Commission for Environmental Cooperation of North America

Summary of the Workshop on Exploring Pollutant Release and Transfer Data in North America: Experience and Future Opportunities in the Academic Community

23 March 2002

Montreal, Quebec, Canada

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Introduction

On 23 March 2002, in Montreal, Canada, a group of twenty-five people from the academic community throughout North America met to discuss their research experiences using pollutant releases and transfer registers and to explore future opportunities. A pollutant release and transfer register (PRTR) provides detailed data on the types, locations and amounts of chemicals released on-site and off-site and the amounts of chemicals transferred for further waste management by facilities. The workshop was hosted by the Commission for Environmental Cooperation (CEC) to facilitate collaboration among the academic communities in the three countries.

The workshop was structured around three roundtables:

Roundtable 1:   What can be learned by analyzing PRTR data in conjunction with data on economic and/or social measures?

Roundtable 2:   What relationships can be drawn between PRTR data and environmental health measures?

Roundtable 3:   What can PRTR data tell us about the effectiveness of public policy?

Victor Shantora, Head of the Pollutants and Health program area at the CEC, welcomed the participants. Erica Phipps, PRTR Program Manager, outlined the objectives of the meeting, the CEC's PRTR program and global PRTR activities (see attached presentation). Participants described their areas of interest and the main findings of their recent research (see attached participant summaries). Sarah Rang, consultant to the CEC, provided an overview of the Ad Hoc PRTR Group and the findings of the recent *Taking Stock 98* report (see attached presentation).

Roundtable 1: What can be learned by analyzing PRTR data in conjunction with data on economic and/or social measures?

Many of the participants had experience in analyzing PRTR data in conjunction with financial, economic or social measures. Participants described their areas of research:

Madhu Khanna, University of Illinois (Khanna1@uiuc.edu) described a set of studies examining U.S. Toxics Release Inventory (TRI) data and corporate behavior. TRI data show substitution from on-site to off-site releases and transfers, with no significant change in total toxic releases. One study found that the 33/50 program had a significant effect on reducing TRI releases. The profitability of a facility or company was not an important factor in the decision whether to participate in a voluntary emissions reduction program such as the U.S. Environmental Protection Agency (EPA) "33/50" program. Larger facilities and companies and those more in contact with consumers were more likely to participate. Other research examined corporate environmental management systems (EMS) and also found that larger, more consumer connected companies are more likely to develop EMSs. The adoption of an EMS does not have a significant effect on on-site releases, but does seem to reduce off-site transfers per unit of output. Firms that generated more hazardous air pollutants did not appear to be more active in making reductions.

Firms that participated in voluntary emission reduction programs experienced a positive effect on their market value, with an increase of approximately 1-1.5% (similar findings with the adoption of an EMS).
Firms' profitability may have decreased in the short term, but increased over the long term.

Seema Arora, Stanford Institute for Economic Policy Research (sarora@stanford.edu) had explored some similar types of analysis using TRI data and corporate behavior. Larger companies, those in competitive industrial sectors and those seeking to distinguish themselves from competitors were more likely to participate in voluntary emission reduction programs such as EPA's 33/50. The EPA's 33/50 program showed a significant effect in driving reductions in releases (more than the effect of just reporting to TRI). Firms that participated in the 33/50 program were not trying to evade regulations or "curry favor" with EPA.

TRI data can also be combined with census data to analyze environmental justice. Politically active jurisdictions tend to have lower TRI releases.

Event studies can be used to examine stock market reactions to pollution prevention claims. Under- performing firms were penalized in the stock market and those firms meeting or exceeding expectations experienced no payoff. This was similar to results seen for market reaction to financial disclosure about dividend prices. Using buy and hold returns, there was no apparent difference in stock market returns between under- and over-achievers after one year, but there was a positive performance for over achieving firms' in the longer term, over two years.

Paul Templet, Louisiana State University (ptemple@lsu.edu), has used TRI data with a variety of economic measures. He has developed a normalized measure of TRI, releases per job, which significantly positively correlates to poverty levels, crime statistics, gaps in income levels and health spending. Energy consumption is also positively correlated with TRI releases per job. In general, as mo re energy and chemicals are moved into goods and less into waste, then the facility, industry and jurisdiction become more competitive and experience more positive socio-economic measures and higher public welfare.

Jim Lee, American University (jlee@american.edu), a consultant to EPA, has used TRI data to estimate costs of environmental cleanup. Jim Lee discussed the need for caution in using latitude and longitude data and the need to recognize the strengths and limitations of the data.

Ruth Madsen, Thompson Institute of Environmental Studies, discussed the positive role of environmental information for communities. She also noted the need to report pesticides to NPRI, and the difficulty in obtaining information about pesticide use in Canada.

Eungkyoon Lee, Massachusetts Institute of Technology (vivakyoon@hotmail.com), discussed the difference between TRI and the Massachusetts Toxic Use Reduction Act (TURA), commenting that TRI emphasizes pollution releases and end-of-pipe solutions, while TURA encourages a materials accounting approach that can result in reductions in chemical use. The benefits of TURA were greater than the costs. While not required to do so, many firms had implemented their toxic use reduction plans.

Robert Klassen, University of Western Ontario (rklassen@ivey.uwo.ca), discussed how information disclosure affects people inside the firm, as well as outside investors. Robert Klassen uses surveys of facilities to assess the allocation of environmental spending between pollution prevention measures and pollution control measures. In general, pollution prevention measures have been more successful in reducing releases than pollution control measures. The personal values held by managers also makes a difference in environmental spending at the facility. He also noted the need to look at the whole supplier chain, as often releases can be moved up the supplier chain. Dr. Klassen's current research is focused on the role of ISO certification in reducing releases.

Subhadra Ganguli, University of California (subhadra98@hotmail.com), is examining the potential role of environmental factors in firms' decisions to relocate from the United States to Mexico (testing the pollution haven hypothesis). Electronics, textiles, computers, chemicals and metal manufacturing sectors have all shifted some production to Mexico. It is difficult to get data on releases from facilities in Mexico, although some data are available from the maquiladora sector. Dr. Ganguli noted that any assistance in obtaining data from Mexico would be appreciated.

Rina Aguirre, *Universidad Nacional Autónoma de México* (ras@correo.unam.mx), described the current system of voluntary reporting of 178 chemicals in Mexico, the *Registro de Emisiones y Tranferencia de Contaminantes* (RETC). Recently legislation making the RETC mandatory has been passed. It is difficult for industry to develop accurate estimates of releases in Mexico. Some sources are unique or need to be customized for Mexican situations.

Werner Antweiler, University of British Columbia (Werner@economics.ca), has used Canadian National Pollutant Release Inventory (NPRI) data to analyse green consumerism. It is difficult to directly measure consumer preferences, so an indirect measure was chosen. While green consumerism did "work", regulatory effects were found to be mo re important in reducing emissions than green consumerism.

Kathryn Harrison, University of British Columbia (khar@interchange.ubc.ca), described difficulties linking NPRI data to financial data, due to the number of companies that are not publicly traded, name misspellings, etc., which

resulted in only about a 30% coverage between NPRI and financial data. It is now possible to use Dunn and Bradstreet (DUNS) numbers, which may make the matching easier. An area to explore may be the role of estimation methods and what happens to releases when estimation methods change.

Nancy Olewiler, Simon Fraser University (olewiler@sfu.ca), is using NPRI data as a basis for potential financial instruments. She is interested in using NPRI data to measure the change in natural capital, and further link environmental and economic measures. Her areas of interest include ecological fiscal reform, through working with the National Roundtable on Environment and Economy.

Tisha Emerson, Baylor University (Tisha_nakao@baylor.edu), is interested in the effect of public disclosure on environmental performance. Her work builds upon some of the work by Madhu Khanna and Seema Arora, using toxicity instead of quantity of chemicals.

Jose Luis Lezama, El Colegio de Mexico (jlezama@colmex.mx), works with air quality policy and science in large urban cities. He is interested in the link between science and policy, and how to communicate research into policy actions. He was surprised at the 3 million tonnes of toxic chemicals reported as released and transferred in 1998 in the *Taking Stock* report, as this is less than the total for criteria air contaminants from Mexico City alone.

Several participants noted the wealth of expertise around the table and suggested that it could be combined into a series of articles or chapters, incorporated into the EPA's paper on uses of TRI, and/or described on the CEC web site.

Participants discussed their experiences in using TRI and NPRI data. Several areas were noted for possible improvement such as latitude/ longitude of facilities, standardization of parent company names, standardization of names of off-site transfer facilities, and use of identification numbers for off-site transfers for NPRI. NPRI has now provided a standardized pick list of names for off-site transfers, and TRI is also working on standardizing off-site names. Several participants noted that data quality in general was good, internal consistency was high, and that PRTR data was often "the only game in town." Estimation methods were an important determinant of data, and there was interest in the relative use of different methods and how this may influence results.

Participants were interested in sharing ideas on:
- o Standardization of latitude/longitude of facilities
- o Standardization of parent company names
- o Standardization of off-site transfer names
- o Role of estimation methods
- o Linking PRTR data to financial databases such as DUNS
- o Methods to take into account differences in facilities such as size
- o Ways to obtain financial data at the facility level
- o Increasing the use of PRTR data in sustainability indices, green investor funds, banks
- o Combining expertise to write a PRTR series for a journal
- o Increasing linkages among academics though web sites such as that of the CEC

Roundtable 2: What relationships can be drawn between PRTR data and environmental health measures?

Participants provided a summary of research in this area:

Kathryn Harrison, University of British Columbia (khar@interchange.ubc.ca), described her recent NPRI research indicates an increase in toxicity of some waste streams over time. There has often been a reduction in mass and an increase in toxicity. This trend is especially noticeable in some of the least visible waste streams such as underground injection and off-site transfers.

Matthew MacLeod, Trent University (**mmacleod@trentu.ca**), described efforts to incorporate PRTR and other data as inputs into environmental modeling. In general however, PRTR data are not sufficient to account for the

levels of contaminants seen in the environment. PRTR data needs to be supplemented with data on mobile, natural, small and other sources for contaminant modeling. The Canadian Ecological Modeling Center has developed several contaminant fate models for North America, for toxaphene, benzene and trichloroethylene. Working with other researchers at the University of Berkeley and Harvard School of Public Health, these contaminant fate models are now being linked with human exposure models.

Participants discussed the toxicity of chemicals, and how the differing toxicities of chemicals could be taken into account in PRTR analyses. There was interest in exploring methods of toxicity ranking and weighting. Each method of toxicity weighting has assumptions, and different methods will lead to different conclusions. Several existing sources were noted including the Scorecard site (www. scorecard.org), a background paper prepared for the CEC's PRTR Consultative Group meeting in Mexico City, February 2001 (**www.cec.org**) and some EPA methods (www.epa.gov).

The difficulty in establishing cause and effect linkages between environmental releases and health effects was discussed. Several participants were in favor of the precautionary principle approach, and reducing exposure to chemicals. One participant noted difficulties in working with health care data, and had correlated TRI releases and health care spending as a way around using health care data. The recent report by the National Environmental Trust and Physicians for Social Responsibility was noted as an important study linking TRI data to attention deficit disorder, autism and birth defects and other developmental conditions. Participants supported using a list approach in analyzing the PRTR data, such as the California Proposition 65 list.

Participants were also interested in methods to distinguish the importance of different waste streams, such as air, water and land releases.

Participants were interested in sharing ideas on:
- o   Methods to prioritize chemicals and waste streams based on health and environmental impacts
- o   Methods of toxicity weighting and ranking for PRTR analysis
- o   Increasing the linkage between releases and environmental impacts and health effects
- o   Methods to work with health data
- o   Access to recognized lists of chemical health effects such as carcinogens and neurotoxins
- o   Access to recognized lists of environmental effects such as persistence, bioaccumulation and toxicity
- o   Increasing the linkage among academics working on economic and financial aspects of PRTR data and those working on health and environmental impacts

<u>Roundtable 3</u>: What can PRTR data tell us about the effectiveness of public policy?

Participants discussed the balance and effectiveness of voluntary reduction programs and mandatory regulations. In general, regulation was seen as the most effective tool in reducing releases. The threat of regulation also could be effective in some scenarios. Some participants saw voluntary programs as additional strategies, and so any gains here were additional benefits. Others felt that if governmental resources were limited, it was more effective to devote these scarce resources to regulations rather than voluntary reduction programs.

The role of information disclosure as a method of reducing releases was discussed. In general, information disclosure such as PRTR rankings and reports was seen as an effective and relatively easy way to reduce releases. Participants also noted that the number of green consumers tends to be small, that many people are not aware of NPRI or TRI data, and that the culture of information disclosure is not well developed in Mexico.

Participants noted their experiences with companies reducing releases in response to rankings, new awareness of their releases and/or community pressures. Several participants had researched the value of ranking lists in motivating company behaviors, and found that many companies responded to rankings. The stock market response to rankings was shown to depend on the "surprise factor." Facilities in smaller communities sometimes faced more consumer pressure due to widespread local exposure. Companies also were driven to reduce releases by concerns over liability. The number of Superfund sites a company had influenced the balance between on-site releases and off-site transfers.

The role of pricing in influencing consumer behavior was discussed. Prices were seen as generally not supporting decisions leading to long-term sustainability. Prices do not generally reflect true energy costs, environmental damage or draws on natural capital. Because of these pricing problems, consumers generally cannot be relied upon to reach sustainability targets.

Participants were interested in:
- o Examining the data field describing the reasons for change in a facility's releases and transfers (only available in NPRI data) and potentially adding this field to TRI and RETC
- o Exploring why some facilities do not report in one year and then report in subsequent years, as this can create a major data analysis problem
- o Exploring the extent to which PRTR data is used in financial disclosure provisions and in investment decisions and green funds
- o Increasing the use of PRTR data in indicators
- o Obtaining more information about compliance and enforcement data on facilities
- o Analyzing methods to promote increased pollution prevention, and so further reduce releases
- o Examining the incentives for a company to reduce releases and to continue to reduce releases
- o Examining the role of pricing of off-site disposal and treatment in shifting chemical streams.

Following the discussions, the participants drafted a workshop statement (see final edited version attached). This workshop statement will be sent to the national governments, the CEC's PRTR Consultative Group and others, and posted on the CEC web site.

Participants were encouraged to send in participant summaries to CEC for use on the CEC web site and for use in the EPA's new TRI paper.

The workshop adjourned at approximately 5.30 pm.

Annex A

SVP veuillez informer le Secrétariat de toute erreur ou omission
Please inform the Secretariat of any mistake or missing name
Favor de informar al Secretariado de cualquier error u omisión

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Annex B

Participants' Summaries

Name	Affiliation
Eungkyoon Lee	Ph.D. Candidate with Dara O'Rourke, Assistant Professor of Environmental Policy at Massachusetts Institute of Technology

Area of Interest:

Research on Information-based Environmental Regulation: TRI and Scorecard – Dara O'Rourke; PROPER, TURA, and Environmental Results Program (ERP) – Dara O'Rourke and Eungkyoon Lee

Recent Work

Title of the Paper – Mandatory Planning for Environmental Innovation: Evaluating Regulatory Mechanisms for Toxics Use Reduction (2001)

Abstract

This paper analyzes the Massachusetts Toxics Use Reduction Act (TURA), evaluating what TURA has achieved, how it has been implemented, how it actually motivates firms to change, and how its underlying principles might be strengthened to better support innovation for toxics use reduction. Through this analysis we engage recent debates about the potentials and limitations of using regulation to promote innovation for the environment. Our analysis shows that TURA is distinct from existing regulatory programs in how it requires firms to self-evaluate and plan for process improvements, supports implementation through technical assistance, and focuses on pollution prevention rather than control. Increased transparency, new mechanisms of accountability, and improved processes of learning have all been critical to the Act's success in motivating firms to innovate for the environment. Taken together, these factors have supported incremental innovations in industry that may point the way toward policies to support even greater environmental improvements.

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Name	Affiliation
James Lee	Director, Social Science Research Lab, School of International Service, American University

Area of Interest:

I have some relation to PRTR's in three contexts.

a.   EPA grantee and employee

I have received EPA grants and other cooperative agreements in the office of Environmental Information. I prepared two case studies that tested a premise of environmental information in a scientific context and reported on the technical aspects of performing that task. These case studies examine the use of PRTR data in two contexts:

1) First, PCS (Permit Compliance System) that is a US PRTR to measure water discharges was used to attempt to substantiate claims of outbreaks of pfiesteria along the East Coast of the United States. One source was thought to be the agricultural run-off from chicken farms. Would PCS data actually show this trend? <http://www.american.edu/TED/esp/pfiesteria.htm>

PFIESTERIA: Using the Permit Compliance System (PCS) to Determine Causes for Pfiesteria, by Jim Lee, David Crosby and Beth Walsh, American University

2) Second, TRI data was used to estimate the amount of certain pollutants dumped into a water area for estimating clean-up costs. The sample area was the area around Baltimore in the Chesapeake Bay and the dumped pollutant was benzene.
<http://www.american.edu/TED/esp/benzene.htm>

BENZENE: Using the Toxic Release Inventory (TRI) to Estimate Benzene Emissions Around Baltimore, by Jim Lee

Policy Implications:

These case studies are meant to (1) test the accuracy, viability and process for using TRI data for the purposes of using it in research and (2) the general use of PRTR data and its validity for use in statistical analysis.

I also run two web sites that are relevant:

1) Trade Environment Database
Case studies on environmental issues that use a variety of data sources.
http://www.american.edu/ted/ted.htm (University Web Site)

2) Environmetrics Web Site
Clearing house on Environment and statistics events, reports, and news, including PRTR related. Available only on internal EPA.

Could this be available to all NAFTA partners?

b.	Professor

I teach a course "Computer Applications in International Relations" and briefly discuss international PRTRs as part of instruction.

c.	Social Science Research Lab Director

I run the quantitative research labs at American University and some professors whom we work with use PRTR data in their classes. For example, one professor we support uses our lab and teaches a GIS class that uses TRI data and analyzes it. We apprise him and others of data opportunities for research and their limitations.

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Name	Affiliation
Kathryn Harrison	Associate Professor Department of Political Science University of British Columbia

My co-author, Werner Antweiler, has summarized our recent research and future plans. Rather than repeating what Werner has already written, I will elaborate on what I see as the policy implications of our work.

- First, we find that the vast majority of the reductions reported in the early years of Canada's NPRI can be attributed to conventional regulation. This challenges the assumption that has often been made, not least by policymakers, that the dramatic reductions in on-site released observed after the inventory was introduced demonstrate the effectiveness of information dissemination as a policy instrument. Our research suggests that it is premature for policymakers, at least in Canada, to count on information dissemination as a substitute for regulation.

- We have found that facilities reporting to NPRI that are regulated under the Canadian Environmental Protection Act are making greater strides in reducing their releases than facilities that merely face a threat of regulation under the same Act. While it is still possible that negotiated voluntary agreements with some sectors will deliver significant reductions, these findings raise questions about the effectiveness of mere threats as opposed to actual regulatory mandates.

- The NPRI data indicate that facilities continue to rely heavily on off-site transfers for storage or treatment, rather than source reduction. Moreover, we have found that off-site transfers are not only growing in volume but in toxicity as well. The same is true of on-site underground injection. This suggests a need for new strategies to promote pollution prevention and greater attention to the ultimate fate of some of these waste streams, since our recent progress may be masking transfers of risks to other communities or future generations.

<div align="center">*********</div>

Name	Affiliation
Madhu Khanna	Associate Professor, Department of Agricultural and Consumer Economics University of Illinois, Urbana-Champaign

Area of Interest:

I have been conducting research with the Toxic Release Inventory (TRI) data to examine (a) the impact of environmental information disclosure on investor behavior an on firms' environmental performance
(b) the effectiveness and economic impact of the 33/50 voluntary pollution control program
(c) the incentives for firms to adopt to environmental management systems and its implications for their environmental and economic performance and
(d) the incentives for pollution prevention and implications for firm performance.

The first study (Khanna, Quimio and Bojilova, 1998) examines investor reactions to the repeated public disclosure of environmental information about firms in the chemical industry in the U.S and the effectiveness of this information as a decentralized mechanism for deterring their pollution. We find that by allowing investors to benchmark the performance of firms, repeated provision of the TRI leads firms to incur statistically significant negative stock market returns during the one day period following the disclosure of that information in the years 1990-1994. These losses have a significant negative impact on subsequent on-site toxic releases and a significant positive impact on waste transferred off-site, but their impact on total toxic waste generated by these firms is negligible.

The second study (Khanna and Damon, 1999) examines the motivations for participation in the voluntary 33/50 program and its implications for the toxic releases and economic performance of firms in the U.S. chemical industry. It demonstrates that benefits due to potentially avoided costs of liabilities and compliance under mandatory environmental regulations and due to public recognition provide strong incentives for participation. After controlling for a sample selection bias and the impact of firm-specific characteristics, this research shows that Program participation led to a statistically significant decline in toxic releases over the period 1991-1993. It also had a statistically significant negative impact on short run profits of firms, but its impact on their expected long run profitability was positive, though statistically insignificant.

The third study (Khanna and Anton, forthcoming, 2002) seeks to explain the shift in corporate approach in environmental protection from regulatory-driven reactive mode to a more proactive approach involving voluntarily adopted management practices that integrate environmental concerns with traditional managerial functions. Several hypothesis about the role of regulatory and market based pressures in explaining the diversity in the environmental management systems adopted by firms are tested using survey data from a sample of S&P 500 firms and environmental performance data from TRI. The analysis shows that the threat of environmental liabilities and high costs of compliance with anticipated regulations as well as market pressure on firms that produce final consumer goods and have large capital-output ratios play a significant role in inducing corporate environmentalism. Additionally, high costs of off-site transfers of toxic releases and public pressure on firms with high on-site toxic emissions per unit output create incentives for adapting a more comprehensive and higher quality EMS. In a related study (Anton, Khanna and Deltas, 2002) we examine the implications of adopting an EMS for the on-site toxic releases and off-site toxic transfers by firms. We find that adoption led to a significant improvement in environmental performance of the large polluters but not that of small polluters.

I am currently examining the incentives provided by voluntary participation in the programs such as the 33/50 programs and by the adoption of an EMS for pollution prevention activities and for environmental friendly innovation. We are using the data on pollution prevention methods adopted by firms that are reported to the TRI together with data on toxic releases and investment in research and development to examine the incentives provided by voluntary actions for innovation and implications for firm performance.

Policy Implications

My research shows that information provision and voluntary approaches can be effective policy tools for achieving environmental protection through the market. These tools provide incentives through the market, by creating pressures from consumers, shareholders, public and other firms from improvement in environmental performance. Pressure from consumers and communities depends, in large part, on the provision of environmental information about firms and products. The requirements for mandatory reporting to the TRI and mandatory labeling of toxic products

are increasing the amount of information available to the public and thus enabling them to make informed choices and signal their preference for environmental behavior thorough non-regulatory means.

The effectiveness of these approaches however depends on the existence of a regulatory framework that would impose penalties on firms that do not undertake proactive measures for self-regulation. Voluntary programs are likely to be less effective without the backstop of mandatory regulation. Moreover, in some cases, these approaches can induce substitution between alternative ways of pollution disposal, such as between on-site release and off-site transfers. This implies that there may be a need for supplementing voluntary approaches with targeted mandatory regulations in order to create incentives for firms to take a more holistic view towards pollution control.

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Name	Affiliation
Matthew MacLeod	Post-doctoral Researcher Department of Environmental and Resource Studies Trent University Peterborough, Ontario, Canada

Area of Interest:

My research is focused on development and verification of regional and large-scale contaminant fate models, including models for Canada and the North American continent. These models address issues of trans-boundary pollution, long-range transport and deposition of contaminants, and the requirement for continental or global scale efforts to achieve reduction in local contaminant levels. PRTR data from Canada's NPRI and the United States' TRI are used as input to the models, which calculate concentrations of environmental contaminants that can be expected as a result of identified releases, and track the movement of chemicals between ecological regions of the continent. I have also collaborated on contaminant fate modeling studies in Japan using data from their PRTR pilot program. The attached figure shows sample output from the North American contaminant fate model (BETR North America). The figure shows calculated concentrations of trichloroethene in 24 ecological regions of North America air as a result of emissions estimated as the sum of PRTR identified sources and population-based diffuse sources.

Trichloroethene Concentration in Air (ng/m^3)

	1 - 8
	8 - 32
	32 - 67
	67 - 129
	129 - 203

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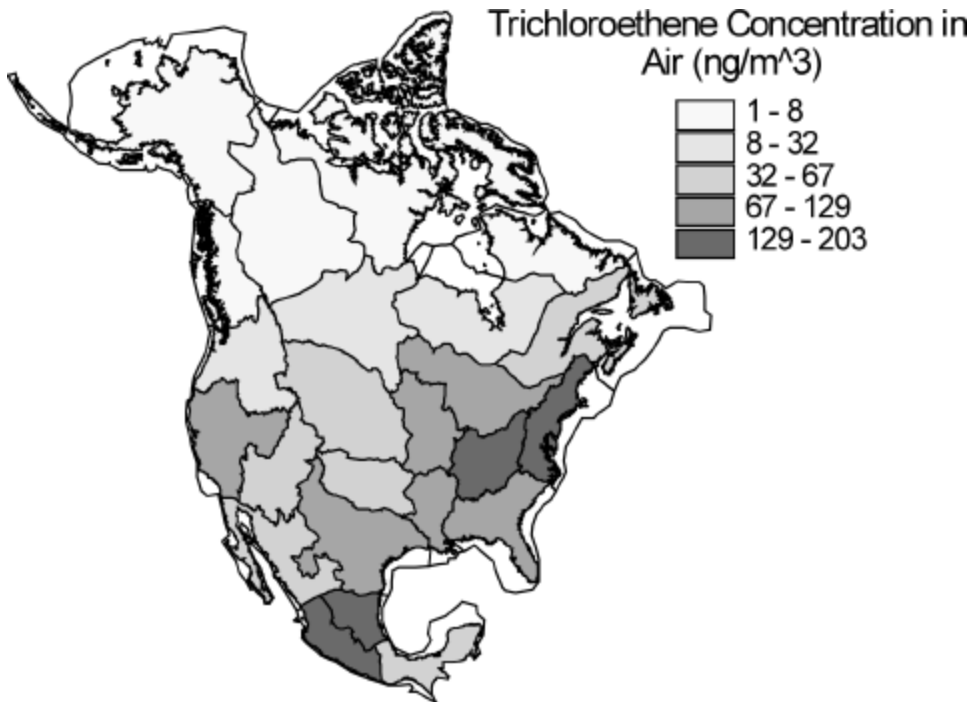
Name	Affiliation
Nancy Olewiler	Department of Economics, Simon Fraser University, Burnaby B.C, Canada

Area of Interest:

I have a long-standing interest in the use of PRTR data for research, policy analysis, and teaching. In a working paper done for the Ministry of Finance, Canada (with Kelli Dawson), we provided a methodology for computing a toxicity index for the pollutant release data of Canada's National Pollutant Release Inventory (NPRI). This data was then used to rank industries by toxicity. NPRI and TRI data were also weighted by employment and output to allow comparisons between the two countries. Using the employment and output weighted data, we found that there were significant differences between Canada and the United States. Canadian industries that ranked among the highest in the overall toxicity indexes had volumes of toxic releases that exceeded those same industries in the U.S. by more than 50 percent (chemicals, non-metallic minerals, paper and allied products, refined petroleum and coal, and rubber and plastics). The data was used in a chapter on "Environmental Taxes" of the *Report of the Technical Committee on Business Taxation*. The *Report* was a comprehensive examination of business taxes in Canada with a large number of policy recommendations. The recommendations from the environment chapter included a restructuring of the current excise tax on motive fuels and investigation of the introduction of a toxics tax.

In other papers, I compared the tax treatment of toxic-intensive sectors with those that release far few toxic compounds and found that the most toxic sectors face much lower marginal effective

tax rates on corporate income than those that are not toxic intensive. When comparing these sectors in terms of employment and output growth, the toxic-incentive sectors generally lag those with lower toxic intensity. Tax reforms that remove preferential tax treatment of pollution-intensive sectors and lower effective tax rates on business income, combined with the introduction of measures to provide incentives to reduce toxic emissions (taxation, voluntary actions, pollution rights, regulation), would help improve environmental quality and economic performance of the Canadian economy.

PRTR data also feature in analysis of other important environmental policy issues. Critics of regional trade agreements and the WTO have alleged that greater integration of the North American economy will lead to lower levels of environmental quality due to a 'race to the bottom' to weaken environmental regulation to prevent footloose industry from locating in 'pollution havens' – countries with weak or ineffective regulations. I use PRTR data, along with other indicators of environmental quality and regulatory stringency to see if there has been a race to the bottom in North America. The data on emissions and regulation does not support this hypothesis. PRTR data can also help examine the role of environmental resources in sustaining productivity in Canada. Calculations of productivity growth that ignore environmental resources will lead to biased estimates that in turn, affect our understanding of whether sustainable development is possible. Because of the scarcity of long-term data, it is difficult to quantitatively assess the role of environmental resources in productivity growth. Looking at PRTR and other environmental data, preliminary calculations show that improvements in environmental quality are positively correlated with higher productivity growth and conversely, environmental/ecosystem degradation contributes to lower growth. These results support the argument that environmental policies help contribute to better economic performance. This work is ongoing.

PRTR data provides many learning and research opportunities for students. I introduce undergraduate students to the data in a chapter on "Policy on Toxic and Hazardous Substances" in my Canadian environmental textbook. They examine trends in toxic releases and see how they are linked to specific environmental policies at local, regional, and national levels.

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Name	Affiliation
Paul Templet	Department of Environmental Studies, Louisiana State University

Area of Interest:

My interest in the Toxic Release Inventory (TRI) dates from my service as the Secretary of the Louisiana Department of Environmental Quality (1988-92) in which I used the TRI data by facility to compare levels of releases. I also used TRI to show that Louisiana, #1 in TRI releases in early years, was not doing enough to reduce pollution and passed legislation and regulations designed to reduce releases. When using TRI its often helpful to adjust for size of the industry that is doing the releasing. I use jobs in the facility or sector as a normalizing factor. Releases/job (called emissions/job or E/J in earlier papers) became a measure for assessing a score for each facility for the purpose of granting economic incentives.

In my research I have used the R/J to show differences in levels of releases across the states of the US for comparison purposes (a graph of the 1999 R/J for the fifty states is attached) and to make policy recommendations. I have found that the R/J is also related to many socioeconomic variables, such as income/capita, poverty and unemployment, and it provides a means of linking pollution with public welfare. I have also used TRI data to show that states which produce less waste (TRI) have better and more efficient economies and citizens are better off. I am currently

working on a paper which links pollution prevention measures taken from the TRI to the efficiency of an economy and the welfare of the citizens.

Abstract from paper 2

Abstract

The assumption that the environment must be sacrificed to create more jobs is prevalent in American business and society. However, environmental studies tell us that the economy is dependent on the environment to provide resources and accept wastes so a good environment should be able to provide more such services and thus to make a better economy. Empirical evidence from a number of studies substantiate that finding and show that states with lower pollution levels and better environmental policies generally have more jobs, better socioeconomic conditions in general and are more attractive to new business. Pollution is only one of many external costs borne by the public and which provide subsidies to an economic sector but distort the market and result in poorer socioeconomic conditions, including growing income disparities. A Louisiana case study is presented which explains why jobs increase while pollution declines. Other similar studies are reviewed and a connection to sustainability is presented. Sustainability concepts are examined with respect to externalities with the finding that as externalities, and their subsidies, decrease sustainability becomes more probable. Recommendations are presented for improving the environment and the economy thus promoting sustainability.

Figure 1, 1999 Toxic Releases per Job using the Original 1988 Chemicals and Facilities

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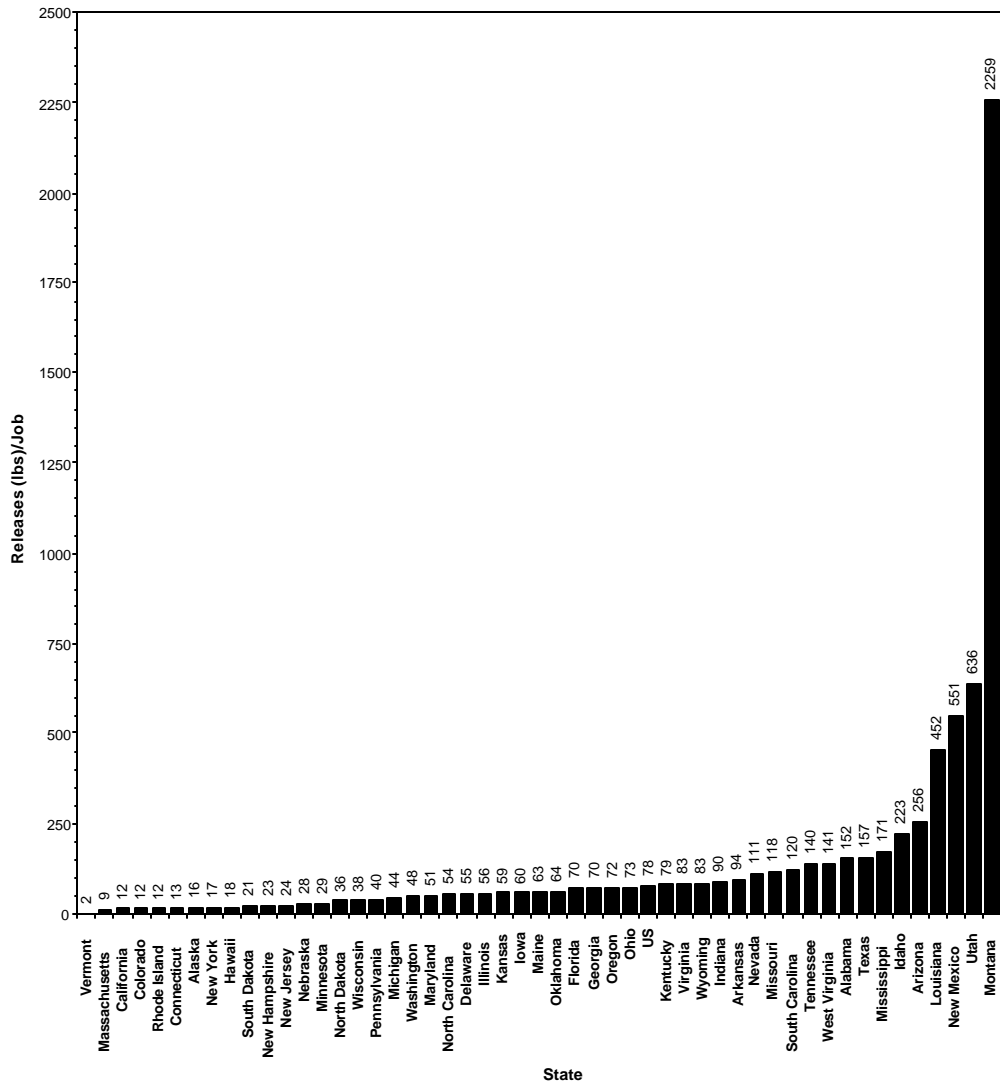
Name	Affiliation
Robert Klassen	Associate Professor
	Ivey Business School
	University of Western Ontario

Area of Interest:

Environment management in manufacturing, pollution prevention, adoption of environmental technologies, green supply chain management.

Summary of Research:

My recent research utilizing the U.S. Toxics Release Inventory (TRI) data has begun to explore these difficult questions through an expanding series of related research projects. Collectively, these published papers are beginning to tell a more complex story that can guide strategy and management practice, with implications for public policy.

First, managers need to better understand the pattern of investments related to the environment that are made within individual sites and manufacturing firms as a whole (Klassen & Whybark, 1999b; Klassen, 2000b). This pattern of investment, i.e., the relative allocation to pollution prevention versus control, was assessed against manufacturing performance—including cost, quality and environmental performance. Increased allocation toward pollution prevention reduced toxic release emissions and transfers, adding support for public policies that favor pollution prevention over control. Moreover, adopting a more proactive, leadership strategy also contributed to better performance (Klassen & Whybark, 1999a). In each of these papers, environmental performance was measured using TRI data.

Second, as the personal values held by manufacturing managers shifted from a short-term economic toward ethical values, environmental performance improved, again assessed using TRI data (Klassen, 2001). Thus, senior management and public agencies must capture multiple dimensions of performance, sometimes termed a balanced scorecard, to explicitly recognize economic, social and environmental objectives. Unfortunately, more recent survey research of two Canadian industries revealed that environmental investments were still being regarded as ancillary (Klassen, 2000a). On a more positive note, increased investment in quality-related systems favored simultaneous investment in recycling programs and pollution prevention.

Third, my current research is exploring the linkage in Canada between ISO certification and environmental performance, measured using the National Pollutant Release Inventory (NPRI). The ISO 14000 family of voluntary standards has been developed by the International Organization for Standardization that to certify process-, site- or firm-specific environmental management systems. I expect that this research will reveal insights that will guide both managerial practice and public policy formulation.

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Name	Affiliation
Seema Arora	Visiting Scholar **Stanford University**

Area of Interest:

My research philosophy and my academic work are driven by my strong desire to positively influence policy making through rigorous research. My academic work has evaluated the effectiveness of a voluntary approach to regulation. Until recently, standard approaches to environmental regulation consisted of command and control, taxation and emissions trading. My work relies on theory and empirical methods to establish that a voluntary approach to regulation, together with mandatory public disclosure of a firm's environmental profile provides strong motivations for firms to improve their environmental performance. My most recent work examines the financial implications of environmental activities for a firm, both in the short run and in the long run.

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Name	Affiliation
Subhadra Ganguli	Graduate Student, Department of Economics, University of Riverside, Riverside, California

Area of Interest:

"Pollution Havens" in Mexico? -An Econometric Analysis of Industrial Relocation from the US before and after NAFTA.

The objective of my current research, funded originally by the IGCC-UC Internship Fellowship (2001) and subsequently by the UC-MEXUS Dissertation Grant (2002-2003), is to study the validity of the "pollution haven" argument and explore whether the North American Free Trade Agreement (NAFTA) has influenced "relocation" of polluting industries from the United States to Mexico.

US-based parent companies which have set up maquiladoras in Mexico have been identified, using the Toxic Release Inventory (TRI) of the EPA and the maquiladora databases of the International Trade Commission in Washington DC, USA, for various manufacturing industry sectors such as textiles and apparel, wood and furniture, chemicals, rubber and plastics, primary and fabricated metals, electronics and computer and transportation equipment. Parent company level data and toxic pollutant emissions information have been collected from the S&P Compustat database and the TRI database respectively from 1987 through 1999. An econometric model of company relocation for the period 1987 till 1999 is being studied for evaluating the significance of the various factors in the relocation decision of these companies.

Econometric theory suggests that liberalization of trade policies between countries with differing levels of environmental protection could lead pollution intensive industries to be concentrated in

nations where regulations are comparatively lenient. This effect, referred to as the "pollution haven" hypothesis, is greatly discussed in theory but finds only ambiguous support in empirical research. Past studies have not studied company level data to analyze this issue at the bi-national environmental policy perspective. However, for examining the "pollution havens" hypothesis the Mexican PRTR data needs to be considered.

My current project addresses this issue to help resolution of the ongoing debate on "pollution havens" and help formulation of international environmental policy through cooperation among nations.

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Name	Affiliation
Werner Antweiler	Faculty Of Commerce And Business Administration University Of British Columbia

Area of Interest:

Together with my co-author Prof. Kathryn Harrison (UBC), I have been investigating if information released through Canada's NPRI has been positively affecting emissions. We consider the effects of regulation, regulatory threat, and information transmission channels such as green con-isomerism.

We currently have two research papers on these topics that have been submitted to scholarly journals for publication. We are now working on extending our research to include a joint US-TRI/Canadian-NPRI data set provided by the CEC, which would allow us to carry out performance comparisons between the U.S. and Canadian industries. In what follows I provide abstracts of our two research papers to date.

Environmental Regulation vs. Environmental Information: A View From Canada's National Pollutant Release Inventory. Using data from Canada's NPRI, we attempt to discern the effect of information dissemination on pollution abatement through governmental and non-governmental transmission channels. Governments are increasingly relying on voluntary pollution reduction programs, as supplements as well as substitutes for conventional interventions. We thus consider the effect of conventional regulation, the effect of threatened regulation of particular substances, and the effect of non-governmental pressures from better-informed communities, consumers, workers, and shareholders. We find strong effects of regulation under the Canadian Environmental Protection Act, but we also find that Canadian facilities have responded much less aggressively to the mere threat of regulation. Our empirical analysis also shows that large and pollution-intensive facilities are making the greatest effort to reduce on-site releases. Raising concerns are disparate trends among release streams and a substitution from on-site releases to off-site releases. There is also evidence that emission reductions by weight are not matched by a reduction of emission levels adjusted by toxicity. Facilities appear to be shifting the composition of pollution by substituting low-volume high-toxicity pollutants for high-volume low-toxicity pollutants.

Toxic Release Inventories and Green Consumerism: Empirical Evidence from Canada. We investigate the empirical relevance of green consumerism as a reaction to the dissemination of information through toxic release inventories. Assuming that consumers cannot attribute pollution to individual products from a multi-product firm, we identify the effect from green consumerism

through intra-firm inter-plant spillover effects in pollution abatement when consumers reduce demand equally across all product lines of the multi-product firm. We subject the predictions from a simple theoretical model to empirical tests using 1993-99 panel data from Canada's NPRI in conjunction with related census data. We adjust our analysis for the toxicity of pollutants. The empirical results establish that green consumerism "works". Even though the dissemination of information through toxic release inventories positively affects pollution abatement activities of firms, the estimated magnitude of this effect is very small.

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Name	Affiliation
Rina Aguirre	Professor/Investigador Universidad Nacional Autónoma de Mexico

[see attached Powerpoint presentation]

Annex C

Workshop Statement
(revised draft, for review)

We, a group of academics from North America, met in Montreal on 23 March 2002, to discuss research experiences using pollutant release and transfer register (PRTR) data and to explore future opportunities. A PRTR provides detailed data on types, locations and amounts of specific chemicals released on-site and transferred off-site by facilities. This workshop, hosted by the CEC, is an important first step in facilitating collaboration among the academic communities in the three countries on uses of PRTR data.

We agree that PRTR data are the most available and most comprehensive source of information for the public and for the academic community on toxic releases and transfers. PRTR data provide an important input into research aimed at better understanding their impact on environmental quality and health.

Workshop Findings

We find that the availability and communication of PRTR data has led to positive changes in the behavior of industry, citizens, governmental agencies and academics.

We confirm the importance of PRTRs as a valuable tool for:
- Tracking environmental performance
- Identifying potential drivers of environmental improvement
- Disseminating information and educating the public, in keeping with the importance of information in the democratic process
- Addressing key questions of environmental management and sustainable development, including the linkages among environment, health, economy and societal well being
- Assessing the effectiveness of public policies.

We discussed our research in three areas: economic and social measures, environmental and health measures and effectiveness of public policies.

1) PRTR Data and Economic and Social Measures

Based on our research linking PRTR data to economic and social measures, we have found evidence that:

- PRTR reporting can lead to improvements in economic efficiencies
- PRTR data are an important input for economic and environmental indicators
- PRTR data show which types of facilities are most likely to participate in voluntary reduction programs (e.g. EPA's 33/50 Program) and what factors motivate facilities to make reductions in chemical releases and transfers

- PRTR data can be used to understand the effects of firms' environmental performance on profitability, market value and investment decisions
- PRTRs have been used in combination with social and demographic data to better understand the relationships between community characteristics and levels and types of toxic releases and transfers
- PRTRs can be used by companies, governments and communities to identify priorities

2) PRTR Data and Environmental and Health Measures

Based on our research linking PRTR data to environmental and health measures, we have found:
- PRTR data underscore the need to reduce releases as a means of reducing exposures to toxic chemicals
- The availability and communication of PRTR data promote actions to improve human health and welfare
- PRTR data can be used by facilities and governments to identify priorities for further investigation to reduce chemical releases
- PRTR data can be used to identify trends, such as shifts of toxic chemicals from on-site to off-site releases, or from one environmental media to another, or shifts in the composition and toxicity of waste streams
- PRTR data support the development of multi-media contaminant fate models that link releases to contaminant concentrations in air, water and land

3) PRTR Data and the Effectiveness of Public Policies

Based on our research analyzing PRTR data and the effectiveness of public policies, we found that:
- PRTR data have been used to track the effectiveness of regulatory and non-regulatory initiatives, and to identify priorities for future policy actions
- PRTR data can help show the extent to which firms are undertaking pollution prevention
- PRTR data have triggered the development of innovative, flexible toxics reduction programs, and are used as a tool for tracking progress within such programs

<u>Areas for further exploration and research</u>

We have identified the following questions as requiring additional investigation:
- Why are some facilities and chemicals shifting from on-site releases to off-site transfers?
- Why are some facilities no longer reporting, or reporting intermittently?
- What are the effects on the data of using different estimation methods? What are the effects of changing the type of estimation method?
- How can we encourage the development and sharing of commonly accepted methodologies for analyzing PRTR data?

With respect to *environmental and health analyses*, the following questions need to be further explored:
- How can we increase the analysis of the relationships between chemical releases and environmental quality?
- How can we increase the characterization of releases and transfers? For example, tools for incorporating information on toxicity, bioaccumulation and persistence.
- How can we better understand the relationship between PRTR data and pollution prevention and innovation?
- How can we enhance the comparability of pollution prevention data gathered through PRTRs?
- How can we increase the awareness of and data on other sources that are not captured under existing PRTR reporting (e.g. small facilities such as dry cleaners)?

In the area of *economic and social analyses*, there is a need for further research to address questions such as:
- How can the use of PRTR data by "green" funds and by investors be encouraged?
- What are the changes in the PRTR releases/transfers along the links in the supply chain?
- What are the relationships between environmental performance and competitiveness across firms and nations?
- How can PRTR data be analyzed with other data sets , e.g. socio-economic data?
- Where are off-site releases going? Are there environmental justice implications?

Additional **policy analyses** are needed to explore:
- What impacts do changes in regulatory requirements have on PRTR releases and transfers?
- How can public access and use of PRTRs be increased? How can PRTR data be made more useful for public decision-making?
- Can PRTR data help in understanding the impacts of trade policies?
- How can we increase the sharing of experiences among other countries interested in developing PRTRs?

Recommendations and Next Steps

We encourage the CEC and other groups to….

Build stronger relationships among academics and researchers in North America, and governmental agencies and legislators through:
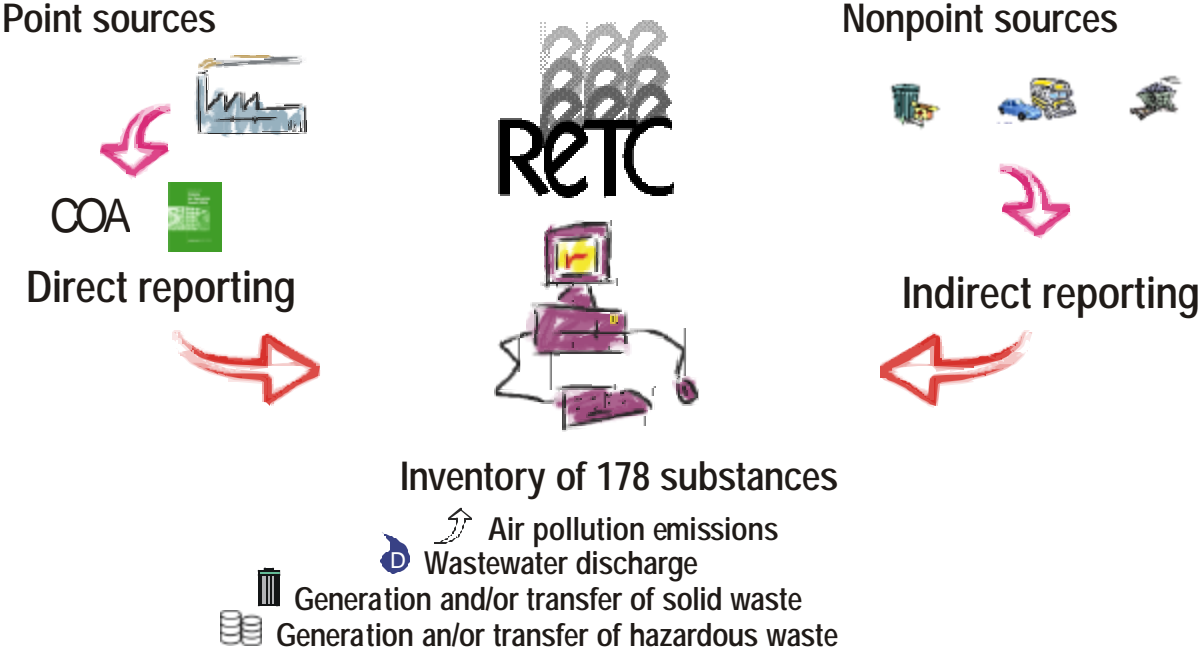1. Initiating a working paper series (abstracts, policy briefs) on PRTR data
2. Organizing a trilateral conference on PRTR data
3. Promoting PRTR-related academic research on topics and questions of interest to government programs
4. Organizing cross-border graduate student projects, student exchanges and/or internships
5. Developing an expanded CEC web site to facilitate information exchange and networking

Continue efforts to enhance comparability among the national PRTRs by:
1. Building on existing experiences to contribute to the further development of the RETC in Mexico
2. Encouraging the publication of 1999-2000 data in Mexico, including the release of facility-specific data
3. Creating pilot projects on releases/transfers from industry sectors in Mexico
4. Encouraging NPRI to include an identification number for the sites to which transfers are being sent
5. Encouraging all three countries to develop means of obtaining information from facilities on reasons for changes in releases and transfers from year-to-year
6. Making matched PRTR datasets available on-line
7. Identifying other sources of toxic chemicals that are not captured by current PRTR systems
8. Adjusting for double counting and increasing toxicity-related analyses in the CEC report *Taking Stock*

As a result of this workshop, we look forward to increased communications and collaboration among academic, researchers and others interested in PRTR-related research.

Rina Aguirre (PhD)

Point sources

COA

Direct reporting

RETC

Nonpoint sources

Indirect reporting

Inventory of 178 substances

Air pollution emissions
Wastewater discharge
Generation and/or transfer of solid waste
Generation an/or transfer of hazardous waste

Research projects

- **Specific sources**
  - Paper industry
  - Landfills
  - Agriculture
  - Mercury sources

- **Data validation**
  - Format evaluation
  - Data comparison against emission factors

- **Data uses**
  - Emission factors development
  - Input for dispersion models

- **Others**
  - Industrial guides
  - Local inventories development

Mexican PRTR (RETC) tridimensional structure

PRTR

Federal industry (11 sectors)

State industry (30 sectors)

NONPOINT sources (6 sectors)

Environmental priority substances (178)

Point and raster of 1x1 Km.

Traditional air pollutants (6)

Environmental topics (6)

State and municipal

National

Pollutants

Sources

Aggregation level