-Asia Environmental Partnership, a coalition of Asian and American individuals and institutions supported by the U.S. Agency for International Development, working with the World Bank and the Metropolitan Environmental Improvement Project (MEIP) have implemented two projects in Sri Lanka.

The MEIP is a cross-sectoral approach to urban environmental management in Asia. Five national governments have endorsed this United Nations Development Programme-funded, World Bank-executed program. Work has begun in the following cities: Beijing, Bombay, Colombo, Jakarta, and Metro Manila.

In the first project, the US Agency for International Development Environment Officer in Colombo selected six industries that have the critical need for waste minimization and pollution prevention measures. Out of these six industries, four will be represented by Minnesotans. These experts performed factory assessments to advise the Sri Lankan industries as to new environmental process optimization measures and cutting-edge U.S. pollution control technologies.

The second project consisted of the development of a National Waste Minimization Institute. The World Bank is committed to fund this institute and would like to replicate it in capital cities around Asia. Because Minnesota is recognized as a leader in non-regulatory environmental protection, a delegation of three Minnesotans were selected to provide guidance to their Sri Lankan counterparts in designing and implementing this new institute.

These projects took place during the time period 1 October to 15 November 1993. The Minnesotans involved graciously offered to volunteer their time, while WEC, through its US-AEP Environmental Business Exchange Program, provided the delegates airfare, hotel and a per diem for meals and other incidental expenses.

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WASTE MINIMIZATION PROGRAM DEVELOPMENT **IN THE UNITED STATES**

Components and services

There are a total of fifty-eight (58) state- and locally-sponsored programs in the United States that provide some sort of waste minimization technical assistance. These programs operate from a variety of bases and provide various combinations of services, and implement their mission by offering information and referral services, on-site assistance, or in some case financial support to generators seeking their assistance. Although these services are somewhat interrelated, it may be easier to understand them by treating them separately.

--Information and referral

At their most basic, most programs are designed to encourage the implementation of waste minimization by delivering relevant information to their clients. The programs deliver this information, which they usually assemble into some sort of information clearinghouse, either by means of telephone hotlines or by publishing and distributing the information under their own letterhead. Ultimately, it is the brokering of this technical information that gives the programs access and stature in the waste generating community. Most programs operating today have developed a library of waste minimization literature. These libraries, or information clearinghouses, make up the base from which all the information and technical transfer functions proceed. Nearly all new programs spend a great deal of their start-up time gathering and indexing these resources.

The volume and degree of technical sophistication of the documents in these clearinghouses varies according to the age of the program, the sophistication of its staff, and the financial resources available to it. A program with little funding or a limited mission is unlikely to acquire a volume of documents it has little space and less staff time to properly maintain. Often these programs do not collect documents at all. A limited program can function just as well collecting bibliographies of waste minimization information rather than collecting the complete set of documents.

The type of documents available also varies. Naturally, these program have access to all the applicable state and federal legislation having anything to do with their mission. Articles published in scholastic and industrial journals (which often carry copyright restrictions), as well as documents developed and distributed by state and local programs, trade associations, and the

USEPA related to waste minimization efforts may also be made available. The fact sheets, manuals and guides, and case studies published by these public entities are public record documents which can be made distributed through the clearinghouse free or at a reduced cost.

Telephone hotlines, often with 800 numbers limited to a particular state or area, provide a way of establishing an early presence with the industrial audience. Many programs find that this service becomes a "first-call-for-help" on a range of waste issues, including regulations and management, which then provides an entry for discussion of waste minimization opportunities. Targeting of telephone assistance is difficult, however, and the response time required can be considerable and not at all proportional to the size of the company or volume of materials used or waste generation. *Fact sheets* are used to transfer information when the audience is sufficiently large to justify their development and/or distribution. Fact sheets are typically no more than four pages in length, and may describe the best available information and advice dealing with a particular industry's waste minimization options, options associated with a use or waste stream, considerations when evaluating a type of option, or details on a class of similar options. Fact sheets often function as quick summaries and guides, and do not substitute for detailed, site-specific analysis.

Manuals and guides are usually industry-specific, and sometimes waste-or use-specific, and are much more detailed in their treatment. This type of information describes processes and operations sufficiently that site-specific analysis and option identification can be done. Considerable discussion is often given over to pros and cons of particular approaches, and a thorough description of technical details which can affect applicability of an option to a specific facility. A subset of this type of information is directories of resources and organizations which are useful in a particular geographic area; e.g., used oil haulers, vendor lists, list of consultants.

Newsletters can provide topical information which is important to the industrial audience, information with both local and national impact. Newsletters also function as disseminators of other types of program information, such as seminar announcements, assistance availability, and new waste minimization opportunities. Some programs have a mailing list based on all waste generators in an area or even all industrial concerns, but finances usually dictate a periodical, usually a quarterly, targeted to those active in, or actively interested in, waste minimization. *Curricula* for more traditional academic settings is seeing more development effort, with considerable emphasis on K-12 by some programs, pursuing the notion of waste minimization as both a long-term and a short-term priority.

Seminars, usually industry-specific, are widely used as a tool in this regard. Industry seminars are usually four or eight hours long, in deference to the demands already placed on industries' time. A typical seminar will have a keynote of some note either from an industry or political perspective, who functions as both a draw for the seminar and someone who can set the tone for the proceedings. Remaining time is often divided between suppliers describing their offerings which can function as waste minimization options, and industrial concerns giving case studies concerning how they implemented waste minimization. Waste minimization program staff may only offer resources and act as facilitators, except in rare cases where they may, because of experience, be able to play a content role. *Conferences* are targeted toward a wider audience, and often cover an issue such as newly-mandated requirements (e.g., facility-wide waste minimization planning, new regulations concerning releases to the air) or approaches to waste minimization (CEO breakfast, use and motivation of staff in implementing waste minimization). Again because of time demands, conferences only last one or two days, and draw heavily upon industrial participants for content. Motivation and facilitation are often key goals, as is promotion of a waste minimization program's availability and capabilities.

Many programs that have a history in technical assistance have recorded their efforts in the form of *case studies* and make these available to the public. Case studies are generally considered valuable by waste generators in that they help them move from the theoretical aspects of waste minimization to the nuts and bolts of implementation. The published results of a technical assistance effort (particularly when the effort is demonstrably successful) not only gives some real-world grounding to what is often presented in theoretical terms, but also provides the sort of materials use and hard financial information that can help a company rationalize the adoption of waste minimization options. Being able to see how a real company making real changes can have a real effect, financially or environmentally, goes a long way to convincing waste generators that there may be benefits to the adoption of waste minimization techniques.

--Technical assistance

On-site assistance is the most direct form of assistance programs provide. This type of assistance can take many different forms and be delivered by staff from a variety of backgrounds. Whether designed to simply promote the concept of waste minimization or establish and maintain a facility specific waste minimization option, on-site assistance is a difficult, resource consuming and successful method of transferring information or technology to the waste-generating community.

Of the state and local programs that say they provide technical assistance, a high percentage (over 80%) provide some type of on-site assistance. When it comes to the more experienced programs

(those with 4 years of experience or more), all provide for some sort of on-site technical assistance. Since the start-up time and financial resources necessary for an on-site component of technical assistance place a relatively heavy burden on a program's infrastructure, it normally takes some time for such a component to become operative in an emerging program.

By far the most common form of on-site technical assistance is the waste audit or assessment. Assessments are designed to further a generator's waste minimization efforts by analyzing their waste producing processes, developing a clear picture of their waste streams, and isolating waste minimization options. These audits are generally performed free of charge by one of the technical assistance program staff.

Programs also make their staff available for more involved, longer term consultations. Consultations of this type often involve assisting the client uncover site specific waste minimization options and providing support for the development of those options. Technical assistance program staff are able to pull together case studies and other documentation from the program's resource center, review available technologies, and analyze the client's current production processes as they work with the client's employees to develop a set of realizable waste minimization options. Programs usually provide these kinds of consultations in instances when the techniques developed by the effort are easily transferred to other similar industries and the client is willing to publicize this cooperative effort. Such efforts not only help develop possibly new and innovative technologies, but by publicizing these efforts, the program is also able to promote its services and the positive outcome of the adoption of waste minimization options. Insurance and liability considerations prevent program staff from recommending specific technologies.

Research and financial assistance are considered together as program components because the two are often intertwined in implementation. Basic research is not usually conducted by waste minimization programs, but more applied forms of research, such as on-site demonstrations and pilot projects, are a common tool. These are nearly always conducted in collaboration with industrial facilities, and may be staffed by program personnel or by a facility's own employees. As in technical assistance, targeting is a very important aspect in the conduct of these projects, as they typically require expenditures of \$50,000 to \$200,000 per project, and thus can only be applied to high-priority concerns. Financial assistance in the form of grants or loans is simply another mechanism for conducting program research. While there clearly is some interest in

facilitating a particular company's implementation of waste minimization , projects funded with public money nearly always have a requirement that the funds not be used to purchase capital equipment, and that the information developed be made public through tours and reports.

--Regulatory integration

Programs which emphasize regulatory integration of waste minimization use the existing capacity and capabilities of regulatory agencies to encourage implementation of waste minimization. In some cases, waste minimization is not only encouraged as the preferred method of waste management, but its use may actually be mandated. While a wide variety of activity is ongoing, and judging the effectiveness of these efforts is difficult at this early stage, the following program components are all being attempted:

- Inspection
- Enforcement
- Permits
- Rules
- Outreach and promotion
- Cross-media inspection and permitting
- Legislation

The program component of longest standing in this area is integration of waste minimization with inspection activities. Publicly-owned treatment works (POTW's), which have as an important part of their activities industrial visits (particularly true in large cities) have been in some cases assisting their industrial users by providing waste minimization information for eight years and more. Inspectors for a variety of regulatory functions are able to give and have been giving informal advice and referrals for a number of years. An inspector for a regulatory agency is many times the only on-site government representative a facility will see, and as such can not only offer information which is specifically appropriate to a facility, but also can raise waste minimization as an option and opportunity and direct the facility to other organizations. Many inspectors are at this time limited, because of time and other resources, to mentioning simple options in the context of other activities. For example, an inspector may notice waste minimization opportunities while walking through a facility, and suggest that those opportunities be explored. Literature specific to that industry or to wastes generated by that facility can be left for later reference. Or, a listing of resources such as books, articles and technical assistance programs may be provided. (For examples of integration with other regulatory activities, please see Appendix A).

Following is a summary table of the program components and services offered by programs in the United States, divided by the basic thrust of their program:

Promotion	Regulatory Integration
<ol style="list-style-type: none"> 1. Informal, voluntary facility planning 2. State-wide strategies 3. Technical assistance (on-site & phone) 4. Training retirees to provide assistance 5. Conferences, workshops and seminars for public, labor and industry 6. Research centers 7. Technical reference/information referral (manuals, fact sheets, etc.) 8. Directory of assisting organizations 9. Curricula: primary to post-secondary 10. Innovation grants and loans 11. Consumer information services 12. Setting priority user/generator SIC codes 13. Governor's awards, other recognition 14. Events and meetings for CEOs 15. Newsletters 16. Slogans 	<ol style="list-style-type: none"> 1. Formal, mandatory facility planning and prevention-related performance standards 2. Reduction tied to biennial/TRI reports 3. Regulatory assistance 4. Facility-wide or multi-media permitting 5. Cross-media inspection 6. "Throughput" data reporting 7. Source reduction-biased enforcement 8. Innovative settlements/consent decrees 9. Entering success stories into facility records 10. Public petition for access to facility plans 11. Land bans/sunseting of materials 12. Training of regulatory personnel in waste minimization 13. Restructuring regulatory, single-medium programs to make waste minimization part of standard operating procedure

Staffing

There are approximately 340 people employed by state and local waste minimization programs. The staff-per-program counts vary from a single staff person (Maine, Oklahoma, Wyoming, and a number of county programs) to thirty eight (Illinois' Hazardous Waste Research and Information Center). Of the programs that provided information on their staffs (fifty four programs accounting for a total of 267 individuals), assistance staff were drawn from the expected (engineering, chemistry, public health, regulatory) and somewhat unusual (public relations, journalism, geography) backgrounds. Programs operating out of state agencies attempt to draw on the regulatory experiences of their staff while university based programs tend to concentrate on exploiting the research backgrounds of their personnel.

Each program currently operating in the United States conforms roughly to one of four models: the regulatory state agency model, the non-regulatory university model, the mixed agency model (including non-regulatory state agencies) and the economic development model. Each type is able, by virtue of its administrative base, to draw on different sets of individuals to make up its assistance staff.

--Regulatory State Agency Model

Programs that reflect this model tend to draw staff from existing regulatory programs. Although the academic backgrounds of the individuals employed by these programs do cut across the range of programs in general, the work experience identified by the respondents is heavily weighted toward media specific regulatory work. Of those individuals who identified the media program they were involved in, all media were more or less equally represented with a significant number of people stating that they had worked in two or more media programs before getting involved in waste minimization .

--Non-Regulatory University Model

Many of the earliest attempts to provide waste minimization technical assistance to businesses came about as a result of efforts to transfer technology from the laboratories and research centers of public universities to the shop floor. Many of these programs (MISSTAP, the Mississippi State Technical Assistance Program for example) began as a result of faculty searching for an expeditious means of transferring their experience and expertise directly to the public.

In terms of academic background, chemical and industrial engineering are the most widely represented in this group. Other engineering disciplines are also well represented. Some of the programs have attempted to draw from a wider academic base (Virginia Polytechnic's Center for Environmental and Hazardous Materials which includes a Political Scientist and a specialist in Biotechnology) while others tend to concentrate on applied research in fairly specific areas. As one might expect, many of these programs have little direct industry experience. The vast majority of these university based programs have developed some sort of program that uses student interns as technical assistance providers. With the high availability and low cost of student workers, interns allow these programs to get more workers out on-site with relatively small additional expenditures

--Mixed Agency Model

Included in this group are all the non-regulatory state agency programs, public benefit corporations and publicly sponsored non-profits. These programs draw from all academic backgrounds and work experiences. In addition to the engineers, people with regulatory experience, and environmental scientists, staff of these programs also include former small business owners, public relations specialists, community activists, and professional educators. This wider range of staffing backgrounds can be explained by the wider, education and outreach orientation these programs possess. Many of these programs stress the clearinghouse function of technical assistance (collecting information that already exists and providing a means of transferring it to their clients) over the research and development function and as such place a great deal more

emphasis on staff with communication skills. These types of programs also seem to emphasize the importance of private sector experience in their staffs. Nearly sixty percent of the assistance personnel who were not part of a retiree program and indicated that they had primary industry experience are on staff of one of these types of programs.

--Economic Development Model

Programs that are grouped under this model are fewest in number (two) and vary from the non-regulatory state agency model only to the extent that they contain people with resource and economic development experience. Here again, industrial experience is emphasized in the staffing of these programs.

Special Staffing Initiatives

Staffing a labor-intensive program designed to provide free or low-cost assistance program in this era of restricted state budgets has become the central challenge for many managers of these programs. In response to this challenge, many programs have tried to incorporate the services of part time personnel in addressing these staffing needs.

--Retired Engineers

Accessing people with direct industry experience has always been difficult for technical assistance programs. A significant number of these programs have had a great deal of success in hiring and training retired engineers to go into facilities and perform in depth waste assessments in an effort to highlight waste minimization opportunities. Programs in Connecticut, Alabama, Kentucky, Tennessee, Ohio, and Iowa have begun making use of this valuable and underutilized resource. The Florida Waste Reduction Assistance Program (WRAP) is in the fourth year of a very successful retired engineer program. Beginning the year with a staff of eighteen Retired Engineer Waste Reduction Assessment Partners, WRAP has been able to harness the extensive experience of these retirees (see inset for an example) to get out into facilities and assist waste generators identify and implement waste reduction options. This group has been extremely successful in garnering the cooperation of facility owners by meeting them on their own terms, sharing war stories and giving the owners the benefit of their extensive experience.

--Student Interns

As mentioned above, many technical assistance program employ university students as a motivated, albeit inexperienced workforce. The student intern program operated by the Minnesota Technical Assistance Program (MNTAP) is a good example of the way many of these programs operate. At MNTAP, interns are normally provided waste minimization training and then matched

with an assistance provider whose problems are similar to those issues the student is interested in studying. The intern then works directly with the client at their facility on a specific waste reduction project. The assistance client has access to all MNTAP's resources through the intern and is able to attempt to solve a specific waste reduction problem with a low-cost, dedicated staff person.

--Retired Engineer & Student Interns

The Pollution Prevention Program at the Georgia Tech Research Institute has incorporated the best of both of these types of programs in its Pollution Prevention Mentor Program. The Pollution Prevention Program pairs the talents of retired Georgia Tech Alumni with graduate students and assigns the team to a technical assistance client. Although no hard data or case studies are available at this time, anecdotal information from program personnel portrays this as a very successful effort to provide assistance to Georgia business and industry.

--Retirees

In another effort to tap heretofore underutilized resources, the Hazardous and Toxic Materials Office (HTM) of the City of Los Angeles employs retired people from all walks of life to provide assistance to local waste generators. The L.A. Senior Environmental Corps, a group of 20 retired teachers, building inspectors, engineers, and others, are provided basic technical assistance training and then connected with clients to provide a variety of waste minimization assistance. These volunteers are highly motivated, intelligent, and enthusiastic and the Senior Corps has provided the HTM with a valuable resource in its efforts to assist Los Angeles waste generators deal with their environmental problems.

Implementation

Little information exists describing how concerned individuals made final choices of program components, and how they staffed their programs. Often political creations, in the sense that they must respond to a constituency beyond their specific client base, many programs seem to have been built opportunistically rather than strategically, assembling components and staff to suit the situation as it existed. This is especially true in programs that are funded by grants, the Pollution Prevention Incentives to States grant mechanism administered by the USEPA being by far the most common. Many times grant applications for these programs were required to be responsive to the newest trends in waste minimization programs or, conversely, were not funded to provide services that were "old", regardless of their efficacy. This has even been the case in some programs funded at the state and local level, where on-site technical assistance is reflexively funded and provided, in spite of its high cost (\$2000+ per site) and its unproven effectiveness. Programs funded through

general revenues or from fees based on volume or type of waste generation have often been allowed to think and grow more strategically. Many times these are the "veteran" programs, the ones that have been in place long enough to establish themselves with their client base and show that their services and approach deserved to move from a grant-and-demonstration base to one of more permanency. These inherently more stable programs are more able to innovate and think strategically, since they are less subject to the changing whims of funders. Some implementation restraints remain, staffing issues primary among them, but in general it can be said that the more mature the program, the more strategic the implementation

Many technical assistance programs try to develop some sort of targeting mechanism to make the most effective use of their resources. For example, the Massachusetts Blackstone Project, considered at this stage to be a good example of effective waste minimization technical assistance, targeted an small industrial sector (metal finishing) in a limited geographical area (Blackstone River basin) to receive direct, on-site assistance. Other programs have followed a similar strategy, targeting specific industrial sectors in order to develop an information base or set of effective waste minimization options that can be easily be transferred to other similar industries. Still others have targeted their have targeted their services at larger generators, or small and medium sized businesses.

Some technical assistance programs have approached this issue from an entirely different point of view. Rather than targeting industries, these programs survey waste generators to find out what services the would be likely use. These programs then use the responses to the survey to prioritize their technical assistance activities. The Washington State Department of Ecology recently collected responses to just such a survey and believe it will help them set up their pollution prevention technical assistance program. Being able to demonstrate some correlation between the technical assistance program's efforts and changes in the behavior of the waste generating community has become an important issue for a number of these programs. By limiting the range of industries they intend to serve, or focusing on specific types of services, programs hope to be able to demonstrate real reductions in the amount of waste generated by their clients, thereby demonstrating their overall effectiveness in a tangible fashion.

Evaluation

Recent conversations with and papers by waste minimization program officials diverge widely as to their assessment of the efficacy of these programs. One program, staffed by university professors and students, reports wide-scale implementation, with only limited availability of capital

hindering even more changes. Another program says that out of over 100 visits that identified pollution prevention options with paybacks of less than three years, only 12 facilities have gone to implementation. A third says that although they have generated many reports and case studies, they still find implementation lagging the information and opportunity. In this area of intense experimentation, many questions await firm answers.

Waste generation and release data collected do not yet adequately correct for the possibility of multiple causes for changes in generation or release rates, such as:

- fluctuations in production levels or economic activity;
- new treatment techniques that reduce the amounts reported while leaving generation rates unchanged;
- changes that shift releases from land to air, air to water, water to land, or from any one of these to the product itself;
- material substitutions that may result in new types of wastes or releases that are regulated differently or not at all;
- changes in personnel, their training and in operating procedures.

In addition, collection and large-scale aggregation of waste generation and release data have been designed primarily to help guide policymaking, to monitor compliance with regulations, or to account for program activity to state legislatures, Congress, or the public. Therefore, focusing on these data as the measure of a program's effectiveness may not be adequate. In spite of these imperfections, efforts to correlate reported trends in waste generation and release with specific waste minimization actions are now underway. Until these connections can be established reliably, programs must resort to having industry clients make a judgment call about the impact of program services on operating costs or on waste generation numbers.

Current Means of Evaluating Programs

--Internal

Programs focused on promotion of waste minimization facilitate information transfer and provide tools to producers that assist in process change. These programs have few direct ties to costs, production, sales, or waste reduction numbers, so that quantitative measurement of their "productivity" is limited to documenting levels of activity. At the state agencies, this has taken several forms.

Categories of internal evaluation, and methods in use:

Quantity of services

1. Raw numbers of:
 - grants disbursed
 - on-site visits
 - reports generated
 - case studies written
 - newsletters written
 - policy statements written
 - permits granted
 - inspections completed
 - governor's awards given
 - workshops, conferences, training sessions delivered
 - pollution prevention programs established in industries
2. Raw hours spent:
 - on-site, on-phone, researching, promoting, writing reports and following up
 - preparing and delivering conferences, training, etc.
3. Rates of compliance with requirements for facility planning or payment of fees
4. Periodic reports to legislature/governor

With these components collected, there are a variety of methods that can measure number and duration of individual contacts against total time, allowing programs to track so-called "productivity trends."

--External

Through a variety of follow-up and feedback mechanisms, many programs have clients evaluating services rendered. A smaller group of programs contracts periodically for independent evaluation. An independent evaluation adds statistical reliability to internal evaluation by separating a survey of clients from the service providers, and it can confirm or refute a program's internal evaluation.

Current types of external evaluation:

Evaluation by clients	Independent evaluation
<ol style="list-style-type: none"> 1. Questionnaires at time of service: <ul style="list-style-type: none"> -after on-site technical assistance, asking for an assessment of value -after trainings, conferences, etc., assessing content, style and actual learning taking place 2. Surveys/questionnaires as follow-up (by mail, phone, or in-person) <ul style="list-style-type: none"> -indicating pollution prevention program is in place -demonstrating "vision change" -assessing retention -asking for estimates of savings realized or wastes reduced as a result of service 3. Number of requests for follow-up assistance or information 4. Number of referrals by clients 5. Presence of new internal programs as reported on data submission forms 	<ol style="list-style-type: none"> 1. Contractor/funder conducts reviews, client surveys, interviews, etc.: <ul style="list-style-type: none"> -assessing relative value of program elements, through rankings -assessing impact and staying power of assistance -assessing level of satisfaction with service provided -assessing program targeting (if any) -establishing who initiated contact and through what routes -analyzing any available reduction data -assessing program's value as a "change agent" acting on other institutions

If programs have the resources to do follow-up and evaluation by clients, and confirm it independently, then their "productivity" numbers become much more meaningful.

Context for waste minimization program development in Sri Lanka

PART 1--Research conducted

Following are the institutions and industries visited by the scoping mission:

Board of Investment (BOI)	National Development Bank (NDB)
Ceylon Institute for Scientific and Industrial Research (CISIR)	National Building Research Organization (NBRO)
Central Environmental Authority (CEA)	
MKC Industries (textiles)	Agro Technica (agricultural machinery and implem
Hayleys Sunfrost (gherkins and plastic blow molding)	Cocolanka (coconut milk/cream)
Keells Foods (slaughterhouse/processed foods)	Swadeshi Industries (soap manufacture)
Richard Peiris (industrial rubber mats/balloons)	Lankem (manufacture water- and solvent-based pai

Each organization visited by the mission was questioned following a rough outline developed beforehand by mission members. The focus of the questioning was to determine:

- Level of awareness of waste minimization as an approach
- Number of existing activities that could be characterized as waste minimization, even if not recognized as such by the organization being questioned
- Existing capacity to promote or implement waste minimization as an approach
- Organizational structure, including decision-making, recruitment, training, latitude for innovation, and supervision
- Needs for additional capacity to promote or implement waste minimization
- Willingness to promote or implement waste minimization
- Level of awareness of other program activities and resources

Each visit required between two and four hours to complete (excluding transport). In the case of industry visits, a site tour was usually part of the visit. In every case, individuals at the organization had not only been contacted in advance by the mission's project partners, but many times had a prior relationship with them, especially in the case of the MEIP-Colombo. This might indicate a "pre-qualified" sample, at least in the case of the industries visited, that could affect the accuracy of our impressions if applied to other industries. This is addressed as a need for further research in a later section of this report.

Institutions visited

In the investment and finance community, the mission spent a considerable amount of time with the NDB, which was logical given their intimate involvement with several stages of this project. A meeting was held early in the mission, during which the project was discussed in general, and information exchanged about information needs and particular programmatic interest. An official of the NDB accompanied the mission on several of its visits. Another meeting was held later in the mission, at which time a brief progress report was given, and the potential and possible details of NDB involvement in any programmatic effort were discussed at some length. (It should also be noted that the NDB made available to the mission an office suite and staff support that was much appreciated). These discussions with the NDB did not follow the format of the others because of their prior knowledge, but mission members were still able to draw some general conclusions.

In the research community, the mission conducted very detailed and extensive visits with the CISIR and the NBRO. In particular, the mission was able to interview several individuals at each organization, and also visit the facilities and have extensive discussions with staff. For example, the mission toured several of the labs at the CISIR, examining in particular available equipment and project records and results. At the NBRO, the mission toured not only labs but also surveyed the library and assessed the age and extent of its holdings.

In the education community, the mission was scheduled to visit the University of Moratuwa, but this visit was cancelled because of staff difficulties and proved impossible to reschedule. Finally, within the regulatory community, the mission visited the BOI and the CEA. These visits were primarily limited to the interview format described above.

Industries visited

MKC Industries is part of the textile industry, creating and printing its own designs on approximately 7.5 million meters of cloth per year. Their quality system uses teams drawn from marketing, production assistants, and weaving workers to look at new fabric construction, the type of each item, and the quality of the dyeing, usually by looking at samples. The cloth is mostly polyester and cotton, and the facility uses chloride dyes, binders, and pigments. The company has received training from the Ciba-Geigy (supplier) laboratory, and also conducts process investigations through trips abroad and interviewing other suppliers. New workers are given 15-30 days of on-the-job training, and the General Manager stated that he does not want graduates of the (Sri Lanka) textile technology program, because he says that the information learned is not applicable to the situation at MKC. He is aware of the UNIDO Textile Training and Services, and finds Sri Lanka consultants acceptable, but basic in their understanding of his problems. The

company employs a mechanical engineer, who focuses mainly on repairs. There are three supervisors for the entire company. The management team consists of individuals from marketing, production management, administration, packing department, quality control, and production engineering.

There have been residential complaints to the authorities (CEA, BOI, President). The point was made that when the facility was built (1979-1980) there were no residences in the area. MKC spent 4.5-5 m rs. for a wastewater treatment system that has failed. This is a 45,000 gpd system using eight holding pits, and is a biological treatment designed by CISIR. The CEA was contacted for assistance, but MKC was told that the supplier should supply a system and that MKC should run it. Their specific request was for an approved treatment system design. The company is currently spending 35-40 rs./meter for wastewater treatment and 55-60 rs./meter for energy (primarily for drying).

Agro Technica manufactures agricultural machinery and implements. The company fabricates parts from stainless steel, using 30-40 tons of steel per year. Piece parts are assembled, and then painted using standard air guns and paints with a high concentration of organic solvents. Some piece parts are electroplated before assembly, using copper, nickel and chrome. The company is concerned about scrap volumes and efficiency in the machining and assembly areas. Health and safety concerns were also expressed, especially headaches from plating operations.

Hayleys Sunfrost prepares and packs gherkins for export was on strike the day the mission visited. The visit was very limited, consisting mostly of a quick explanation of the project.

Cocolanka is designed to manufacture and can coconut milk and cream, but was not in operation when the mission visited because the facility was out of compliance with wastewater discharge regulations. The process steps require removing the husk; blanching; extracting milk; and expelling solids. This process creates washwater and floor spills with a high (45%) fat content that constitutes the majority of the facility's effluent. Management is not satisfied with their environmental consultant, even though they were recommended by CEA and BOI, because the treatment system has failed to perform. Some neighbors of the facility have complained of water pollution. This company was created based on research performed at the Coconut Research Institute, which provided ideas and initial guidance, but the plant has been self-built by the owner from ideas and plans.

Keells Foods manufactures processed foods, and slaughters most of its own meat. The company has worked with Sri Lanka consultants on treatment problems, and also sought assistance from the BOI, CISIR and the Sri Lanka Standards Institute. The company generates wastewater at the rate of 20,000 gpd; of that 250 lpd is blood, constituting a heavy treatment load. Wastewater treatment costs 60,000 rs. per month, and even though functional, there have been public complaints of odor and water pollution.

Swadeshi Industries manufactures soap, using six tons of lye for every 10 tons of soap. Wastewater is generated from the process of "washing" the soap to remove impurities and glycerol, and is generated at the rate of 15-20,000 gpd. The highest input cost for Swadeshi is fats and oils; second is caustic soda (for saponification); and third is water. Soapmakers have considerable training, and usually have passed graduate level chemistry. There is a quality program in place, with the motto, "Quality is everyone's job". Weekly cost control meetings are attended by the managing director, factory manager, quality assurance staff, the commercial manager, and the production manager. Any environmental issues are raised and considered at these meetings. An expansion to another soap line is currently being processed.

Richard Peiris manufactures industrial rubber mats and balloons. The major waste is latex waste from cleaning dipped molds. Wastewater is sent through a series of settling tanks and overflow weirs to maintain color and pH in the wastewater. There have been complaints from the public about the wastewater. Currently 3% of the latex is lost as waste, and cleanout waste is a particular problem.

Richard Peiris is adding another balloon plant, and is considering an improved process over what they operate currently, which was purchased as a "skid mounted" operation from their business partner in New Zealand. The company has already made changes in steam use, and replaced electricity as a heat source. Waste minimization opportunities already considered include improvements in measurement, monitoring, and metering.

Lankem manufactures water- and solvent-based paints. Of the total production, 80% is emulsion (water-based) and 20 % enamel and automotive. The process is using alkyd resin, pigments and organic solvents for cleaning. Used solvent is sent for burning. Washing containers leads to suspended solids (cobalt, zirconium, lead). The company treats 2-3000 lpd of wastewater in batches using ferrous sulfate or alum, and then polyelectrolyte. The resulting sludge totals 25kg/day, and is disposed in the back lot of plant

Lankem is currently working with an IESC consultant on paint manufacturing, starting with quality issues. They have already introduced a high-pressure pump for cleaning containers, and reduced water use to 1000 lpd for that use. Physical removal of paint from containers is also in place. 220 lpd water is used in a clean-to-dirty recirculating system for cleaning which settles out solids for re-use.

Context for waste minimization program development in Sri Lanka

PART 2--Findings

Awareness of waste minimization

An important element in any waste minimization program or institute design will be the existing level of awareness of waste minimization in a given organization. The scoping mission probed this issue by asking a set of interrelated questions that explored not only simple awareness, but also need and potential for capacity-building; existing sources of information; existing avenues for organizational; and sophistication in management. The answers, and review of other documents provided to the scoping mission, yielded the following analysis and observations. However, the members of the mission would like to point out at this time that the short duration (10 days) of the mission, combined with the unfamiliarity of mission members with many details of Sri Lanka and its institutions leads us to request that these statements be considered as requiring further investigation and corroboration.

--Industries

To begin, the core of process change, technical information, is generally unavailable and/or out of date. Few industries subscribed even to standard industrial trade journals, and international technical journals were rarer still, even in the libraries visited by the mission. Texts and reports available at these were generally 3-10 years old, and not generally used by industries. Since experience is that industry publications are primary methods for organizations to both track and distribute waste minimization information, this seemed to be the primary factor behind industries and institutions having little detailed knowledge of waste minimization.

Industries are willing to innovate but lack support. The supplier base is constricted because of the size of the Sri Lanka market (apparently). In addition, common existing suppliers (India, China, Taiwan, Australia) are not seen as world leaders in waste minimization, leading to the importation of less-than-ideal equipment as regards waste minimization and the resultant inculcation of less-than-desired waste minimization behaviors. Applied research is usually directed, where available, to increasing productivity or expanding markets. Customers, who have begun to create some "green" demand in some countries, are clearly not drivers for waste minimization in Sri Lanka industry. Funding is not easily accessed for anything other than projects that would increase

productivity or reduce costs. This last is also a very attractive "angle of attack" for discussing waste minimization with Sri Lanka industries, since many inputs that would be reduced by practicing waste minimization are imported and therefore expensive.

Industries have great potential for implementation of waste minimization, mostly because so little has been tried and technology tends to be out of date. This does not mean, however, that implementation will proceed quickly. The same reasons that make an industrialization program appropriate for Sri Lanka (old equipment; inefficient processes; over-dependence on a few sectors; lack of local suppliers) constitutes both an opportunity and a hindrance for waste minimization. The opportunity lies in affecting the process of industrialization so that a waste minimization basis is omnipresent. The hindrance lies in the pacing of any industrialization process.

--Institutions

Institutions understand pollution control approaches to environmental protection far more readily than waste minimization. They are heavily "invested" in pollution control, in the sense that staff and existing mechanisms are all designed with a control approach in mind. Institutions also do not easily understand, and even less readily accept, their potential roles in the dissemination and implementation of waste minimization practice. Even the concept of outreach to "clients" (in the case of labs) or generators (in the case of regulators) was foreign. If the intent of a national waste minimization program is long-term change and partnership, the need for capacity-building looms large.

None of these impressions are unique to Sri Lanka industries and institutions, only somewhat amplified. Further investigation is required to determine the profile existing capacity, and the need for and approach to capacity-building. In any case, the situation seems ripe for careful intervention aimed at integrating waste minimization with several ongoing initiatives, and for the development of a support system that could serve a critical catalyst role.

Current activity in waste minimization

No activity was found in any of the institutions that could be said to constitute a planned effort to promote or support waste minimization approaches. While some waste minimization seems to be happening "accidentally" (e.g., volume reduction of dye use mandated because a manufacturer's pretreatment system could not meet discharge limitations), even this is sketchy at best.

The mission did find several examples of current waste minimization activity in industries visited. Agro-Technica is recycling metals; Lankem reclaims dust and solids for re-use; Richard Peiris has implemented energy conservation measures. But each of these can be explained by internal factors that have little or nothing to do with waste minimization as an approach. For example, Agro-Technica recycles because stainless steel and copper and brass have high market value. Lankem reclaims dust and solids for the same reason. Richard Peiris was driven to tighter process controls by quality problems. While all of these could be "counted" as waste minimization, the facts of the matter are that waste minimization requires examining even less-expensive inputs, especially those with environmental effects. The most telling question asked of industries by the mission was about their water source. If groundwater was used, and not treated before entering the process, over-use was extremely common, even though that over-use severely taxed pretreatment systems, to the point of nonfunctionality.

Complementary activity

In this context, a complementary activity is one that could be modified to promote waste minimization approaches while more explicitly achieving other ends. In Sri Lanka, there are several ongoing activities that could be complementary with a waste minimization program. First, the existing requirement of companies to obtain an Environmental Protection License (EPL) from the BOI could be an excellent opportunity to require or support examination of waste minimization as part of the application and approval process, and then be supported through subsequent inspections. All concerns about capacity aside, the relative newness of this requirement makes the EPL an extremely attractive target for modification. And as new regulations are developed and implemented, waste minimization could be integrated at all stages, building an ever broader base of familiarity and support.

The intent and early activity surrounding the establishment of industrial estates, and the isolation of polluting industries, could be another excellent complementary activity. The waste minimization component of the plan for a centralized pretreatment system at Ekala is a good example of this potential. However, it is important to note that easy access to centralized pretreatment can also function as a disincentive to undertake the kind of process-specific investigations and changes that are required by waste minimization. An example of this is the U.S. Filter recovery system in the Minneapolis-St. Paul area in Minnesota in the United States. Existence of centralized treatment and recovery met a long-standing need for excellent wastewater treatment for the electroplating industry but it is only now, eight years later, that companies are finally acknowledging that changes at the

source to reduce waste generation would be more efficient. Be that as it may, a publicly-supported industrial estate offers unique opportunities to "trade" waste minimization requirements for benefits.

Lending activity, including the Pollution Control Abatement Fund administered by the NDB and others, could be complementary in the sense that integrating waste minimization into the consideration of capital equipment purchases can be a "win-win" situation. For the company borrowing funds, waste minimization can reduce the costs of inputs (often expensive imported inputs) as well as the costs of waste management, thus improving profitability and therefore competitiveness. For the lender, a company that is more competitive is more likely to make money and is therefore a better credit risk. Once again, there are clear capacity inferences from this approach, but the difference between the cost of pollution control technologies alone (the current status quo) versus pollution control optimized by the use of waste minimization approaches can be substantial.

Finally, aid from donor organizations, although beginning to require and support waste minimization investigations, is still not focused clearly on the needs for supporting waste minimization implementation. It has seldom been sufficient to expose companies to the benefits of a new approach (witness energy conservation). Far more important are efforts to alter the context of decision-making so that waste minimization becomes an obvious choice, in whole or in part. This might mean that some aid not be targeted directly to industries in Sri Lanka, but rather to their suppliers, so as to overcome barriers of availability and cost. For example, standard air guns for paint application (now illegal in California) waste nearly 70% of the material that is sprayed with them. But three common alternatives are not available in Sri Lanka, apparently because the market is deemed to be too small. These opportunities, and many more like them, would be the stock in trade of a National Waste Minimization Program for Sri Lanka.

NATIONAL WASTE MINIMIZATION PROGRAM FOR SRI LANKA

Discussion

Whether programs in the United States have chosen promotion or technical assistance or regulatory integration as the approach, and whatever the program components, three key implementation issues are staffing, the quality of technical information and integration with other institutions that affect the business life of an industry. Stand-alone efforts such as clearinghouses are effective only to the extent that the information on offer is detailed and site-appropriate. Efforts such as case studies, newsletters and fact sheets can suffer from the same lack of applicability. Seminars, training and conferences are effective only to the extent that the speakers and their information can be used directly, or with very little testing. On-site technical assistance is expensive, and helps only one company at a time. Only by altering the the very context in which industries make their decisions can waste minimization be successfully integrated and therefore implemented, both short- and long-term. This implies working with such partners as financial institutions, industrial associations, suppliers, insurance providers, economic development and planning agencies, and a range of other institutions that to a greater or lesser extent affect industries. This sort of creative alliance-building is only just beginning to occur in the United States.

Whatever their organizational base, these programs share a philosophical orientation about integrating waste minimization into industrial decision-making. First, there is a belief that objective advice and information is needed by the industrial audience. The primary assumption here is that all other providers of similar advice, e.g., consultants, suppliers, industrial peers, have some inherent bias which makes the information offered somewhat suspect. This is not to say that inappropriate guidance is given, only that whatever guidance is offered is weighted somehow to the advantage of the provider. For example, a consultant might only mention opportunities with which they are familiar and comfortable, possibly missing others which are at least as valid. Or, industrial peers might not be willing to share approaches or insights which have worked particularly well for them, since some waste minimization opportunities, once implemented, can confer a competitive advantage.

Objectivity is often seen to flow naturally from a program's organizational base. Programs operating from within an academic institution have the force of history behind them when they are asked to assist a company. Academia has traditionally attempted more to solve problems rather than promote a particular solution. Academia also has long been seen as a source of public information (e.g. industrial and agricultural extension service, land grant universities, basic and applied research), which by and large is offered free to all. Finally, academia has a strong tradition

of being open to scrutiny, through public disclosure and freedom-of-information mechanisms, which serves as a check and balance on objectivity. Programs based in non-profits, or in such entities as a commerce department or a small business development center, can also lay claim to at least a part of this historical perception of objectivity. Even though it might be presumed by some that advice and information from these quarters could somehow "favor" the business community, perhaps by not promoting opportunities with high capital costs or which require substantial rethinking of organizations or facilities, this concern is probably irrelevant. More important is that any information and advice offered be accurate and not attempt to impose a particular type of waste minimization opportunity, no matter how attractive it may seem.

Waste minimization programs operating from a base in a regulatory agency (no matter how they are structurally separated from the agency's regulatory functions) face an additional challenge in the area of objectivity. In addition to being charged with providing advice and information which is accurate and appropriate, the industrial audience must be assured that regulatory compliance concerns are not a hidden impetus for approaching the industrial audience. So in this case, although the information and advice presented may actually be objective, it may not be perceived as objective, possibly limiting a program's effectiveness.

Another philosophical orientation shared by promotion and technical assistance programs is that the industrial audience needs and will respond to being encouraged to implement waste minimization opportunities. This encouragement is nearly always cast in opposition to requirements, and can take many forms. For example, presenting information about costs of use and disposal of a material may help a company decide to examine waste minimization. Case studies, clearinghouses and resource libraries can constitute encouragement in the sense that a company is not a pioneer in implementing a particular waste minimization option. Financial resources, in the forms of grants and loans, can help overcome capital cost barriers once options are selected. Seminars and other delivery methods for training and education can remove lack of competence and experience as discouraging problems.

Promotion and technical assistance programs also attempt to learn the needs of the industrial audience. This is part of an overall effort to build a relationship which ideally is seen as benefiting all parties and a possible mechanism to learn needs can be a feedback effort such as a survey, or an evaluation attached to the earlier mentioned seminars and training sessions. Background research in trade magazines and standard references, and attendance at industry conferences, can also reveal current thinking and concerns, and help to direct promotion and technical assistance efforts. As a philosophical orientation, learning needs is seen as being a contrast to activities which are more

goal-oriented, such as integrated permitting, facility-wide planning, or consent decrees which incorporate waste minimization requirements.

Waste minimization programs which emphasize promotion and technical assistance share many of these philosophical characteristics with efforts such as development (e.g., economic, international, agricultural) and industrial and agricultural extension services. At this time, a primary philosophical and organizational divergence from those models is in the reliance upon the industries themselves for much of the information, which is then transferred. This is probably true in part because industrial concerns are so many and varied, and changing so rapidly, that program staff could ever hope to stay abreast of all the information. And the same reasoning probably also precludes substantial program involvement in directed research unless a base of industrial experience exists in the program or can be drawn upon. A key limitation to the provision of technical assistance by programs is that recommendations cannot be made. Advice and information is generally limited to generating and detailing options, and perhaps facilitating a company's own efforts to generate and detail options. This is so because of liability and insurance concerns, and also because sufficient expertise to conduct engineering studies and make recommendations does not typically exist in waste minimization programs.

Most programs have yet to grapple with what seems to be the next wave of innovation in waste minimization programs: that of integration and capacity-building. It is possible that these first programmatic efforts have nearly fully captured what could be called in classical marketing analysis the "early innovators"; those companies that are inclined for any number of reasons to take on new approaches, simply because they are new. In fact the evidence from USEPA Region 4 (southeastern United States) and USEPA Region 10 (Pacific Northwest) is that requests for assistance have levelled off, or are even declining in some cases. If this situation is responsive to classical marketing analysis, the "market" (industry) may now be populated by the "middle innovators" and the "late innovators". These are companies that will not be so easily swayed to change their approaches, demanding more evidence that is problem- and site-specific.

If this analysis is correct, then the response should be to look for partners who are successful in urging change in these companies, and then building capacity in those partners to carry the waste minimization message forward, but in their own context. Just as one example, a major barrier for waste minimization implementation in the United States in the coming years is likely to be competition for and access to capital, external or internal, necessary to make increasingly sophisticated process changes that will result in reduced waste generation. An extremely important partner for waste minimization programs going forward is likely to be the banking industry.

However, a loan officer will not be able to use the fact sheets on waste minimization that most programs use as their goods in trade. These loan officers will require training, coaching and contextual changes that will allow them to analyze and support loan requests that have environmental benefits. And the companies making the requests will themselves require assistance in analyzing and describing their needs so as to persuade the loan officer. Similar examples can be found for insurance, research, education, trade associations, and many other "conduits of persuasion" that are familiar to and accepted by companies. Waste minimization programs will have difficulty "taking credit" for actions that they foment in their partners, but they ignore them at their peril.

The following vision statements and goals for a National Waste Minimization Program and National Waste Minimization Institute for Sri Lanka build upon the preceding analysis and discussion of efforts in the United States and potential in Sri Lanka. The primary focus is on building an integrated approach to programming in this area that seeks, builds and coordinates capacity in existing institutions. The theme of integration is clearly building in programs in the United States, and Sri Lanka stands to benefit enormously from this trend. Following each of the recommendations are brief comments in italics giving argumentation for its inclusion.

Vision for the National Waste Minimization Program for Sri Lanka

The National Waste Minimization Program (NWMP) for Sri Lanka will promote and support the acceptance of waste minimization as the preferred method of waste management. This acceptance will lead to optimal resource use and environmentally sound economic development. The NWMP will not only build upon program experience in other countries, but will go beyond those approaches to serve as a model of innovation and maximum practical application.

The overarching vision strives to include not just sources of industrial wastes and releases, but other concerns affecting the natural and built environment, and human health and safety. the thematic approach is one of balance between environmental protection and development, emphasized by the use of the term "optimization" rather than "minimization."

Goal

The NWMP will create awareness of waste minimization as an approach by all parties to the generation and management of waste.

Objectives

- *Generators of waste* will have at each facility process-appropriate waste minimization information
- *Generators of waste* will know whom to contact to investigate waste minimization

- *Public agencies* will know whom to contact for waste minimization information
- *Support institutions (lenders; institutes; education; suppliers; consultants; donor organizations)* will know whom to contact for waste minimization information

Measurement: Each of the above to be verified by survey

The first goal of any program has been implicitly one of awareness of the existence and potential of waste minimization as an approach. The objectives for this goal make awareness more explicit, giving specificity to what awareness means for each party to a waste minimization approach.

Goal

The NWMP will promote acceptance of waste minimization as an approach by all parties to the generation and management of waste.

Objectives

- *Generators of waste* will analyze all available methods for regulatory compliance, and choose waste minimization when technically and economically appropriate
- *Generators of waste* will incorporate analysis of environmental effects in all considerations of process and product change
- *Public agencies* will be able to evaluate the feasibility and acceptability of proposed waste minimization approaches

- *Support institutions (lenders; institutes; education; suppliers; consultants; donor organizations)* will be able to evaluate the feasibility and acceptability of proposed waste minimization approaches, and support their analysis when requested or needed

Measurement: Each of the above to be verified by on-site visits, testing, and analysis by process and waste minimization experts

Once awareness has been achieved, waste minimization must still be accepted as an approach by all parties concerned. Once again, the objectives stated give specificity to the meaning of acceptance to each party, in an effort to give guidance on exact approaches. Implicit in each objective is a role for the party involved.

Goal

The NWMP will aid in implementation of waste minimization approaches

Objectives

- *Generators of waste* will be given technical, managerial and financial support for implementation of waste minimization approaches
- *Generators of waste* will be rewarded through reduced fees and reduced permitting and inspections requirements for implementing waste minimization
- *Public agencies* will engage in goal-setting and targeting for waste management and environmental protection that emphasizes and relies upon waste minimization approaches
- *Support institutions (lenders; institutes; education; suppliers; consultants; donor organizations)* will undertake research and other activities to assure that waste minimization approaches as they are proposed for generators in Sri Lanka are viable, appropriate and available

Measurement: All of the above to be verified in aggregate by monitoring the number of installations of technologies that reduce waste generation at the process source, as evaluated against both pre-program and projected baselines.

After awareness and acceptance comes implementation, a goal that has proven to be extremely difficult to reach for programs in the United States. The objectives stated here are specific as to scope and approach, and attempt to incorporate the best practices in this regard as they are currently understood. Since each is so specific, the possibility exists for significant variation once further investigation is conducted in Sri Lanka.

Goal

The NWMP will result in the coordination and tracking of waste minimization activities by all stakeholders

Objectives

- *Generators of waste* will receive consistent and appropriate information through familiar and trusted channels
- *Generators of waste* will be rewarded equitably and effectively for undertaking waste minimization activities

- *Public agencies* will understand their roles in the promotion, acceptance and implementation of waste minimization, as well as the roles of others, and fill those roles as capacity and resources permit
- *Support institutions (lenders; institutes; education; suppliers; consultants; donor organizations)* will understand their roles in the promotion, acceptance and implementation of waste minimization, as well as the roles of others, and act in concert to meet the goals and vision of the program

Measurement: Analysis of roles filled versus roles defined as part of overall needs assessment and capacity analysis

A goal oriented on evaluation and adjustment of program efforts is extremely rare in the United States. However, programs are coming under scrutiny for exactly that reason. Each objective states specifically what could be evaluated in each setting, even though some are subjective and therefore difficult to measure.

Program components

An *advisory board* is recommended to represent all stakeholders in program implementation. The function of the advisory board shall be to:

- Secure and administer program funding
- Review needs assessments conducted for program development
- Evaluate program progress
- Coordinate stakeholder activities
- Solicit support from stakeholders
- Disseminate information to stakeholders
- Contract for support for program activities

An *annual report* is recommended to report on program progress against goals, especially large, difficult-to-measure goals dealing with biodiversity, sustainable development and health of ecosystems.

A *core staff* is recommended to provide communications, coordination and continuity. A Director, Research Assistant and one support staff would be a minimum level of staffing. Key employment requirements would be familiarity with environmental issues; understanding of technical and non-technical factors in the investigation and implementation of waste minimization; previous experience in a similar cross-cutting function (e.g., economic development; industrial retention and/or modernization; environmental policy and program implementation). Of these, experience with the industrial community and their supporting institutions should take precedence.

A demonstration and applications testing center is recommended to provide comparative, evaluative, performance-based information on waste minimization techniques and technologies. For generators, the center would function as a neutral site for low-risk, pre-investment investigation of waste minimization innovation. For supporting institutions, the center would provide a mechanism to determine cost-effectiveness of approaches and/or market analysis (in case of suppliers and distributors). For public agencies, the center would provide country-specific data on the performance on technologies that are relied upon to meet regulatory limits.

A National Waste Minimization Institute is recommended to provide the following services:

- Direct outreach to clients, especially in the service of the formation of a strong stakeholder network
- Direct technical assistance (to generators)
- Indirect technical assistance (to institutions that support generators)
- Links to information sources
- Development of new materials to meet program goals and country-specific needs
- Modification of existing materials to meet program goals and country specific needs
- Coordination of waste minimization assistance provided by donor organizations

Discussion

Vision

The nature of the vision for the NWMP is designed to be all-encompassing, with the intent of capturing the truly global potential effects of waste minimization as an approach to environmental protection and enhancement. As Sri Lanka embarks upon its drive to achieve NIC status, and as it grapples with existing challenges stemming from previous resource use decisions, a centralized approach to waste minimization as it applies to all components of the public and private sectors will be critical. The lack of a centralized approach and support system has in fact led in the United States and some other countries to the creation of artificial barriers to the full utilization of waste minimization. Sri Lanka has an excellent opportunity to not only incorporate, but to integrate and sometimes codify waste minimization as the "rebuttable presumption" as regards environmental protection. But waste minimization has few natural supporters. The benefits of this approach, because of its nonlinear nature, accrue in gradual and often unseen ways--improved productivity; enhanced competitiveness; reduced input costs; reduced environmental impact. In addition, these changes (benefits) are inextricably linked with other parallel ongoing to affect the same parameters.

Therefore, it is very difficult to "take credit" for progress in waste minimization, and even more

difficult to link waste minimization progress to improvements in environmental measures. That means it is in no one party's explicit self-interest to choose this approach over the more-common, more-familiar, more-researched and more-accessible approaches of pollution control. That is not to say that waste minimization eliminates the need for pollution control. Waste minimization functions in concert with pollution control by optimizing its use. What this lack of explicit self-interest does say is that there is a public policy role in the early stages of promoting and supporting waste minimization as an approach, that these critical early stages cannot be left to the "traditional" networks of suppliers, consultants and companies themselves. Hence the need for the NWMP to be broad, even global in its scope, to assure that 1) waste minimization is promoted and supported in as many sectors as possible, and 2) that the eventual effect is to change the context in which environmental decision-making is conducted, by all parties. In fact, to make this point perfectly clear, it is our opinion that waste minimization cannot be allowed to apply only to industrial uses and sources, even though those are obvious and early targets. To do so would risk making waste minimization a control technology, which it clearly is not. Waste minimization is a new way of thinking about and integrating environmental effects with our practices.

Goal #1--The NWMP will create awareness of waste minimization as an approach by all parties to the generation and management of waste.

This goal proceeds from one of the first principles of technical assistance and promotion of change: that awareness is a prerequisite condition for all further program activities. The stakeholders listed in the objectives may or may not be a complete listing, but these are clearly very important stakeholders for the NWMP if it is to successfully promote waste minimization. Inherent in each of the goals for the NWMP is the concept that a primary thrust will be to build capacity in all stakeholders, so that the message will be integrated more and more deeply with all ongoing activities. In fact, it might be said that a goal could be stated for the NWMP that it would "work itself out of a job"--albeit in 10 to 15 years.

An example of creating awareness can already be seen in the activities of EPREA. By reaching out to industrial generators as part of an overall context of examining environmental effects and ways to moderate them, awareness of waste minimization as an approach is created within the context of site visits and subsequent seminars. This model would be expanded, enhanced and repeated with other companies and sectors.

Goal #2--The NWMP will promote acceptance of waste minimization as an approach by all parties to the generation and management of waste.

After, and in many cases parallel with, an effort to make stakeholders aware of waste minimization

approaches, the process of acceptance must begin, and be supported by the NWMP. A very common truism is that stakeholders will act in their own self-interest. If that is true, then acceptance must be predicated upon two key principles. First, stakeholders must reach a condition of understanding that can be called enlightened self-interest. The enlightenment (that waste minimization is a good approach) should be caused or supported through Goal #1. If self-interest (waste minimization is a good thing for me) can be established through Goal #2, acceptance will be a natural consequence. The second key principle is that stakeholders must demonstrate acceptance by putting waste minimization into practice. At the earliest stages of a program, this can be such simple activities as including waste minimization as a part of a process change analysis. This understanding is reflected in the objectives for this goal.

For public agencies, a key focus in reaching this goal will be adding to their capacity and willingness to promote and allow waste minimization approaches to public mandates, e.g., environmental regulations. But even as part of industrialization, this goal can target the process of reviewing and approving financing for capital equipment, with the goal of ensuring that environmental effects have been fully considered, and waste minimization integrated wherever possible. This is in addition to the scope and approach of environmental impact assessments.

Goal #3--The NWMP will aid in implementation of waste minimization approaches

Many waste minimization programs to date have narrowly defined implementation aid as technical assistance, in some instances complemented with promotional activity. The objectives for this goal define a much broader scope for implementation aid. Even the first objective, support for generators in implementing waste minimization approaches, is broadened beyond the technical to include managerial and financial elements. This is in recognition of program experience elsewhere that has shown that technical support is necessary, but not sufficient, to fully aid implementation of waste minimization. In fact, one study has shown that a full 80% of the "barriers to implementation" can be characterized as non-technical. If that is even partially correct, then the other objectives having to do with reduced fees, targeting and research take on added importance. Those objectives become even more important for non-industrial NWMP stakeholders (general public; public agencies; other institutions) since the benefits that they can potentially derive from waste minimization are more diffuse, and therefore less motivating.

One specific example of a possible NWMP approach to this goal would be promotion of regulatory integration of waste minimization. As a mission-driven program with a broad scope, the NWMP could very conceivably militate effectively for the additional resources and policy-making that

would facilitate including waste minimization in permits, inspections and enforcement and, going forward, in rules adoption. The lack of an overarching program "driver" seems to be the primary reason that regulatory integration is lagging in the United States, much to the consternation of public agencies and the regulated community alike.

Goal #4--The NWMP will result in the coordination and tracking of waste minimization activities by all stakeholders

One of the major difficulties of waste minimization program implementation to date has been the "entrepreneurial" nature and approach of many of the programs and their administrators. This is eminently defensible, given the challenges involved and the creativity required to surmount those challenges. However, that nature has led to a lack of coordination among the multitude of efforts and stakeholders, with a resultant welter of sometimes conflicting messages to clients. The objectives for this goal are all oriented toward ensuring consistency of messages by 1) stating, understanding and accepting roles; and 2) monitoring of consistency and equity. Once again, the broad scope and overarching mission of the NWMP should make it easier to discuss, define and maintain such subjective issues as roles and equity.

This is another example of a goal recommended in this report that is drawn as a counterexample to program practice elsewhere. In fact, even after 8+ years of activity in this area in the United States, there is yet to be made a clear statement of roles. This has led to confusion and, frankly, wasted effort. A possible parsing of some of the roles in Sri Lanka could be as follows:

STAKEHOLDER	ROLE
Industry	Investigate Implement
Public agencies (environmental)	Analyze Accept or reject Promote
Public agencies (development)	Analyze Integrate Promote
Public agencies (political)	Set targets Support Promote Monitor progress
Support institutions (lenders; institutes; education)	Integrate Research
Support institutions (suppliers; consultants)	Analyze Respond
Support institutions (donor organizations)	Integrate Support Promote

Program components

All of the program components for the NWMP are drawn from an analysis of implementation experience in the United States. However, even though stated as recommendations, these components should be thought of as part of a "menu" of options. Final selection will depend on analysis of many factors, many of which the scoping mission did not have the time, or possibly the expertise to discover or evaluate. These recommended components are either used frequently in existing waste minimization programs, or come with high recommendations of utility or effectiveness from program administrators. Caveats abound, however.

Advisory boards can be difficult to assemble, difficult to administer, and expensive to keep informed. The most frequent complaint about them is that people agree to serve for "non-program" reasons (recognition; networking; public relations) and fail to perform any functions other than attend meetings. Obviously this sort of board would be a drain on program resources. One innovative solution to this situation has been to appoint members to the board after their organization has received program services or assisted the program in some way. This assures 1) familiarity with program services, and 2) a practical connection with the function of the program. The important factor in successful advisory board management is to assure that the board has an important function, and the power to act in that role. This will attract members who wish participate in an action-oriented program.

The staff for the NWMP can and probably should be shared with the National Waste Minimization Institute (discussed later in this report). A key qualifier is the background and orientation on environmental issues of the Director. The most successful waste minimization program directors to date seem to be those with a range of experiences. An ideal mix would be a combination of public agency, NGO and industry background. While a background in environmental policy and issues is important, even more important are strong marketing and communication skills, especially in the earliest stages of the program's implementation. Also critical is an ability to secure and manage resources, especially as support shifts and the program matures.

The component described as a demonstration and applications testing center does not exist anywhere in the world, as far as our research could determine. However, the need for such a center is widely accepted. The key output would be comparative, evaluative information that is applicable to a wide variety of sectors and waste minimization approaches, but especially useful to small companies and those stakeholders (like public agencies) who are not able choose high-risk applications. The rationale is based on experience to date working with companies on choosing and implementing waste minimization technologies.

Many small- and medium-sized businesses in the United States suffer from an "implementation gap" in what can broadly be called environmentally conscious manufacturing. In Sri Lanka, this gap may even be larger than it is in the United States, judging at least from our initial survey and sample of industries. Many companies, even with increasing attention paid to competitiveness and modernization, are lagging in implementation of waste minimization approaches--in many sectors in Sri Lanka, apparently lagging badly. The implementation gap is due in large part to a lack of appropriate information and support. Many of these issues can be addressed through the NWMP and an associated waste minimization institute, but one category of information cannot be

transferred because it usually does not exist. That is the sort of performance information that is keyed to the unique conditions, opportunities and challenges of Sri Lanka industries, and runs the gamut from comparative evaluations of competing methods to reduce water use to demonstrations of the applicability of a new approach to paint application.

Moving beyond the "opportunity stage" of waste minimization in many Sri Lanka industries will require access to at least three types of information: • a detailed understanding of site-specific factors that will affect implementation; • adequate information to complete good economic evaluations of proposed process changes; and • comparative, evaluative information about that can be used to match particular opportunities with a particular site. Comparative information about the performance of a technology has always been expensive and difficult to develop, and not commonly shared once complete. A center devoted to developing and disseminating such information would quickly move investigations through the qualification phase to the implementation phase. Following are some of the services such a center could offer:

Process demonstrations could be offered based on small-scale production lines. These would be used to support research and dissemination activities by providing a realistic setting and easy access to technical personnel and equipment, and would emphasize a "hands-on" approach to implementation. **Process design assistance** could be made available to help individual companies modify and implement demonstrated technologies. This could be provided on a consultation basis, but be used to create public information to benefit similar companies undertaking similar investigations. Both of these services have been performed by the CISIR and several technical institutes already in Sri Lanka, and those organizations could possibly serve as bases for this sort of activity, with guidance from the NWMP.

Product and technology evaluations could be performed that would be centered on discovering and testing processes and process modifications that can be used to make manufacturing more environmentally conscious, with a special focus on comparative evaluations and evaluations that focus on industries that are unique or nearly unique to Sri Lanka. **Training and publications** and **research and education** would then be used to transfer all of this information for wider use. These last two services might very well be performed by the National Waste Minimization Institute, either alone or in concert with other organizations, depending on its staffing and its physical arrangements. This institute, its goals and program components, is discussed in the next section of this report.

National Waste Minimization Institute for Sri Lanka

Vision

The National Waste Minimization Institute (NWMI) for Sri Lanka will provide tools and linkages such that all stakeholders are able to investigate, support and implement waste minimization to the fullest extent practicable. These tools and linkages will be focused on building capacity in all stakeholders for the analysis and implementation of waste minimization. The NWMI will not only build upon program experience in other countries, but will go beyond those approaches to serve as a model of innovation and maximum practical application.

The vision stated here is directly related to that for the NWMP, but with a focus on industrial generators and those institutions and organizations that support them. The theme is again one of integration, with an explicit concern for building capacity for long-term change and support.

Goal

The NWMI will provide direct outreach to industrial clients and other stakeholders to establish relationships and build trust.

Objectives

- *Individual and group contact with generators with general information on waste minimization as an approach*
- *Attendance at meetings of appropriate trade groups and other gatherings to learn generator concerns and promote waste minimization*
- *Provide materials and presentations in support of or as part of meetings, newsletters and other methods already in use to inform generators*
- *Answer general and specific questions in the role of a neutral party*

Measurement: Each of the above to be verified by survey

This goal is the analogue to the awareness goal for the NWMP. The objectives are drawn from program experience, and are those that seem to function best in situations where many members of the audience are completely unaware of waste minimization.

Goal

The NWMI will provide direct technical assistance to industrial clients investigating and implementing waste minimization.

Objectives

- *Establish a system of referrals to link questioners and possible sources of answers*

- *Provide appropriate general technical information* to all clients on as-needed basis
- *Provide appropriate site-specific technical information* to clients in targeted sectors or using targeted materials of concern

Measurement: Each of the above to be verified by survey

This goal is the analogue to the acceptance and implementation goals for the NWMP. The objectives are drawn from program experience, and are those that seem to function best in situations where many members of the audience require direct assistance. In our judgment this will be the case in the early years of the NWMI in Sri Lanka.

Goal

The NWMI will provide indirect technical assistance to industrial clients on waste minimization by assisting supporting institutions

Objectives

- *Train and support consultants* in the provision of waste minimization services
- *Train and support lenders and development agencies* in the evaluation of waste minimization techniques and technologies
- *Train and support educational institutions and technical institutes* in applied research for and evaluation of waste minimization techniques and technologies
- *Maintain lists of suppliers and distributors* of applicable waste minimization approaches
- *Establish a system of referrals* to link industrial clients and appropriate institutions

Measurement: Performance and utility of each of the above to be verified by survey

This goal could be seen as the integrated analogue to the acceptance and implementation goals for the NWMP. The objectives attempt to link supporting institutions in a wider effort to support industry. The NWMI would benefit from this sort of activity as requests become more specific and more difficult to adequately answer with staff with only one or two kinds of expertise or experience.

Goal

The NWMI will provide links to information sources for all stakeholders.

Objectives

- *Evaluate information needs* of industrial clients, both existing and projected
- *Locate and evaluate existing sources of information* that will meet identified needs
- *Establish linkages* with existing sources of information for targeted sectors, materials or technologies
- *Develop needed information* that is unavailable elsewhere

- *Support access* to all sources of information

Measurement: All of the above to be verified in aggregate by monitoring the availability and use of information about technologies that reduce waste generation at the process source, as evaluated against pre-program baselines of availability

The NWMI in the first years will likely only be able to organize and disseminate existing information. As program experience builds, however, more country-specific could be needed (e.g., supplier information) and be developed.

Goal

The NWMI will develop or modify promotional and educational materials to meet program goals and country-specific needs

Objectives

- *Assess client needs* for materials, and the most acceptable materials, by sector or material use or technology
- *Evaluate suitability and cost-effectiveness* of existing materials and delivery mechanisms
- *Modify or create materials* that are unavailable elsewhere as needed to meet program goals in targeted areas
- *Disseminate materials* for delivery through mechanisms that are familiar to and trusted by clients

Measurement: Assess effectiveness and impact of materials by evaluating: 1) frequency of delivery; 2) results of post-delivery testing; 3) implementation of proposed options. Set baseline pre-delivery by surveying existing type and level of waste minimization implementation.

This goal returns to the theme of integration by stressing evaluation, as we'll delivery through existing, credible "channels." This will mean that NWMI would only deliver promotion and education if they happened to be the content experts. The emphasis otherwise will be on developing, locating and coordinating outside expertise.

Program components

On-site assessments are recommended at a low but steady level (perhaps one per week) to provide a steady stream of evaluative information, client contact, and testing of new materials and approaches. Assessments should be conducted in target areas only (e.g., existing painting operations; facilities planning to expand painting operations) and sufficient technical expertise should be in place pre-visit that information and advice can be provided in a site visit report within 15 days of the completion of a visit.

A *newsletter* with extremely broad distribution should be published on a quarterly basis. The

newsletter would contain at a minimum information about:

- √ Recent site visits and information provided (when not limited by confidentiality concerns)
- √ New information resources available
- √ NWMP and NWMI program updates
- √ Schedules, sites and topics of upcoming events pertinent to waste minimization
- √ Contact phone numbers and services available
- √ One topical focus per issue

No more than eight pages when fully developed, the newsletter would probably begin with four pages for simplicity of production and speed of reading.

A *clearinghouse* should be developed for waste minimization information that is:

- √ Useful in support of program targets
- √ Process-, product-, or technology-specific
- √ Useful in locating vendors or distributors
- √ Comprehensive within chosen focus areas
- √ Verifiably useful
- √ Open to all stakeholders for research and duplication

The types of information needed and the availability of that information will gradually become obvious as the NWMP and the NWMI mature. Special care should be taken to include non-technical information as well as technical information. In addition, even "standard" technical information (trade journals; proceedings; academic journals) without obvious environmental content should be considered for inclusion if the information can be verified to be useful to a systematic approach to waste minimization.

Establishment of a *lending library* is recommended for key texts, manuals, guides and handbooks that are too expensive for a single company to purchase. Once again, identification of these materials should occur as a natural outgrowth of the maturation of the NWMP and the NWMI.

A telephone *hotline*, or its mail-in equivalent, is recommended for response to urgent questions, and questions that require a third-party, especially as regards regulatory issues. A key issue will be staffing for this program component, since experience has shown that this functions as the first introduction to a program and its services for over 50% of clients.

Institutional partners

--In Sri Lanka

Government of Sri Lanka

Natural Resources and Environmental Policy Project

Metropolitan Environmental Improvement Program

Board of Investment

National Development Bank

Ceylon Institute for Scientific and Industrial Research

National Building Research Organization

University of Moratuwa

Other universities

Technical Institutes

Central Environmental Authority

--Other organizations

World Bank

Asia Environmental Partnership

United Nations Industrial Development Organization

International Executive Service Corps

World Environment Center

United States Environmental Training Institute

Discussion

Vision

The nature of the vision for the NWMI is designed to reflect not just existing waste minimization program experience, but to incorporate lessons learned and research from other areas of activity that are complementary, areas such as technology transfer and technical assistance for energy conservation; technology transfer for reduction in the use of ozone-depleting substance; and business assistance for manufacturing excellence. As Sri Lanka moves forward as an industrializing nation, the opportunity exists to link manufacturing excellence with environmental excellence. Achieving this linkage will require adherence to some key principles, principles that have unfortunately not been acknowledged in many, if in any, existing waste minimization

programs.

The first principle, that of enlightened self-interest, was discussed earlier in this report in the discussion of the proposal for the NWMP. Once again, a widely held truism holds that stakeholders (actually, humans generally) will act in their own self-interest. This is true as far as it goes. A more accurate statement would be that stakeholders act in favor of what they perceive to be their own self-interest. Perhaps an individual will overall act more altruistically than someone who owns and operates a business, but, that aside, perception clearly affects choices. For example, in Sri Lanka the current status of enforcement of environmental regulations protecting water resources seems to have led many industries to perceive self-interest in a) installing pretreatment systems, mostly using biological methods, and b) not operating those systems. The perception, however, is limited by a lack of knowledge (or what we are choosing to call "enlightenment") about the costs of their current mode of operations, with or without environmental controls. Change the perception (e.g., introduce the notion of reducing chemical use and thereby the cost of expensive imported inputs) and the self-interest will change, too. This is the task undertaken under the rubric of "promotion and outreach", and is a first-stage activity, demanding more marketing skill than technical skill.

The second principle embodies the realities of what makes process change happen. These realities, in postulated order of importance, are that many industries in Sri Lanka are:

- Dependent on suppliers (including consultants) for technical information
- Conservative in their approach to process change
- Limited in their ability to perform site-specific testing of options
- Limited in their access to capital
- In need of answers of maximum practical application
- Lacking adequate comparative financial information for options

These realities illustrate both needs, and approaches to meeting those needs. Several types of information seem to be needed; none of them are likely to be made available by other than a publicly-supported organization. Capital is needed, as well as supporting financial analysis, it is not clear that any organization other than a lender should be providing that capital and analysis. And if technical information is gathered and made available, it may be most prudent to co-opt a familiar communications link to deliver that information--suppliers. None of these realities illustrate a need for or importance of outside "change agents", i.e., technical assistance programs.

A third and final key principle is that affecting process change requires a slow and careful program of building relationships and trust. A good model for this program could well be that of industrial

sales. Anyone who has been successful in industrial sales will say that the secret of their success is to "know the client better than they know themselves." This simple rule can be expensive to follow, but is the key to successful promotion, persuasion and encouragement in favor of waste minimization as an approach to environmental protection. Time and again it has been shown that changing behaviors requires changing attitudes, and changing attitudes requires much more than providing technical and financial assistance.

Goal #1--The NWMI will provide direct outreach to industrial clients and other stakeholders to establish relationships and build trust.

This goal functions at two levels. The first is the requirement to spend time with clients, in settings where they themselves are gathering and exchanging information. This not only allows opportunity to build familiarity with the client, and they with the NWMI, but allows for more casual exchanges and interrogations. The second involves support of trusted information channels. A stand-alone seminar sponsored by the NWMI and staffed by world-famous experts might very well be well-attended, but experience has shown that a slow, steady drip-drip-drip of articles and presentations will eventually wear down the hardest rock of an industry person.

Goal #2--The NWMI will provide direct technical assistance to industrial clients investigating and implementing waste minimization.

Goal #3--The NWMI will provide indirect technical assistance to industrial clients on waste minimization by assisting supporting institutions

Goal #4--The NWMI will provide links to information sources for all stakeholders.

Goal #5--The NWMI will develop or modify promotional and educational materials to meet program goals and country-specific needs

Since these goals share many of the same challenges, they will be discussed together. The first challenge is to understand what actually constitutes good waste minimization information. Many times technical information used in support of waste minimization is often just that--technical information, often without explicit environmental content. This means that gathering and qualifying information in support of technical assistance can be very problematic. Even production of case studies can falter, and waste resources, when confronted with the reality that each site is very different, and that non-technical issues often account for 80% of the implementation challenges.

The second challenge is that progress in waste minimization is difficult to measure, compounding the already complex problem of determining whether any particular mode or content of technical assistance is effective, or is the most efficient response to generators' needs. Just a few of the problems are:

- delayed effect of pollution prevention projects
- facility staff turnover
- multiple motivations for implementing pollution prevention
- limited time for follow-up
- hard-to-quantify project results

Even ascertaining whether awareness has been raised or a company felt well-served by a technical assistance effort can require expensive (\$50,000 in one instance; \$60,000 for another estimate) surveys and tabulation. And this measurement difficulty carries over to needs analysis and targeting, where knowing what would be "best" would be extremely useful information.

There are two principal challenges which these programs face in implementation of assistance to industrial clients: motivation on the part of the industrial audience, and technical expertise in program staff. Motivation to seek technical assistance can come as a result of promotional efforts, health and safety concerns, or even general environmental and "good business" awareness. In large part, however, the primary motivators in the United States seem to be regulatory pressure, and economic concerns driven by that pressure. Availability of disposal, use restrictions, reporting requirements, and public scrutiny all act to drive the industrial audience to examine waste minimization. Unfortunately, from the perspective of many programs which focus on promotion and technical assistance, this type of pressured motivation can lead to waste minimization being considered in a "rifle-shot" rather than a comprehensive manner, and actually build upon old ways of thinking about environmental concerns reactively rather than proactively.

Technical expertise, on the other hand, is more a functional than a philosophical issue. Given the broad range of industries which any program must serve, technical expertise is often limited to those areas where staff has experience, or where experience can be "borrowed." Compounding this problem is the reality that once staff gains experience, pay scales and other types of rewards can be very attractive in the private sector, contributing to turnover of the staff most needed. Those same issues can prevent employment of highly qualified staff, except in cases where more personal motivations outweigh all others. These limits on technical expertise may limit both a program's viability and its effectiveness.

Another challenge as waste minimization programs mature will be the provision of ever more complex and facility-specific guidance. Recognition and use of waste minimization as an environmental management option can be thought of as proceeding through stages. The first stage is **awareness**, when companies attend seminars, read journal articles and think about how it all might apply to their situation. The second is **data-gathering**, when the facility takes the advice seriously, perhaps requests an on-site visit, and begins to define and select waste minimization options. The final stage is **implementation**, when facilities purchase and install equipment or otherwise make organizational changes. Technical assistance as currently provided by public programs seems very well-suited to the first stage, and in some cases the second. But as waste minimization moves deeper into implementation, technical assistance will require more and deeper technical knowledge in order to be effective.

Summary Conclusions and Recommendations

Areas requiring further investigation

- √ Explore and define the roles of and linkages between institutional partners
- √ Determine the nature of the supply chain for industries in Sri Lanka
- √ Assess capacity needs of institutional partners
- √ Determine the routes of access and level of availability for technical information

Key opportunities

- √ Integration with ongoing regulatory activities
- √ Integration with ongoing industrialization activities
- √ Integration with ongoing donor organization activities
- √ Integration with ongoing modernization activities
- √ Leverage created by public awareness

Key challenges

- √ Inertia created by familiarity with pollution control approaches
- √ Temptation to "transplant" programmatic approaches from the United States
- √ Lack of appropriate technical information
- √ Lack of capacity in institutional partners
- √ Lack of awareness in stakeholders

APPENDIX A
Examples of regulatory integration of waste minimization

Examples of integration of waste minimization into regulatory inspection activities

The County Sanitation Districts of Los Angeles County (CA) have trained their inspectors and engineers so that they are able to see and promote waste minimization opportunities where appropriate. Some of the topics covered in this training are:

- Waste minimization concepts
- Regulatory requirements for waste minimization and future trends
- Guidelines for a waste minimization "program-in-place" as required by the Environmental Protection Agency's (EPA) Office of Solid Waste
- Tools available to perform waste minimization opportunity assessments, e.g., manuals and checklists
- Human psychology and techniques for performing promotion and outreach
- General waste minimization techniques
 - Good operating practices
 - Material substitution
 - Process modification
 - Product reformulation
- Industry-specific waste minimization techniques
- In-depth review of promising technologies, e.g., membrane separation, electrolytic recovery, mechanical cleaning

This program was initiated in March of 1989 by Philip Lo, who has been involved in environmental regulation and planning for the past 15 years. Part of the local industry motivation is an ordinance which states in part that "prevention is preferred over treatment". Industry is also levied a surcharge which covers staff costs and the salaries of two full-time staff. Lo has seen growing acceptance of the prevention ethic within his agency by all staff, after an early bout of skepticism. Industry too is responding, as evidenced by the 200 requests for information which have been received as part of the promotion efforts on the part of regulators.

As a smaller part of a larger effort, the Environmental Health Department of Contra Costa County (CA) has embarked on an effort to provide, among other things, education and technical assistance

to small- and medium-sized businesses to support efforts to evaluate opportunities for waste minimization and overcome regulatory, institutional and economic barriers to implementation of those opportunities. Waste minimization has been integrated into routine generator inspections, and on-site assistance is provided on a case-by-case basis. Incoming staff are trained in an orientation to waste minimization developed by staff of the Hazardous Waste Minimization Program (HWMP). Existing staff have received, at a minimum, that waste minimization orientation, and some have received advanced, industry-specific training in waste minimization options for the photoprocessing, automotive repair, laboratory, and metal finishing industries.

The goal of the HWMP overall is to reduce waste generated in the County by 40% by the year 2000 and improve compliance with environmental regulation, first by implementing use and source reduction, then reuse/recycle of remaining wastes. The program has been supported financially and technically in its early stages by USEPA Region 9. In addition, the County passed an ordinance which increases the amount of generators fees which are paid to the County. These fees, which each facility can deduct from their State taxes, fund the generator inspection program as well as two staff which are assigned to the HWMP. Two full-scale assessments have been completed by inspection staff, and the reports presented to the facilities involved.

Staff involvement continues to increase, and the project is being expanded to include an Implementation Task Force (ITF) made up of representatives from cities within the County, industry representatives, environmental organizations, air and sanitation districts, fire departments and the EPA. The ITF will guide selection of projects, dissemination of information and attempt to integrate pollution into other media programs and inspection activities.

The Alaska Department of Environmental Conservation is an example of a common effort across hazardous waste inspection activities, that of using a checklist during the course of a normal regulatory inspection to spot waste minimization opportunities, and then relay those opportunities to the facility, along with referrals for further assistance, such as technical assistance programs and information resources. Some of the items included on this checklist are:

- Verification that all appropriate documentation (manifests, biennial reports, state annual report) contains required waste minimization information, and, in the case of a written waste reduction plan, that it either adheres to the "Draft Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Plan" or the inspector requests description of the elements of the plan
- Quantity of waste reduced or recycled, by waste code, 1988-1991
- Description of methods used to accomplish recycling and/or reduction, by waste code

- Description of any source reduction or recycling opportunity assessment conducted, 1988-1991
- Evaluation of the generator's "program-in-place" to reduce the volume or toxicity of hazardous waste
- Description of efforts to reduce other waste streams, including office paper, scrap metal, air emissions, potential spills and accidents, fugitive leaks, obsolete stock, wastewater discharges, and evaporative losses
- Does the facility wish to be contacted by the DEC [non-regulatory] waste minimization program?

Examples of Integration of Waste Minimization With Enforcement Activities

Regulatory agencies in the United States feel that they have broad authority and wide latitude to integrate waste minimization into enforcements, if the number of settlements which contain these requirements is any indication. There is a history of innovative approaches in what is required to correct a regulatory violation. Certain situations seem to favor the use of waste minimization conditions in enforcement settlements. For example, facilities where:

- Recurring patterns of violations are unlikely to be corrected by further controls or improved operations and maintenance, therefore suggesting elimination of or substitution for the offending substance/process as the best means to achieve permanent regulatory compliance
- Waste minimization options offer the chance to avoid negative impacts on other media which might be caused by control options
- Economically feasible waste minimization options have already been identified for the emissions or discharges in question

Furthermore, waste minimization can be used as a means to correct a violation of an environmental violation in two ways: waste minimization as a means to correct the violation, and waste minimization conditions which are incidental to or in addition to the correction of the violation, but may still be used to mitigate the penalty.

The Massachusetts Department of Environmental Protection began in 1990 to include waste minimization conditions in their notices of noncompliance, in order to raise the awareness of waste minimization options and increase implementation. Several examples of this language follow.

Company A had registered with Air Quality the use of nine cold wash

tanks which emitted 25 tons annually of 1,1,1-trichloroethane. The Company was found to be emitting excessive amounts of solvent because of a lack of emission control devices, and in addition had switched to using a different solvent with Department approval. In the Notice sent to the Company, the following was required in order to support examination and possible implementation of waste minimization opportunities:

"3. A discussion of alternative degreasing techniques. Include for each proposed cleaning method:

- A. Description of the process equipment, raw materials, and product cleaned;*
- B. Any problems implicit with altering the operation (e.g., cleaning quality, centralization); and*
- C. Cost of equipment and annual operation cost, including raw materials, hazardous waste, maintenance and operation costs, compliance costs..., insurance premiums, and worker safety.*

4. Within forty-five (45) calendar days of this Notice, inform the Department as to your intentions to either eliminate your current cold degreasing system, or complete design data sheets for all your cold wash tanks, in compliance with..."

Company B was found in violation of numerous water pollution control and air quality regulations, including lack of manuals and documentation and two uncontrolled operations resulting in emissions and/or discharges. In the cover letter for the Notice of Noncompliance, the Department stated that:

"Finally, in the opinion of Department personnel, you may be generating unnecessary emissions or wastes. Specifically, there may be opportunities for reducing wastes and costs associated with [Company B's] coolant management and disposal practices. A review of these practices is required with this Notice. If you eliminate the generation of specific waste streams you may cut environmentally driven costs and even reduce the regulatory requirements applied to your firm.

...

The Department of Environmental Management (DEM) provides technical assistance to industries on source reduction. Their consultation is free, confidential, and assistance-oriented rather than enforcement-oriented."

Later in the Notice, the following was specifically required to encourage examination and implementation of waste minimization options as ways to return to regulatory compliance:

"II.

2. *Submit documentation of [Company B's] " program in place to reduce the volume and toxicity of waste generated, to the degree...economically practicable", as per...*

III. ...

A....Update your operation and maintenance procedures annually to incorporate new waste minimization and compliance objectives.

3. *Document, by building and department, the Company's use and management of coolants, including.*
 - a. *an itemization of amounts used and disposed of, and*
 - b. *an itemization of management and disposal methods (filtration, biocide additives, centrifuging, pasteurizing)"*

Cross-media efforts

A final area of integration actually has waste minimization as a corollary benefit rather than a primary focus. An effort has begun to explore the possibility of conducting inspections and writing permits which consider all the wastes and releases generated by a facility simultaneously. This is in contrast to a system which currently compartmentalizes air, water, hazardous waste and sewer authority regulatory activities, addressing each separately, and usually at different times. Joint inspections and coordinated writing of permits have been conducted on a trial basis in order to test the efficiency and efficacy of this approach. One motivation at least is to prevent the cross-media transfer of pollutants, an important focus of the waste minimization concept. For example, without coordination, a pollutant removed from an air emission may be captured as a water-borne pollutant. This may be sewerred, with or without pretreatment, and can resurface later as a water wastestream problem. Or, more commonly, pollutants removed from water streams can be

transferred to solid wastes destined for land disposal, or even in some cases cause air pollutant releases. Integrated inspections and permitting can "plug all the pipes at once", easing the burden on the facility, and do a superior job of protecting the environment.

Legislation

Legislation which mandates waste minimization activity by industry is not directly a regulatory agency directive. However, much of this legislation has components, such as facility-wide waste minimization plans, goals and progress reports which are the object of agency staff oversight. Reviewing these progress reports (and in some cases, the plans themselves) have the dual effect of educating staff in opportunities and allowing for an exchange of ideas over benefits of and barriers to implementing waste minimization .

APPENDIX B
Examples of innovative efforts
to promote and implement
waste minimization

INTRODUCTION

State and local governments across the country are developing and implementing pollution prevention programs as an effective means for achieving environmental goals. This section contains examples of both typical and innovative State, county or local agency programs. It is intended to demonstrate the variety of activities and approaches now being employed to promote pollution prevention and highlight some of the unique programs now in place. However, inclusion here is not intended as a "stamp of approval" for any given effort; this is simply a summary of the types of activities now underway.

Summaries are grouped into six categories: Collaborative Efforts, Regulatory Innovation, Innovative Implementation, Technical Assistance Programs, Task Forces, Pilot Projects, and Incentive Programs in the States. Examples and discussions in each category provide an indication of the different methods by which States have accomplished similar goals and how similar resources are being applied differently by different programs. Some programs have been established for several years, other programs have been recently altered, and still others can be considered to be in their infancy. Some of the programs summarized do not have pollution prevention as the basis of activity, but are considered innovative for other reasons.

Without fail, the same central factor is the key to the success of each of these programs: the people behind the effort. It is clear that the people working within these programs are committed to finding better solutions, regardless of the burdens which stand in their way. By showing these success stories, it is hoped that other factors can be identified as key to overcoming barriers in the pursuit of comprehensive environmental solutions.

COLLABORATIVE EFFORTS

WASTE REDUCTION AND RECYCLING IN WASHINGTON STATE

All divisions of the Washington State Department of Ecology are trying to change the thinking that waste is only a management issue and not a minimization issue. As part of the effort to accelerate this change, the Waste Reduction and Recycling Program is driven to publicize the projects which have been successful, promoting waste reduction at every possible opportunity.

"For too long now, the issue of solid and hazardous waste have been considered a management problem, not a minimization problem. This has to change."

Mark McIntyre, Washington State Department of Ecology

As a division of the Washington State Department of Ecology, the environmental regulatory agency for the state, the Waste Reduction and Recycling Program provides technical assistance to two different groups: local governments and business/industry. The approach to these audiences is not regulatory or enforcement-oriented. What sets this program apart from many (but not all) other programs is that every person employed by the Waste Reduction and Recycling Program approaches facilities with a multi-media stance.

This predisposition for multi-media integration stems from deliberate actions on the part of Program Manager William Alkire. Alkire sees the multi-media approach as a critical component for all activities undertaken by the Waste Reduction and Recycling Program. Multi-media integration is not achieved through a restructuring of the media programs, but through improved vertical communication within departments and horizontally between departments. This open communication hinges on a system of weekly and monthly meetings, where group activities are shared. Every division assesses the actions of other divisions and troubleshoots foreseeable problems. When deemed appropriate, two divisions will team up for projects with a cross-program method.

One example of the cross-program method was the teaming of the regional Air Quality office and the Local Waste Reduction office to address yard wastes. Air Quality regulations stated that, because of the threat of airborne pollutants, citizens could not burn yard wastes. Simultaneously, the local waste reduction program needed to publicize their yard waste composting program. These two divisions came together, utilizing the best resources of each division while each carried out their own mission. The result was an accurate relay of information to the public, while also offering a realistic and viable solution to the dilemma posed by yard waste. It is important to note that this example could have easily resulted in individualized projects and agendas by separate programs that would have been conflicting and confusing to the public, giving citizens no solution to disposal of their yard wastes.

"The recommendations for yard wastes, without the collaborative efforts between the divisions of Air Quality and Waste Reduction and Recycling, would have been made independently, thus sending mixed signals to the public, and offering no realistic solution at all."

Mark McIntyre, Washington State Department of Ecology

COLLABORATIVE EFFORTS

PARTNERS IN PREVENTION

The Illinois Environmental Protection Agency's Partners in Prevention Program advocates voluntary pollution prevention planning. In the absence of legislation mandating plans, the state relies upon this program to recognize the planning efforts of companies to bring about pollution prevention. The program is targeted to companies which release over 100,000 gallons of hazardous waste annually and those which release over 100,000 pounds of solid waste under SARA. Out of 325 companies identified by the state, 50 from this group have signed up for PIP, and 40 smaller companies which were interested also signed up.

To participate in the program, a company must enter into a pollution prevention agreement with the Illinois EPA. Upon signing an agreement, a company is placed in a certain phase depending on what activities the company is undertaking and what progress the company has made in pollution prevention. To further illustrate, the phases are outlined below:

- **Aspiring Partner** is the category for companies which have not begun to pursue pollution prevention in any way. This phase is designed to help companies get started with pollution prevention activities, and such activities are specifically outlined as goals for a company to meet in order to move on to the next stage as a partner.

- **Partner** is the phase for companies that are ready to begin pollution prevention planning, and is for companies that are committed to pollution prevention. In this phase, a company is guided by specific activities which show them how to proceed to the next phase, senior partner.

- **Senior Partner** is the phase for a company that practices pollution prevention as part of its every day way of doing business. For companies implementing their pollution prevention plan regularly, this status could be sustained indefinitely.

- **Sustaining Partner** is an optional phase for companies to go beyond the level of Partner or Senior Partner, allowing a company to demonstrate their support for pollution prevention throughout the state of Illinois. Again, there are specific activities outlined for companies to meet this status, along with contributions of money or activities.

In addition to the phases of recognition for companies, the Partners in Prevention Program has several options for companies to utilize in their pollution prevention planning. Among them are suggested techniques for companies to conduct community outreach, and a network (PIPNET) for technology transfer and resources.

The intent of this voluntary program is to make progress in pollution prevention by providing companies the means and recognition to implement their own facility-specific plans. Unlike under most planning legislation enacted to date, there are incentives for companies that escalate their pollution prevention efforts, whereas most legislation stops short by simply requiring a plan. The Partners in Prevention is performance-oriented and draws in companies that are serious about their commitment to pollution prevention.

COLLABORATIVE EFFORTS

THE TECHNICAL AND EDUCATIONAL ASSISTANT MODEL (TEAM)

SAN DIEGO, CALIFORNIA

The TEAM project, spearheaded by local governments in California, has set out to incorporate industry, academia, government, and the public in multi-disciplinary pollution prevention programs. The TEAM project evolved from discussions of data collected for the Hazardous Waste Management Plans, during which interest was expressed by many representatives in preventing the generation of hazardous waste. The County Health Departments of San Diego, Ventura and San Bernardino counties, along with the EPA and the State Department of Health Services, began the multi-agency effort.

One of the most important factors identified by the leaders of TEAM is the need to change agency cultures, which are currently focused on "end of the pipe" technologies. The aim was to incorporate behaviors that institutionalize pollution prevention. As part of this mission, the county of San Diego began by looking at their own region to assess what specific or unique environmental problems they faced, and what exactly the Department of Health Services (as the lead agency) was responsible for and could do, so that they could act as a model for other agencies.

Of primary concern to San Diego County was the volume of hazardous waste generated, totaling about 100,000 tons. The county found that there were three media-specific agencies enforcing environmental laws, and that, when facilities were inspected, media-specific recommendations for waste reduction sometimes resulted in inadvertent transfer to other media. To remedy this situation, San Diego county appointed a task force to identify strategies for overcoming the inadequacies of the current program. The task force, comprised of members from local environmental agencies, city/county planning departments, and fire departments, made the following recommendations:

- Promote a consistent policy in both county and city programs which provides incentives to minimize the use of hazardous materials and the emission of pollutants from both government and industry operations.
- Advocate for sufficient staff and resources to institutionalize pollution prevention.
- Devise a strategy for multiple levels of educational outreach which utilizes a multi-disciplined approach to pollution prevention.
- Advocate cross-training of staff of local environmental agencies.
- Through administrative changes, enact a comprehensive evaluation of county-wide pollution prevention activities, summarizing the findings into an annual report for use by multiple agencies.

Evidence of the program's success includes a number of resources and models which are utilized by local governments throughout the state of California, the continuation of task force, and the example which San Diego has set for other cities and counties to follow. Like other successful programs, one of the most predominant success factors is the people in the program, as well as those outside the program who have either directly supported or set precedents for this program to follow. San Diego officials attribute the success of their program to the commitment of the upper management and the countless federal, state and local government employees who have been and continue to be committed to pollution prevention.

"Within the County Health Department, we are just starting to convince the enforcement and inspections staff that bean counting is not cutting it anymore."

Linda Pratt, San Diego County Health Department

REGULATORY INNOVATIONS

REGULATING OZONE DEPLETERS

IRVINE, CALIFORNIA

In response to national and international legislation which is seen as inadequate, twelve cities and ten states are enacting laws which reduce the use and emissions of ozone-depleting chemicals beyond restrictions established by national and international standards. Irvine, California passed an ordinance in August 1989 which became effective in July, 1990. It is outlined below:

1. Prohibited by the Ordinance:

Use of ozone depleting chemicals and halons in

- *manufacturing*
- *foam packaging*
- *insulation made with ozone depleting compounds*
- *service industries*

2. Restricted by the Ordinance (activities subject to city approval):

City-approved recovery and recycling system must be used:

- *In the service of equipment using CFC refrigerants and halon fire suppressants*
- *By facilities which buy CFCs*

City approval is needed:

- *For disposal of insulation, air conditioning equipment and refrigeration units*
- *For special testing of halon fire suppressants*

3. Facilities which are exempt from the Ordinance:

- *Military contractors*
- *Health care facilities*
- *Manufacturers of medical devices and drugs*
- *Researchers looking for alternatives*

- Persons who demonstrate that no technically or economically feasible alternative is available
- Users that emit less than 55 gallons annually

4. Recycling requirements are as follows:

- For mobile air conditioning, a U.L. approved recovery and recycling system, or a method of recovery and recycling which is equivalent
- For stationary air conditioning and refrigeration applications, a commercial recovery and recycling system can be used to collect CFCs and ship them to a recycling facility

In enacting this legislation, the city had a two-pronged mission: to minimize the use and emissions of targeted chemicals (CFC-113 and 1,1,1 trichloroethane), and to act as a model for other municipal, state and federal agencies to mandate reductions. In carrying out this ordinance, the primary emphasis is on education followed by enforcement. Through workshops, fact sheets, newsletters, media coverage, mailings and direct technical assistance, the city has heightened the awareness of businesses to the requirements of the ordinance and to information on alternatives to ozone depleting chemicals. Such information has also been circulated to nearby communities and government agencies.

Success of the ordinance was seen early on in that businesses responded to the ordinance before it was passed, relying on the notion that if the city didn't pass it, another level of government agency would. The result of the ordinance is that it forced companies to take a critical look at the usage of ozone depleters and consider substitutions and production alternatives. Prior to this ordinance, federal standards on the use of ozone depleting compounds did not force companies to reassess their operations to this extent.

Enforcement of the ordinance has been through on-site inspections and follow-up phone calls to facilities. The goal of this so-called enforcement is not control; it is getting facilities to look at and become committed to alternatives in the production process. This task can be overwhelming in California, given the combination of restrictions, both regulatory and environmental. As an example, when an electronics firm looks for options for cleaning conductors, there is hesitation to recommend aqueous cleaning because there is the concern for chemicals involved in the process, and there is a movement toward minimal water use. There is a need to avoid both the excessive use of water and disposal of a chemical which is considered hazardous waste.

Enforcement of the ordinance is targeted to 30-40 facilities in the city. Industry receptiveness to this ordinance has been hesitant, with concerns mostly centered on enforcement of the ordinance. Companies are concerned with what will happen to them if they are found violating the ordinance. Where the drive to find production alternatives is concerned, companies that have devoted a great deal of effort toward engineering research for alternatives feel short-changed, especially if their efforts have not produced a suitable alternative. Another source of resentment on the part of some companies is that they think they are being singled out too early. Some companies believe that such legislation will be coming to all industries in about five years, so why should they have to bear this burden now, when other companies do not? It is important to realize that California companies must comply with numerous regulatory requirements that few other states have.

Irvine is also serving as an example for other cities. By working with various agencies and organizations, Irvine has been assisting other cities interested in an "ozone depleters ordinance" and has enlisted the support of the South Coast Air Quality Management District (SCAQMD) to help enforce their own ordinance. The District has also adopted a policy to eliminate the use of ozone depleters throughout the region by 1997. Irvine's initiative was adapted by the SCAQMD staff in drafting rules to require recovery and recycling of automotive air conditioning refrigerants. The future activities for the City of Irvine include pollution prevention and source reduction of toxics. These efforts will be directed at assisting area businesses and citizens.

REGULATORY INNOVATIONS

TARGETTING FOR PLANNING

CALIFORNIA PLANNING LAW

The California Hazardous Waste Source Reduction and Management Review Act of 1989 focuses on source reduction of hazardous waste, and puts the responsibilities on the generator to implement. The Department of Health Services verifies the plan and may mandate that a generator show its plan at any time. While this is one of many examples of state facility planning legislation, the unique aspect of this legislation is that the Department is targeting facilities for planning. The legislation is designed to make industries look at options for source reduction as opposed to simply looking at the end of the pipe treatment options. At this point, the approach of the Alternative Technologies Division, (ATD) which is responsible for enforcement of the legislation is education-based, and efforts are geared toward facilities meeting planning requirements.

The first-year group that will have their plan summaries "called" includes a number of manufacturing facilities that are unique to the California area. Targeted are more than 160 aerospace industries, 28 petrochemical refinery companies, over 200 painting and coating technologies, and the semiconductor manufacturing industry. Once these industry plans have been thoroughly reviewed, future efforts will focus on other industries. For the time being, the Department is overwhelmed with the task of reviewing these plans.

Enforcement of the legislation is somewhat uncertain at this juncture, because plans do not have to be implemented by facilities when it is not economically feasible for them to do so. However, ATD checks certain elements of the plan for "completeness," which is enforceable. Plans can also be compared to those of similar industry facilities. If the facility in question is asserting that a change cannot be implemented for economic reasons, for example, ATD personnel can draw upon the example of a similar industry facility that did implement the change as supporting evidence.

INNOVATIVE IMPLEMENTATION

POLLUTION PREVENTION FOR INDUSTRIAL DISCHARGERS

LOS ANGELES COUNTY SANITATION DISTRICTS

The Los Angeles County Sanitation District's Wastewater Ordinance states: "Recovery, reuse and waste minimization procedures established by industrial wastewater dischargers to meet the limitations set on their discharges will be preferred by the Districts over those procedures designed solely to meet wastewater discharge limitations." The Sanitation Districts have established a program that adds prevention to their focus on pretreatment regulations. The Sanitation Districts provide sewer treatment and refuse disposal for half of the population in L.A. county.

The change to pollution prevention involves incorporating language into outreach materials and correspondence with new facilities. They also use industry-specific opportunity checklists to help identify where pollution prevention can be enacted. The staff of the Sanitation Districts is also receiving training on pollution prevention. The approach will likely expand to other programs such as landfills and Publicly Owned Treatment Works (POTWs). The audience for this pollution prevention approach is the regulated community which discharges to POTWs.

Expansion of pollution prevention efforts will occur in the following areas:

Technical Assistance: A pollution prevention engineer and a permit engineer conduct voluntary source reduction audits. These engineers visit a facility and request a walk-through audit with an industry representative. Source reduction opportunities are discussed with the industry representative and reviewed with the industry. There are three and six month follow-ups to gauge industry activity in source reduction.

Permit Requirements: Future permits must include their plan in accordance with Senate Bill 14 (planning legislation), and a report, if applicable, or a pollution prevention opportunities checklist.

Staff Training: Inspectors and engineers will receive waste audit training.

Enforcement: Upon notification of a first time violation, a facility must review source reduction options as solutions to eliminate future enforcement actions. A narrative of this review must be included in the report to the enforcement section.

The Pollution Prevention program is considered successful in meeting its goals:

- Staff engineers and inspectors have gained a greater awareness of pollution prevention and their attitude changes exemplify this increased awareness.
- Regulatory staff have taken the initiative in incorporating pollution prevention into policies, permit requirements, reporting requirements and enforcement compliance records.
- There has been an increase in the number of requests for assistance from permit engineers and inspectors to help regulated industries on pollution prevention.
- There has been an increase in the number of written requests for pollution prevention information from the various information outreach efforts and request for information forms.

INNOVATIVE IMPLEMENTATION

LOCAL PROGRAMS WITH POLLUTION PREVENTION INTEGRATION

MINNEAPOLIS-ST. PAUL, MINNESOTA

County enforcement agencies in some states have been successful in promoting pollution prevention to the industries in their areas. In the seven county metro area surrounding Minneapolis-St. Paul (MN), counties have been delegated responsibility for regulating hazardous waste. County officials found that the most comprehensive solution to the problems posed by hazardous waste is to prevent it from entering the environment through a combination of strategies. This involves recommending pollution prevention as a better way to comply with environmental regulations.

Through an educational approach, inspectors bring to the attention of generators the numerous financial, legal, public relations and environmental incentives to putting pollution prevention in place at a facility. In doing so, the inspectors make referrals to a local technical assistance program or to a similar industrial generator who has adopted a program with success. Another convincing point of pollution prevention that makes it applicable to enforcement agencies is that it calls for measures which succeed in taking the generator beyond compliance or "closing the loop," taking the generator out of regulatory consideration.

"Through an educational and training approach, Scott County has convinced most of the chemical manufacturing companies in the area to implement a closed loop system."

Al Frechette, Scott County Environmental Health Department

The factors which contribute to the success of these programs include:

- The incentives are inherently local (for both inspectors and generator operators).
- The scope is realistic and attainable.

- The frequency of contact between inspection agencies and generators is about once a year (a better average than most local or state inspection programs).
- The public relations implications can boost a company's reputation or ruin it, due to the fact that the generators are so well-known in community circles.

Another factor which plays a significant part in the success of this program is the fact that officials within some companies actually set aside a portion of their time to address pollution prevention issues within their facility. The result of this is that industry drives the standards higher and legislation is established to uphold the higher standards.

TECHNICAL ASSISTANCE PROGRAM

WASTE REDUCTION ASSISTANCE PROGRAM IN FLORIDA

As one example of the many technical assistance programs currently in operation, the Florida Waste Reduction Assistance Program (WRAP) stands out as a successful program. Like others, Florida WRAP utilizes a non-regulatory, educational approach to teach generators about the incentives of changing processes and behaviors to bring about pollution prevention.

In approaching generators, WRAP utilizes a hierarchy of waste management alternatives and identifies opportunities for pollution prevention at all facilities. In order to carry out the mission of the program, funding is secured through the state to employ full-time staff for the WRAP. Staff also includes 18 pollution prevention partners, who are retired engineers employed on a part-time basis. The WRAP is currently offering an information clearinghouse, research activities, education and training, and awards for excellence. Future plans for the program include expanded training and educational events, pollution prevention incentive grants, and local government program development.

Florida WRAP, while funded by the state, is not based on legislation. From the onset, WRAP approached its pollution prevention mission without rules. As a result, WRAP began with a wide latitude in their approach. This program still receives wide latitude in part because they achieve results above and beyond what would be expected of a staff of this size.

An example of one activity is the unofficial intra-agency multi-media group, which was formed by state government, but not given any funding. Contacts throughout the state call members of WRAP staff about projects which pose opportunities for pollution prevention. This informal referral and review process is driven by the awareness of other WRAP success stories.

Florida WRAP is successful because its staff does not overwhelm a generator with reports and information. WRAP does not impose expectations upon generators; rather, the staff makes recommendations which are realistic in application to the facility and its employees. Another success factor for WRAP is the program's director, who is very successful at obtaining resources from bureaucracies and at providing motivation to staff members of WRAP. As testimony to the success of the program, WRAP no longer looks for projects to do; the projects now come to WRAP as referrals on the momentum of other successful projects.

TASK FORCES

DRAFTING PLANNING LEGISLATION

MINNESOTA

From October of 1989 to February of 1990, the Toxics Use and Industrial Waste Reduction Steering Committee met six times to establish draft legislation which was amended by the Minnesota State Legislature and in May, 1990 was signed into law as the Minnesota Toxics Pollution Prevention Act. The initiative for pollution prevention legislation was recognized by the Minnesota Office of Waste Management (OWM). OWM organized an initial meeting, inviting representatives from industry, business, environmental groups, and legislative agencies to acknowledge the need for reducing the amount of toxic chemical waste being generated in the state. Once this general consensus was established, OWM drafted a proposed list of members to be on the newly formed Toxics Use and Industrial Waste Reduction Steering Committee (TUIWRSC). Among the proposed members were representatives from the Minnesota Pollution Control Agency (MPCA), Minnesota Technical Assistance Program (MNTAP), the Minnesota Chamber of Commerce, the Toxics Use Reduction Network (TURN), the 3M Corporation, the metal plating industry, and OWM; the final membership roster varied little from the proposed list.

As preparation for the first meeting of the steering committee, OWM drafted a meeting agenda which laid out points of discussion: 1) a mission statement, 2) points of consensus, and 3) issues for further discussion. In addition, this meeting agenda also stated the goals that OWM was trying to achieve, attempting to identify areas of general agreement upon which to expand, followed by discussion on whether relevant issues have been correctly categorized at the previous meeting. OWM's goal was to come to a consensus on as many issues as possible over time.

The first steering committee meeting established a mission statement: "The purpose of this group is to develop a strategy for the state of Minnesota that will encourage reduction in the use of toxic and hazardous substances and will encourage multi-media reduction of industrial pollutants at the source." Following that, the steering committee members came to a consensus on six of the seven points presented in the OWM agenda:

- pollution prevention
- the multi-media approach
- technical assistance
- regulations which are disincentives
- the need for training and continuing education programs
- support of top management

Last on the OWM agenda were issues to discuss further, which addressed what chemicals should be listed, and what barriers to pollution prevention exist.

The second meeting of the steering committee was held November 29, 1989 and was mostly overview, with a presentation of the 1988 TRI data.

The third meeting of the steering committee was held December 19, 1989 and was highlighted by OWM's presentation of "Draft Multi-Media Reduction Strategy," an outline of a bill to be presented in the upcoming 1990 session. This draft was an adoption of the consensus points established during the first steering committee meeting, along with other points which had been discussed, but not agreed upon. This presentation became proof of OWM's intentions to introduce and get passed a bill in the upcoming session of the state legislature.

The fourth steering committee meeting was held January 25, 1990, and covered comments on the reduction strategy, budget and staff needed to implement a strategy, and possible funding mechanisms. Disagreement was voiced by business and industry factions on use data as a part of the reduction policy (they wanted *emissions* reductions.) Other points of disagreement were the possible funding mechanisms, upon which consensus was never achieved, and the possible applications of technical assistance, upon which big and small business representatives held differing opinions.

The fifth steering committee meeting, held February 2, 1990, found members discussing draft language for the proposed legislation. OWM circulated a draft of the "Minnesota Pollution Prevention Act," which included provisions for technical and research assistance to generators of hazardous waste, grants for pollution prevention, pollution prevention plans and progress reports. At this point, environmental representatives expressed discontent on the lack of use data language in the draft, as well as the omission of language regarding technical assistance to citizens. At the same time, the Minnesota Pollution Control Agency (MPCA) expressed dissatisfaction with the

omission of enforcement provisions. The second issue of discontent for the MPCA was the fact that the bill, if passed, would result in additional staff and defined implementation roles to many state environmental agencies: OWM, MNTAP, and the Emergency Response Commission (ERC) -- the MPCA was **not** one of them.

The sixth and final meeting of the steering committee again found representative in disagreement over what facilities should be eligible for technical assistance. The determination on eligibility requirements for technical assistance was never resolved, but the provision in the Minnesota Toxics Pollution Prevention Act (MTPPA) set aside \$560,000 for this program. Other issues left unresolved by the steering committee included funding mechanisms and use reductions. The MTPPA states: "~~...Reduce, reducing, or reduction.~~ This term is used in the definition of pollution prevention. It means lessening the quantity or toxicity of toxic pollutants, hazardous substances, and hazardous wastes used, generated, or released at the source."

The outcome of this steering committee's activities was draft legislation that, in its final legal form, is similar to other states' planning legislation. The role of the steering committee in forming this legislation was that of a traditional sounding board utilized to encompass as many agendas and views as possible. The acknowledged disagreements and disparities are part of this traditional process, and are inevitable in the attempt to arrive at a consensus.

TASK FORCES

REGIONAL HAZARDOUS WASTE PLANNING

CALIFORNIA

In the nine counties surrounding San Francisco and San Jose, there is a group which is comprised of a representative from each county in the region known as the Tanner State-Wide Hazardous Waste Planning Committee. This two-year old committee guides the development of hazardous waste planning. The primary focus is on small quantity generators (primarily metal finishing facilities and automotive care) and Publicly Owned Treatment Works (POTWs), both of which emit heavy metals into the San Francisco Bay Area. They also consider non-point sources. The committee addresses the problems faced by the nine county metropolitan area by working cooperatively to bridge gaps between regulated facilities and regulatory agencies.

Through workshops and forums, the committee works to increase the level of communication, assisting companies with limited resources, time and incentives to meet compliance standards. The committee emphasizes employing pollution prevention concepts in doing so.

"Among the success factors for the Tanner State Wide Hazardous Waste Task Force are good dialogue, staff personnel, and the fact that we invest people in the solutions to their own problems."

Isao Kobashi, Program Manager, Santa Clara County Hazardous Waste Management

In addition to this technical assistance function, these nine county representatives meet with city officials to review planning for the nine county area. State legislation sets out planning for industrial facilities as a voluntary procedure. The State determines whether a county has had a shortfall based on the planning legislation, and if so, the county is responsible for the waste. Because companies which are non-responsive to the planning requirements generally have no regard for their location, a county can be saddled with enormous responsibilities.

As an effort to lessen this burden, shortfalls are determined on a regional (not county) basis. In this manner, the area is able to distribute the burden, mitigating the exposure of facilities which are non-responsive with regard to location. Further, counties can approach planning legislation proactively. For illustrative purposes, when shortfalls are found in the region, the responsibilities are delegated to counties according to their descending shortfall. The county with the greatest shortfall is responsible for the highest risk activity conducted in the region (maintaining the regional incinerator), and responsibilities are delegated to counties accordingly.

The system of shortfalls and responsibilities provides a double incentive for counties to promote their efforts, because in addition to their own county, their efforts directly affect eight other counties. The committee also provides a forum where environmental and hazardous waste issues may be "aired." With representatives from cities attending these forums, the review base becomes broader. The program has evolved from planning to waste management to pollution prevention. Funding for the committee has been and continues to be secured through voluntary contributions and grants. The committee attributes its success to the people who comprise it and their approach to business. Of particular interest is the great dialogue which is ongoing between business and regulators. Through this committee and their activities, success has been investing people in the solutions to their own problems.

PILOT PROJECT

PUBLIC/PRIVATE PARTNERSHIP

LAKE SUPERIOR

The Minnesota Pollution Control Agency (MPCA), has joined forces with the Western Lake Superior Sanitary District (WLSSD) to achieve significant reductions in the discharge and emission of toxic chemicals into Lake Superior and the surrounding environment. This effort illustrates a public/private partnership which seeks the cooperation of regulatory agencies, businesses, academia, and environmental groups. The partnership was established in July of 1991 as one of several initiatives of the Minnesota Toxics Pollution Prevention Act (MTPPA) enacted in 1990. Through MTPPA and urging of the International Joint Commission (IJC), a bi-national organization which addresses problems along the U.S.-Canadian border, Lake Superior was targeted as a pilot project for demonstrating zero discharge of toxic pollutants from point sources.

The primary focus of the partnership is a multi-media inspection program, a joint effort by the Sanitary District and the MPCA. Within this multi-media approach there will be a strong emphasis on using pollution prevention to come into compliance. As part of this, the MPCA is seeking funding for a position within the District to train inspectors and industrial staff on pollution prevention. The joint inspections will explore various ways in which a facility may come into compliance, with each inspection geared to be facility-specific and in accordance with the permits held by that facility. These inspections are also likely to promote voluntary activities by facilities. Along with technical assistance, a service which might be offered is a pre-inspection conference to help the facility identify and achieve compliance prior to the full inspection.

Incentives for companies to participate in the inspection program are synonymous with pollution prevention: one-stop inspections, cost savings from pollution prevention measures, free suggestions for pollution prevention (from the MPCA and the Minnesota Technical Assistance Program), public relations factors, and cost savings associated with noncompliance (through the elimination of fines or litigation costs).

One hoped-for outcome of this project is to give companies a multi-media focus and to "sell" pollution prevention on a long term basis. The primary goal is to reduce discharges into Lake Superior through implementation of pollution prevention.

INCENTIVE PROGRAMS

GREEN INITIATIVE

DELAWARE

The Green Initiative is a collaborative effort on the part of the Delaware Development Office and the Department of Natural Resources and Environmental Control. It is premised on the idea that both the use of recycled materials and waste reduction at the source are vital to solving the pollution problems in Delaware. This initiative is designed to provide incentives to business and industry to use recycled materials in their manufacturing processes. The program also offers incentives to companies that reduce the amount of waste produced in manufacturing and emissions to the environment. In order for businesses to be eligible for these incentives, they must fit into one of the following categories:

- Companies with raw materials/components of production must be composed of at least 25% recycled materials or materials removed from the municipal waste stream.
- Companies that either process or recycle materials removed from the municipal waste stream, reselling such materials to manufacturers as raw materials or production components.
- Companies collecting and redistributing recycled materials which have been generated in Delaware.
- Companies which voluntarily reduce waste generation of chemicals under the Toxics Release Inventory by 20% and other wastes by 50%.

Incentives made available to the companies will include: site-specific technical assistance, training assistance, expedited environmental reviews, voluntary audits, marketing assistance, information from the Delaware Pollution Prevention Clearinghouse, and advocacy for other state and local approvals. In addition, there are a number of financial incentive programs slated. However the specific details regarding these financial incentives are required to be withheld until they have been approved by the Delaware Legislature.

INCENTIVES PROGRAMS

PRE-PAID FEES FOR WASTE REDUCTION ASSISTANCE

NEVADA

Nevada generators of hazardous and toxic wastes are being provided technical and research assistance for waste reduction initiated, as well as funding to cover the administration of such programs. Their incentive to avail themselves of these services is that they have paid for the services in advance. The funding of this program, though somewhat convoluted, serves more than one purpose.

Funding is generated through fees paid by operators of disposal facilities for hazardous and industrial wastes. These operators pay quarterly based upon the tons of waste disposed of in that facility. Included with the fee payment is a detailed accounting of the waste volumes collected, to ensure that the fee corresponds to the amount of waste taken in by a facility.

The second aspect of this fee system is the mandate that operators [of disposal facilities for hazardous and industrial wastes] raise their disposal rates per ton to the rates of similar facilities in California. This change was implemented so that transportation of hazardous and toxic wastes from California would cease. There are some critics of this mandate, including operators of landfills, contesting that the price hike is a violation of interstate commerce and hinders economic gains for the state.

The grant money that is generated through this method goes to generators for pollution prevention. The allocation of the grant monies is solely up to the generator to use. The only stipulation is that the grant money be used for actions that bring about pollution prevention. Generators can use the money for consultants, equipment, on-site recycling programs and other source reduction programs. In contrast, other state programs that grant money put strict limitations on where the funding is allocated.

INCENTIVES PROGRAMS

INDUSTRIAL TAX EXEMPTION PROGRAM

LOUISIANA

Louisiana's Industrial Tax Exemption Program, which has been in effect since 1938, was modified by recent political influences, changing the legislation dramatically. The legislation was originally intended to attract industries into the state, thus producing jobs for citizens and capital for the state. The program exempts over three hundred million dollars in taxes every year. Upon the election of Governor Roemer, the incentive program went under a reformation to tie the industrial incentives to environmentally responsible actions by the industrial companies.

In reforming the tax exemption program to consider environmental factors, the LDEQ devised a point system to tie 50% of an industry's tax incentive to its environmental score. As a result, up to 50% of the exemption amount requested depended upon the environmental review of the company's activities, 25% from previous activities, and 25% from the jobs to emissions ratio. For purposes of the environmental evaluation, only violations which have been finalized would be counted against the firm. Each company would begin with 50 points and deductions would be made for violations in the jobs to emissions category. In rating the environmental reviews, the program will consider violations of the past five years, with older violations counting less than recent ones, diminishing in value each year until the sixth year when it goes off the company's record. In order to prevent the resistance of industry to violations and final decisions, the LDEQ stipulated that for every violation voluntarily settled, the impact upon the environmental review would be reduced by half.

Industries countered the LDEQ, challenging that this system was unfair because companies could only lose points, and thus the program was based solely on disincentives. Companies sought positive incentives to recognize the progress made and to get bonus points in the environmental review. Under the program new bonus points are available as follows:

- Facilities can receive up to fifteen bonus points (up to 15% applied to the exemption request) for an LDEQ approved emissions reduction plan.
- One point is to be awarded for facilities for every one percent of recycled hazardous waste in a closed loop system.

- Up to 10 bonus points are available to recycling companies which manufacture consumer products.
- Up to 15 bonus points are available for projects that create at least one new job for every \$30,000 in tax exemptions in counties where unemployment is one percent greater than the state average.
- Up to 10 points can be awarded to companies which diversify the economic base of the state

The LDEQ has placed certain restrictions on the tax exemption program:

- There will be a 50% reduction in tax exemptions for any company producing more than 20% of a material banned by the USEPA.
- Companies which import more than 15% of their hazardous waste for disposal, or import hazardous waste from other facilities owned by a parent or subsidiary of the parent for disposal in Louisiana will not receive any tax exemption.

The support of Governor Roemer and his administration was crucial to this change in the use of tax exemption monies. However, in light of the recent election results, the future of the program is in question. The value may be in its use as a model for other states to examine and perhaps modify.

APPENDIX C
Itinerary

APPENDIX D
Business cards of persons contacted

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**SRI LANKA - MINNESOTA WASTE MINIMIZATION PROGRAM
INSTITUTIONAL MISSION**

AGENDA

DATE/TIME	INSTITUTION	VENUE
OCTOBER 11 10.00 AM 3.30 PM	MEIP/USAID/NAREPP NDB	MEIP -OFFICE, BATTATARMULLA NDB-COLOMBO
OCTOBER 12 9.00 AM 11.00 AM 1.00 PM 3.30 PM	MKC INDUSTRIES AGRO TECHNICA HAYLEYS SUNFRÖAST COCOLANKA	JA-ELA EKALA INDUSTRIAL ESTATE EKALA EKALA
OCTOBER 13 9.00 AM 11.00 AM 1.00 PM 3.00 PM	KEELS FOODS SWEDESHI INDUSTRIES RICHARD PERIES LANKEM	EKALA JA-ELA EKALA EKALA
OCTOBER 14 9.00 AM 2.00 PM	CISIR-LABORATORY UNIVERSITY OF MORATUWA (CIVIL & TEXTILE DEPT.)	COLOMBO MORATUWA
OCTOBER 15 9.00 AM 10.30 AM 12.00 PM 3.30 2.00 PM	BOARD OF INVESTMENT CEA NBRO NDB (discussion)	COLOMBO COLOMBO COLOMBO NDB-COLOMBO
OCTOBER 16 10.00 AM	WARP-UP MEETING	COLOMBO RENAISSANCE

SAMAN HEMANTHA JAYARATNE B.Sc (Agri.)
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A Project of the United States Agency for International Development
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APPENDIX E
Curriculum vitae

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WRITAR is a 501(c)(3) independent non-profit organization facilitating the implementation of techniques and technologies that reduce waste generation at the source and optimize resource use. WRITAR's non-advocacy approach emphasizes research and education that builds capacity in organizations and individuals seeking to change their practices and processes in order to balance all their effects, with a special emphasis on environmental effects.

President/Co-Founder

July 1, 1990 - present

- Coordinate core professional staff team functions and participate in projects on an on-call basis, providing materials development and technical review
- Maintain network of WRITAR clients and partners by providing reviews and serving in an advisory capacity
- Seek and manage projects in the focus areas of information quality and management; program development and evaluation; technical assistance
- Develop and test training approaches that reach across functional boundaries; manage WRITAR's training mission

MnTAP (Minnesota Technical Assistance Program)

University of Minnesota, Minneapolis, MN

Scientist

1987 - 1990

Precious Metal Platers, Inc.

Hopkins, MN

Production Manager/Plater

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Affiliations

Chair, subcommittee of the National Advisory Council on Environmental Policy and Technology performing short- and long-range for the Pollution Prevention Information Clearinghouse operated by the United States Environmental Protection Agency

Member, Working Group on Cleaner Production in Metal Finishing Industries, United Nations Environment Program

Member, Technical Advisory Committee on Business Issues and Funding Issues Workgroup, Great Lakes Protection Fund

Education

University of Minnesota

Minneapolis, MN

B.S. - Technical Communication

1987

Accomplishments

Training Activities

EPA Region III (Philadelphia), training to Agency management in waste minimization options and strategies, October, 1988 and January, 1990

Waste Reduction Assistance and Technology Transfer (EPA Region IV - Atlanta and TVA), training for retired engineers to conduct technical assistance in waste minimization for metal finishing industry, February, 1989

UCLA, Seminar on Industrial Processes, waste minimization options for the metal finishing industry, March, 1989

Center for Environmental Research and Information (EPA), training for waste minimization in the metal finishing industry, seminar series, Chicago, Seattle, Boston, Los Angeles, April-December, 1989

United States Army Environmental Health Agency, Aberdeen Proving Ground, MD, training for engineers to conduct metal finishing waste minimization audits and implementation studies, September, 1989

California Department of Health Services, waste minimization training for regulatory personnel, seminar series, Los Angeles, Oakland, Sacramento, September 1989.

EPA Region IX and Santa Clara County, CA, training for electroplaters in rinsing process modifications and production, November, 1989 and June, 1990

Retired Engineers Waste Reduction Assistance Program, (Florida Technical Assistance Program), training for retired engineers to conduct technical assistance in waste minimization for metal finishing industry, December, 1989.

Minnesota Pollution Control Agency, training in industrial processes for regulatory personnel, seminar series, Monthly, 1990

Directed research at three companies under Small Quantity Generator Research Program, EPA-ORD, 1987-1988

Lead manager for pilot projects in waste minimization at metal finishing companies under grant program for EPA-ORD, 1989-1991

Project manager for "Industry/University Cooperative Effort in Waste Minimization", with Meco USA, Inc.; Clemson University and the University of South Carolina.

Prepared text for "A Minnesota Manual for Pollution Prevention Planning", with A. Innes.

Project manager for cooperative effort with USEPA ORD and TVA to develop and pilot pollution prevention training materials for four industry sectors.

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Publications**

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Updated 10/93

APPENDIX F
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- Establishment of an Environmental Unit within the National Development Bank, Sri Lanka",
- Questions for use in meeting on the design of a waste minimization program for Sri Lanka, eliciting responses from industry on possible design elements

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