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Background Paper

This paper has been prepared as background document for the Special Session on Tools That Use PRTR Data, which will take place on 6 March 2001 in Mexico City. The session is part of the annual Meeting of the Consultative Group for the North American Pollutant Release and Transfer Register (PRTR) Project, organized by the North American Commission for Environmental Cooperation (NACEC). This paper does not attempt to give a comprehensive summary of all existing tools, but rather it is intended to provide a general overview of the types of tools that exist and how they relate to PRTR data, illustrated by the use of specific examples.

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NACEC welcomes your comments and feedback on the document.

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1. INTRODUCTION

Because PRTR data are publicly available, they have had a large impact on the knowledge that stakeholders have of pollutant releases at facilities subject to reporting requirements. As reported, these data are useful for gathering information on the quantities and types of chemicals released and transferred by particular facilities or groups of facilities. However, stakeholders are often interested in additional questions that are difficult to answer with PRTR data alone. For example, stakeholders may wonder what types of risks they face as a result of pollutant releases from a nearby plant, and whether other plants that make similar products do so with less pollution. Or they might want to know whether a company's efforts to control pollution are having an effect over time. There are a number of different types of tools available that may be instrumental in furthering stakeholders' understanding and use of PRTR data for these types of questions.

We discuss five types of tools, three of which are useful for using and understanding PRTR data, and two that may potentially use PRTR data as inputs. The first type of tool is a toxicity-weighting tool (see Section 2). Toxicity weighting is a tool that adjusts or "weights" the amount of a pollutant released into the environment based on the relative toxicity of the pollutant. The second type of tool is a risk screening or scoring tool (see Section 3).¹ A risk screening tool is designed to rank chemicals according to their potential risk to human health and the environment by accounting for toxicity, environmental fate, and exposure potential. The third type of tool discussed is normalization (see Section 4). Normalization is a process of apportioning releases on the basis of a standardized or "normal" measure. The fourth type of tool is an environmental indicator, which is a quantitative way of expressing a facility's or company's environmental performance, drawing on information that is available (see Section 5). Finally, the fifth type of tool is an environmental management system (see Section 6). An environmental management system is a tool with which companies can assess the overall environmental impact of their activities, set targets to improve performance and regulatory compliance, and assess the most effective ways to meet these targets.

2. TOXICITY WEIGHTING TOOLS

This section of the paper discusses toxicity weighting tools and their relationship to PRTR data. We begin by defining toxicity weighting. We then examine how the use of these tools can be used with PRTR data and describe several examples. Finally, we discuss the general strengths and limitations of this type of tool.

¹ In preparing this paper, an effort was made to include examples from throughout North America. However, many of the most common and readily available examples of toxicity weighting and risk scoring tools are from the United States.

2.1 What is toxicity weighting?

Toxicity weighting (also referred to as toxicity scoring) is a process by which the amount of a pollutant released into the environment is adjusted or “weighted” to account for the relative toxicity of the chemical. Toxic potency is a measure of a chemical’s potential to harm human health or the environment. Even among chemicals that are generally considered toxic and often reported in PRTRs, the toxic potency can vary considerably. Toxicity weighting allows the user to account for the variations in the inherent environmental or health toxicity of chemicals in a relatively simple way. Generally, toxicity weighting entails multiplying the quantity of a pollutant released by a standardized toxicity score for that chemical. Releases weighted by toxicity can then be aggregated and compared much as facility-reported PRTR data are added and compared. Specific weighting or scoring tools available to the stakeholder range from arbitrary weights based on broad groupings of chemicals to detailed, scientifically derived weights based on quantitative toxicity data for individual chemicals.

2.2 How might toxicity-weighting tools be used on PRTR data?

Toxicity weighting offers an additional way of evaluating pollutant releases that allows the user to assess the relative toxicity of different chemicals. Toxicity weighting gives greater emphasis to releases of a chemical that has a relatively high level of toxicity for a given human health or environmental end point, and less emphasis to a chemical with a relatively lower toxicity for that same end point. For example, when considering potential impacts to human health, arsenic has been shown to be more toxic than copper. On the other hand, when considering ecotoxicity, copper has been shown to be more toxic than arsenic. Thus, a comparison of chemicals weighted for a particular toxicity endpoint provides a relative indication of the potential harm or damage associated with the releases of the chemicals. The success of this process assumes that toxicity weights have been carefully constructed and that the toxicity endpoint(s) accounted for in the weighting scheme is (are) consistent with the concerns of the user. Where effects are unknown or unaccounted for in the weighting scheme, the weighted releases may not accurately reflect the potential for harm.

2.3 What are some specific examples of toxicity weighting techniques?

This section discusses two toxicity weighting tools to illustrate the range of tools available. First we discuss the generic approach of toxicity weighting based on chemical grouping. Then we discuss the more complex approach of developing and applying weights based on quantitative toxicity data using U.S. Environmental Protection Agency’s (EPA) Sector Facility Indexing Project as an example.

2.3.1 Weighting based on chemical grouping

The simplest method of toxicity weighting is to assign a greater weight to certain chemicals based on whether they belong to a group of chemicals associated with a certain toxic endpoint. For instance, a stakeholder could account for well-publicized health effects by giving greater weight to releases of carcinogens, ozone-depleting substances, and other specific chemicals that have been identified as relatively highly toxic, persistent, or bio-accumulative (e.g., chemicals listed in Canada's Accelerated Reduction/Elimination of Toxics program).

The simplest means of accounting for chemical grouping is to focus exclusively on chemicals in a particular group, such as carcinogens, which in effect gives chemicals in the group a weight of one and chemicals that are not in the group a weight of zero. Alternatively, any chemical that falls into any one of these high priority groups might be assigned a greater weight that has been determined using some general rule-of-thumb. For example, releases of benzene, a widely acknowledged carcinogen, might be given twice the weight of a non-carcinogen. Any chemical that does not fall into one of these categories retains its weight of one. After multiplying the releases of each chemical by the appropriate weight, it is possible to then aggregate to the facility, firm, or location level. These adjusted releases account for differences in toxicity in a general way and therefore comparisons across facilities, firms, or locations allow one to focus on releases of chemicals with a particular type of toxicity (e.g. developmental effects) or that are associated with a particular environmental effect (e.g. ozone depletion). Given the way in which such weights are determined, however, limited levels of confidence should be placed in results.

2.3.2 Relative toxicity weights

Another way of weighting by toxicity is to examine the toxicity of each chemical relative to a reference compound for each type of toxicity being considered. The U.S. EPA plans to add already developed relative toxicity weights to its Sector Facility Indexing Project (SFIP) for TRI chemicals released by five sectors. The weights are derived from a compilation of toxicity data developed by EPA. The relative toxicity weight is defined as the ratio of the potential human health risk posed by the release of one pound of a given chemical to the risk posed by the release of one pound of the reference chemical. Thus, according to this method, a weight of 10 for a given chemical indicates that 10 pounds of the reference chemical would have to be released into the air or water in order to pose the same approximate level of potential health risk as the reported release of the chemical. It should be kept in mind, however, that this assumes that the environmental fate for the two substances is the same, which is not likely to be the case. To calculate toxicity-weighted releases, the reported releases of a particular chemical are multiplied by its relative toxicity weight. Once all chemicals have been translated into reference-chemical equivalents, they can be compared directly or aggregated in order to assess the relative impact that different facilities or firms have on human health.

More information on
EPA's **Sector Facility
Indexing Project** is
available at
es.epa.gov/oeca/sfi .

EPA's Science Advisory Board has not endorsed the method used in SFIP. This is because toxicity weighting does not account for factors such as environmental fate and exposure potential (see Section 3 of this paper for a discussion of tools that do account for these factors). EPA has responded by treating toxicity weighting as an interim step to a more detailed relative risk-based analysis.

2.4 What are the strengths and limitations of such methods?

Scoring or weighting tools based on toxicity have a number of important strengths and limitations that warrant consideration.

2.4.1 Main strengths of toxicity weighting

- Toxicity weights can be easily calculated in one step.
- Toxicity weights can be summarized, and releases can then be ranked on the basis of potential harm.
- Once developed, toxicity weights can be applied with little specialized expertise.

2.4.2 Main limitations of toxicity weighting

- Toxicity weighting does not consider environmental fate and exposure potential, and therefore does not reflect the risks posed by releases.
- Toxicity weighting tools are typically designed to address only one or at most a few toxicity end points. If the user is concerned with other effects that are not accounted for in the weighting scheme, the resulting information will not be particularly useful.
- Toxicity weighting generally does not account for multiple chemical releases from the same source or nearby sources, the combined effect of which could differ from the sum of individual chemical releases.
- Variations in the amount and quality of toxicity data available for different chemicals introduces uncertainty into the weights based on such data.
- Multiple toxicity weighting systems may be required to address different hazards (e.g., acute versus chronic affects²) posed by different chemicals.
- Toxicity weighted releases may not be how a community or other stakeholder wishes to view pollutant releases, particularly for a chemical that has been shown to present a risk based on other attributes, e.g. persistence and/or ability to bioaccumulate. A chemical that appears to be of less concern based solely on a toxicity weighting may have a much higher risk potential based on its other inherent attributes.

² Acute effects occur at the time of exposure and are of short duration but may be severe, e.g. death. Chronic effects take longer to appear, but are often long lasting or recurring, such as a disease.

3. RISK SCREENING AND SCORING TOOLS

This section of the paper discusses risk screening and scoring tools and their application to PRTR data. We begin by defining risk screening or scoring. We then examine their use in interpreting PRTR data and discuss several examples: the Environmental Defense's toxicity equivalence potential risk scoring tool, and the U.S. Environmental Protection Agency's risk screening environmental indicators tool. Finally, we describe the general strengths and limitations of this type of tool.

3.1 What is a risk screening or scoring tool?

A risk screening tool is designed to rank chemicals according to their potential risk to human health and/or the environment using three independent elements: toxicity, environmental fate, and exposure potential. Each of these elements plays an important role in determining the probability that a chemical will harm human health or the environment. Most risk screening tools focus on human health risks and do not factor in ecological risks.

As discussed in the previous section, toxicity is a measure of the potential adverse effects a chemical may have on human health or the environment. The likelihood that a chemical will actually cause such harm is affected by two additional factors:

- **Environmental fate** - how long a chemical remains in the environment and its movement through different environmental media; and
- **Exposure potential** - how likely it is that an environmental receptor (e.g. fish, wildlife, plant species, human) will come into contact with the chemical.

Unlike toxicity weighting tools, risk screening tools consider these two additional factors. Specific risk screening or scoring tools range from simple tools that sort chemicals into groups according to nature and degree of risk to tools that rank or weight chemicals based on results of complicated exposure models. Some risk screening tools also incorporate into the analysis the size of the exposed population. Even the most complicated modeling techniques, however, result in risk screening or scoring tools that are relatively simple to use. Through the use of such a tool, users can explicitly account for the fact that chemical releases vary widely in their potential risks and can incorporate this into their decision-making. In particular, stakeholders can focus on pollution prevention for those chemicals or facilities that pose the greatest potential risk or harm, provided that the tool is designed to consider all of the health and/or environmental effects in which stakeholders are interested.

3.2 How might risk screening tools be used on PRTR data?

PRTR reports provide data on the absolute amount of pollutants released and transferred by facilities subject to reporting. Some users of PRTR data may wish to assess the potential risks these releases present. To do this, these data need to be combined with other information to begin to assess the health or environmental risk associated with these chemical releases. Risk screening or scoring tools offer a way for users to gain this additional perspective to PRTR data.

Consider two chemicals, Chemical A and Chemical B. Both chemicals are neurotoxic, although Chemical A is more highly neurotoxic. The chemical that has a lower level of neurotoxicity, Chemical B, does not degrade in the environment as readily as the more highly neurotoxic chemical, Chemical A. The risk screening model takes into account both the degree of neurotoxicity and the environmental fate. In this scenario, although Chemical A is more highly neurotoxic, it does not necessarily pose a greater potential risk to a particular population because it degrades more quickly and thus is not as readily available.

Similarly, a facility's ranking may differ depending on whether raw data or weighted data are used. For example, Mobil Torrance Refinery is the top air polluter in California when ranked by absolute amount of all TRI chemicals released into the air (1.2 million pounds in 1998). However when its releases are weighted by cancer risk scores developed by Environmental Defense, Mobil falls in its ranking to 72nd and Dow Chemical, which released only 59,000 pounds of pollutants into the air in 1998, is ranked first in its risk to human health. Evaluated according to other health endpoints, the rankings would be likely to change yet again.

3.3 What specific examples of risk screening or scoring tools are available?

A wide variety of organizations have developed risk screening tools that consider toxicity, environmental fate, and exposure potential. ICI, a British chemical company, has developed a weighting formula to determine what it refers to as the “environmental burden” of its releases.³ The company uses weighted releases to evaluate its performance over time, to compare releases with other aggregated sources (such as naturally occurring chemicals), and to set targets for improvement. Similarly, DuPont Corporation has created an internal system to sort chemicals into groups based on a predefined set of toxicity and exposure criteria. The University of Tennessee has developed a system to assign a numerical score to each chemical analyzed based on a

Environmental Defense’s *Toxic Equivalency Potentials Risk Scoring tool* is available on the web at www.scorecard.org and can be accessed by clicking on “Chemical Releases from Manufacturing Facilities.” Information about EPA’s *Risk Screening Environmental Indicators tool* is available on the web at www.epa.gov/opptintr/env_ind/index.html.

³ Environmental Burden: The ICI Approach. May, 1997.

categorization by types of effects (e.g. human, ecological, other). This scoring system has been used by Environment Canada to conduct a risk screening of the NPRI.

To further illustrate what risk screening tools are available and how they work, the following sections focus on two specific tools that are relatively widely used -- Environmental Defense's toxicity equivalence potentials (TEP) risk scoring tool, and the U.S. EPA's risk screening environmental indicators (RSEI) tool. EPA's model differs from Environmental Defense's in that it considers the size of the exposed population.

3.3.1 Environmental Defense's Toxicity Equivalence Potentials Risk Scoring Tool

Environmental Defense, a U.S.-based environmental group, has developed a risk screening tool that can be applied to any PRTR data set on chemical releases to air and water to assess the relative risk of different chemical releases. Environmental Defense used a detailed multi-pathway exposure assessment model to predict the average daily dose received by a model environment and compare this dose with a reference dose to develop a set of chemical-specific scores. The resulting scoring system consists of a set of calculated toxicity equivalence potentials (TEPs), which are defined as the ratio of the risk posed by the release of one pound of Chemical X to the risk posed by the release of one pound of a reference chemical. Environmental Defense's risk scoring tool does not consider the size or characteristics of the exposed population that may make it particularly susceptible to risk. Environmental Defense has developed a separate set of TEPs or risk scores for carcinogens and non-carcinogens released into the air or water. In the case of carcinogens, the reference chemical is benzene. In the case of non-carcinogenic chemicals, the reference chemical is toluene. A cancer risk score of 83 for cadmium indicates that 83 pounds of benzene would have to be released into the air or water in order to pose the same approximate level of carcinogenic health risk as the reported release of cadmium.

Environmental Defense's tool is widely available over the Internet. A stakeholder in the United States or Canada does not have to recalculate TEPs based on the complicated exposure model underlying these values.⁴ He or she simply multiplies the TEP for a particular chemical by the reported pounds of that chemical released into the air or water. Once all chemicals have been translated into reference-chemical equivalents, they can be compared directly or aggregated to compare the relative human health risk that different facilities or groups of facilities pose. Environmental Defense has developed TEPs for chemicals that represent approximately 78 percent of air releases and 12 percent of water releases reported to the TRI in 1998. These chemicals also represent 83 percent of air releases and 73 percent of water releases reported to the NPRI in 1998.

As noted above, Environmental Defense's screening tool relies on model environment assumptions (e.g., meteorological, hydrological, or soil characteristics) to determine exposure potential. Consequently, the tool will be less accurate in areas where the environmental conditions vary considerably from those assumed in the model.

⁴ The results of the exposure assessment model have been shown to be relatively insensitive to small changes in assumptions when evaluating Canadian data.

3.3.2 EPA's Risk-Screening Environmental Indicators Tool

The U.S. EPA has developed the Risk-Screening Environmental Indicators (RSEI) Tool, which allows for risk-based comparisons of toxic chemical releases.⁵ EPA constructs what it refers to as "indicators" that integrate (1) the chemical-specific reference (or "safe") dose for non-cancer effects and the potency for carcinogens with (2) a measure of exposure potential. Each indicator is based on four factors: the quantity of the chemical released, an adjustment for the toxicity of the chemical, an adjustment for the pathway-specific exposure potential of the chemical, and an adjustment to reflect the size of the potentially exposed population. The chemicals are ranked relative to each other by the tool, not relative to some absolute or benchmark value, and carcinogenic as well as chronic non-carcinogenic effects are considered. The screening tool presents absolute TRI releases reported by facility and chemical, and TRI releases weighted by toxicity, exposure potential and population (using 1990 U.S. Census data). The software allows the user to view weighted releases by chemical, facility, or industry, and a variety of geographic levels. Weighted releases are available for TRI data since 1988, which can be selected in the tool as a base year to aid in comparisons of releases over time. Thus far, weighted releases have been developed to assess the chronic human health risks from 98 percent of TRI chemicals released into the air. EPA intends to extend the tool to consider acute human health impacts and chronic and acute ecological impacts. While not directly accessible from the Internet, the tool is available to the public by request.

While useful for examining pollutant releases in the United States, the EPA's tool is not directly applicable to analyzing pollutant releases in other countries without first replacing the population data and other parameters in the tool with data specific to the particular country of interest.

3.4 What are the strengths and limitations of risk screening tools?

Risk screening or scoring tools that consider toxicity, environmental fate, and exposure potential are widely available. Most, however, are relatively new and may still have limits to their usefulness. This section highlights the main strengths and limitations of these tools.

⁵ EPA is developing other tools, such as the Waste Minimization Prioritization Tool, that may also include TRI data. We present the RSEI tool as an example.

3.4.1 Main strengths of risk screening tools

- Risk screening tools quantify exposure potential.
- Risk screening tools provide a means for comparing release data for chemicals with different health effects.
- Most tools are easy for non-experts to use.
- These tools are effective as screening-level tools that can quickly pinpoint chemicals, facilities, or geographic areas of potential concern for the particular impacts for which the tool has been designed.
- Because they attempt to address the actual risks posed by chemical releases, risk screening tools may more closely address the types of questions people are likely to have.

3.4.2 Main limitations of risk screening tools

- Risk assessment tools support comparisons but generally cannot be used to predict actual cancer rates or other population-level effects.
- Cumulative or multiple-exposure pathways are not considered.
- Releases to land are rarely considered because data are less dependable.
- Risk screening tools generally rely on many assumptions that can greatly affect results, and which may not be generally applicable (for example, climatic and meteorological parameters in the model may not be valid for all regions). To understand the nature and applicability of these assumptions, users may need advanced knowledge of each tool's underlying assumptions and substantial technical expertise.
- In some cases where data needed for exposure modeling are missing, default assumptions are used to ensure the inclusion of as many chemicals as possible. These default assumptions may be inaccurate.
- Data related to potentially exposed populations reflect average populations and do not account for people that may have atypical exposure patterns or are more sensitive to exposure.
- Risk screening tools generally focus on human health risks and generally do not consider ecological risks.

4. NORMALIZATION

This section discusses techniques for "normalizing" PRTR data. We begin with a definition of normalization, and then examine how these tools can be applied to PRTR data and describe specific examples. Finally, we discuss the general strengths and limitations of this type of tool.

4.1 What is normalization?

PRTR data tell us the amounts of particular pollutants released and transferred in a given year by a facility or set of facilities. Normalization as discussed here is a process of allocating or apportioning these pollutant releases on a standardized or “normal” basis (e.g., tons of steel produced, energy used, value of shipments, jobs created). In mathematical terms, normalization typically entails the simple division of releases by some measure for the same set of industrial activities (e.g., 10,000 pounds of lead released by a plant that produces 1,000,000 circuit boards per year is 0.01 pounds of lead per circuit board produced).

Normalization is of particular value to users interested in the environmental performance or eco-efficiency of a facility, company or sector. By expressing pollutant releases on a per unit basis (e.g., per unit economic output), normalization attempts to account for the varying amount of productive activity over time, or for differences among facilities, firms, and/or locations. However, normalized data do not provide insight into the risk to health and/or the environment from particular pollutant releases.

The key aspect of normalization is the selection and application of the best basis on which to normalize. Possible levels for normalization of PRTR data range from a particular process within a facility to the facility, firm, industry sector, jurisdiction, or country level. After determining the level of interest, users can choose from various productivity or value measures to normalize the data. The choice may depend on availability or appropriateness of data at each level. Some measures, such as GNP, are subject to effects such as price fluctuations and exchange rate changes at all levels, others have effects that are only seen at certain levels.

For example, choosing material input as a measure of productivity is useful at the industry level for industries such as petroleum refining, where the input (crude oil) is an easily measured commodity. Releases could be expressed in terms of barrels of oil refined. This measure is less helpful in industries such as chemical manufacturing, where inputs may be considered confidential or may vary to a degree that makes comparison difficult. For firms in this industry, a production ratio may be a useful measure. A production ratio is produced by firms that prefer not to report exact output, and allows each facility at the firm to be compared against its own ratio over time. This ratio is useful at the facility level, but is not applicable at broader levels. To develop and use normalized data, users must determine beforehand what level

The productivity or value measure that can be used to normalize pollutants vary widely and include:

- ***Gross Domestic Product***
- ***Gross National Product***
- ***Value of exports***
- ***Population***
- ***Income***
- ***Land area***
- ***Units of production***
- ***Value of output***
- ***Sales***
- ***Revenue***
- ***Value added***
- ***Value of shipments***
- ***Material input or output***
- ***Production ratio or activity index***

of analysis is necessary, and which productivity or value measure would capture the most relevant information at that level.

4.2 How might normalization be used on PRTR data?

As explained above, normalization is typically used to compare relative "environmental performance" or efficiency, e.g. among facilities, companies or jurisdictions, on some normalized basis such as units of production or GNP. Normalized data alone will not tell you what quantities of the chemical(s) are being released into the local or regional environment, nor whether those environmental loadings have increased or decreased from one year to the next.

The following example illustrates one method of normalization of PRTR data. According to the TRI, firms in Texas emit more ammonia than do firms in Idaho (25.8 million pounds compared to 3.5 million pounds in 1998). Does this mean that facilities in Texas are less environmentally efficient for ammonia releases than facilities in Idaho? Not necessarily. There are a number of important differences between Texas and Idaho such as the number and mix of industries located in the state, the levels of production, and the inputs used. If we examine the amount of ammonia released per million dollars of shipment value in manufacturing, we find 86 pounds of ammonia are emitted for every million dollars of shipment value in Texas but that 206 pounds are released per million dollars of shipment value in Idaho. In other words, for a given level of manufacturing activity (measured here by value of shipments) firms in Idaho emit more ammonia than do firms in Texas.

As another example, consider a printed circuit board plant that released 1,000 pounds of copper in its wastewater in 1994 and 2,000 pounds in 1999. This does not seem like much progress in pollution control unless one also considers that the same plant produced 500,000 circuit boards in 1994 and 2,000,000 in 1999. In 1999 the facility released a pound of copper for every 1,000 circuit boards while in 1994 it released a pound for every 500 boards.

4.3 What specific types of normalization are available?

Normalization can be used both internally by a facility or firm, and externally by interested parties. Bridges to Sustainability, a not-for-profit organization, normalizes TRI releases for Interface, Inc. by the mass of each product manufactured in order to compare pollution across different product lines.⁶ General Motors Corporation normalizes both its TRI and NPRI pollutant releases by the number of vehicles it produces in a given year. It can then effectively track its progress in reducing

Normalization Examples on the Web:

GM Environmental Report:

www.gm.com/company/environment/

NRDC Study of Electricity Generation:

www.nrdc.org/air/energy/util/index.asp

⁶ Bridges to Sustainability has hosted a number of studies to construct metrics that normalize pollutant releases by the mass of a product, sales, and revenues. Refer to its web page at www.bridgestos.org.

pollution per unit of production over time. This type of normalization can also be applied at the facility level to compare the relative performance of different plants. However, normalization by unit of production is only effective when a company produces a narrow range of products. Normalizing over a wide range of different production units renders the resulting measure less meaningful.

One company may also wish to compare its environmental performance to that of other companies. It is relatively easy for a firm to compare facilities that produce similar and relatively undifferentiated products. Environmental performance could be evaluated by again normalizing by unit of production. For instance, a simple way to compare the relative environmental performance of two utility companies (or facilities) would be to examine their pollutant releases per MWh of electricity produced. The Natural Resource Defense Council (NRDC) compares the environmental performance of the top 100 electric generating companies in the United States by examining pollutants released into the air per MWh produced. According to its study, the American Electric Power Company was the top emitter of carbon dioxide in 1996. However, when ranked by the quantity of pollutants released per unit of electricity produced, it falls to 74th. In other words, while AEP is a large polluter, it produces its electricity more efficiently than two-thirds of other, smaller electric companies.

In cases where the level of economic activity and product lines vary widely across firms, sectors, communities or time, normalizing by a monetary measure of production may be more meaningful than normalizing by a product-specific measure. Care should be taken to adjust for differences in inflation and fluctuations in exchange rates when comparing these normalized pollutant releases over time. One example of this type of normalization is NRDC's examination of US power plants' carbon dioxide emissions per dollar of revenues. In the case of communities or countries that differ widely in size but are host to a variety of industry sectors, normalizing pollutant releases by sales produced by companies or by the value of exports accounts for differences in production activity. It does not however account for differences in the mix of industry located in these two areas.

4.4 What are the strengths and limitations of normalization techniques?

If properly used, normalization can add another perspective on PRTR data. However, normalization also poses certain challenges and complications to the analysis of PRTR data. Below we highlight some of the main strengths and limitations of normalization as a tool for interpreting PRTR data.

4.4.1 Main strengths of normalization techniques

- Normalization provides a basis for comparing environmental performance over time for a given facility or set of facilities.
- Normalization introduces factors (e.g., efficiency) that are relevant to many policy decisions that rely on PRTR data.

- Normalizing pollution releases is not conceptually difficult or difficult to implement once the methodology has been established and the data are in hand.

4.4.2 Main limitations of normalization techniques

- Most data used to normalize PRTR pollutant releases must be obtained from outside sources other than the PRTR and may not be readily available.
- Production information needed for many types of normalization may be confidential and firms may be reluctant to provide the data needed to support such normalization for competitive reasons.
- Normalizing by unit of production decreases in usefulness the more differentiated the products manufactured.
- It may be difficult to find a normalization measure that fits different industrial sectors.
- The usefulness of the production ratio or activity index included in TRI and NPRI for the comparison of different facilities, firms, or industry is severely limited. EPA and Environment Canada do not stipulate that a particular methodology must be used when calculating the production ratio or activity index. Also, the NPRI production ratio and index are currently voluntary.
- It can be difficult or impossible to match production data to the specific group of facilities or regions of interest. This is particularly true at the facility level.
- Raw (non-normalized) pollutant release data provide a more direct indication of actual pollution than normalized values.

5. ENVIRONMENTAL INDICATORS

This section discusses environmental indicators and their relationship to PRTR data. First, we define an environmental indicator. We then examine how PRTR data can be used to develop environmental indicators, and describe particular examples. Finally, we discuss the general strengths and limitations of this type of tool. While the focus here is on environmental indicators, PRTR data may serve as an input into other types of indicators, such as sustainability indicators that attempt to integrate environmental, economic and social factors.

5.1 What is an environmental indicator?

An environmental indicator is a quantitative measurement of environmental performance. Indicators can be used to track or compare the environmental performance of a facility or firm over time, or to compare the environmental performance of different firms and industries. For instance, an indicator may be used to compare the environmental impact of vehicle production across a firm's facilities or to analyze sulfur dioxide releases by the electric power industry in Mexico, the United States, and Canada. Environmental indicators can be used to internally monitor a firm's environmental performance, but are generally used as a means to communicate environmental performance to interested parties outside the firm itself (e.g. the surrounding community, potential investors).

For the most part, environmental indicators are not stand-alone values. They are components of corporate reporting initiatives designed to harmonize the way in which companies measure their environmental progress. One of the most well-known of these initiatives is the Global Reporting Initiative (GRI).⁷ The GRI is an international, voluntary set of sustainability reporting guidelines based on economic, environmental, and social aspects of the production process. The initiative is designed to help companies keep up-to-date, accurate, and complete information about their activities to promote sustainable and environmentally responsible development.

5.2 How might PRTR data be used to develop environmental indicators?

Quantities of pollutant releases, such as those available in PRTR data, can be used as one type of environmental indicator. This provides a measure of the amount of each toxic chemical that is released and/or transferred from a facility or company. Normalized PRTR data can also serve as an indicator. Releases can be normalized to monitor how much of a pollutant is released per unit or dollar of production (See section 4 for a discussion of normalization of PRTR data). For instance, a company may want to use the amount of hydrochloric acid it releases per dollar of sales to monitor its environmental performance over time. Alternatively, releases can be incorporated into an eco-efficiency ratio. Eco-efficiency is a measure of how well a company maximizes the value of its products while minimizing environmental impact. Specifically, it presents the amount of value produced per unit of pollutant releases.⁸ For instance, a company may use an eco-efficiency ratio that expressed total sales of its product per pound of sulfur dioxide releases into the air.

Eco-efficiency =
Product value added
Environmental Impact Added

PRTR data can be used as a type of environmental indicator; they can also be used as inputs into the development of other indicators such as those designed to measure eco-efficiency. Because the standards for creating environmental indicators, eco-efficiency measures, and environmental progress reports based on GRI guidelines are relatively new, few examples exist of companies using PRTR data in this way. However, there is a growing interest in using PRTR releases to construct environmental indicators. The Canadian National Roundtable on Economy and the Environment (NRTEE) has recommended that releases weighted by toxicity be used as an environmental indicator.⁹ Once initiatives such as that of the NRTEE and others are put into practice, it will be easier to compare companies' potential impacts on health and environment and their use of resources in a standardized, measurable way. This information is likely to be of interest to the companies themselves and to the public, but may also be useful for banks,

⁷ Information on the Global Reporting Initiative can be found on the web at www.globalreporting.org.

⁸ The World Business Council for Sustainable Development (WBCSD) has information on eco-efficiency available at its website. <http://www.wbcd.ch/aboutus.htm>.

⁹ NRTEE's Environment and Sustainable Development Indicators Initiative http://www.nrtee-tnee.ca/eng/programs/Current_Programs/SDIndicators/SDIndicators_e.htm

investors, insurance brokers and others who are interested in taking environmental performance and/or liability into account in their business decision-making.

5.3 What specific examples are available?

Governments have taken an interest in measuring environmental performance through the use of environmental indicators. For example, the U.S. EPA and Mexico's Secretariat of the Environment and Natural Resources -- Semarnat (formerly Semarnap) have published a report of environmental indicators to measure the environmental performance of industry in the U.S.-Mexico border area. Quantities of releases for ozone, particulate matter, sulfur dioxide, nitrogen dioxide, and carbon monoxide are used as a set of indicators for air quality.¹⁰

The utility of PRTR data as reported by facilities is demonstrated by the establishment of the GRI model. Many firms have followed the GRI model to prepare a report of environmental indicators and some firms have used PRTR data to develop these reports. DuPont, Duke Power, and Dow Canada use PRTR pollutant release data as environmental indicators. DuPont has used these releases to monitor a 67% reduction in the U.S. since 1991. Duke Power has used its TRI reported releases to monitor a reduction in the release of sulfur dioxide by 20 percent and of nitrogen oxides by 40 percent. Dow Canada has used its NPRI releases to evaluate progress in reducing its release of volatile organic compounds, hydrogen and nitrogen oxides.

<p style="text-align: center;">Examples of Corporate Environmental Reports</p> <p>DuPont: www.dupont.com/corp/environment/</p> <p>Duke Power: www.duke-energy.com/decorp/content/environment/DEIP12.asp</p> <p>General Motors: www.gm.com/company/gmability/environment/env_annual_report/index.html</p> <p>Ontario Energy: www.ontariopowergeneration.com/environmental/apr.asp</p>

In a few instances, firms have used normalized pollutant releases as environmental indicators. Both General Motors and Ontario Energy have used normalized releases as an environmental indicator. General Motors reports its total TRI and NPRI releases per vehicle produced while Ontario Energy reports its pollutant releases per MWh of electricity produced.

PRTR data have also been used by socially conscious investment funds to monitor and evaluate the environmental performance of firms. For instance, Calvert Group based in Bethesda, Maryland uses the quantity of PRTR pollutant releases to evaluate the environmental performance of candidate firms for its investment funds.

¹⁰ <http://www.epa.gov/usmexicoborder/indica97.html>

5.4 What are the strengths and limitations of using PRTR data to formulate an environmental indicator?

Uses of PRTR data as an environmental indicator, as an input into other indicators (e.g. eco-efficiency measures), or as part of a sustainability report have a number of strengths and weaknesses that warrant discussion.

5.4.1 Main strengths of PRTR-based environmental indicators

- PRTR data are widely available and easy to obtain.
- PRTR data are a simple and readily available type of environmental indicator. They can also be used as inputs into the construction of other indicators.
- PRTR data provide firms and other interested parties with a way to directly measure pollutant releases and transfers in a standardized way.
- PRTR data can be a useful aspect of a broader corporate environmental/sustainability report.

5.4.2 Main limitations of PRTR-based environmental indicators

- Although PRTRs are arguably more consistent than many other data sources from country to country, they do not include all chemicals, facilities, or industrial sectors, and are not fully consistent across nations.
- PRTR data alone do not provide a good indication of risk.
- PRTR data do not reflect non-pollutant related environmental factors such as energy and natural resource consumption.

6. ENVIRONMENTAL MANAGEMENT SYSTEMS

This section discusses environmental management systems and their relationship to PRTR data. We begin with a definition of an environmental management system. We then examine how PRTR data can be used in the context of an environmental management system and describe particular examples. Finally, we discuss the general strengths and limitations of this type of tool.

6.1 What is an Environmental Management System?

An Environmental Management System (EMS) is a tool with which companies can assess the overall environmental impact of their activities, set targets to improve performance and regulatory compliance, and assess the most effective ways to meet these targets. This process makes it easier to identify potential environmental problems before they occur and improve efficiency, which can save money as well as reduce environmental impacts. Some companies incorporate their EMS into the overall corporate decision-making process, allowing environmental costs and benefits to be weighed alongside financial considerations.¹¹

Main Components of an EMS

- Corporate environmental policy
- Identification of environmental aspects of operations
- Targets and objectives
- Structure and responsibility for implementation
- Monitoring and corrective action
- Training and awareness
- Documentation and records
- Management review

Companies, government agencies, and organizations from a wide variety of fields have established EMSs as an internal management tool. Some set up their own systems; others choose to adopt internationally recognized EMSs. ISO 14001, the most widespread standard, was developed by the International Organization for Standardization. These standards are voluntary, and are meant to apply to a wide range of users. As such, they do not proscribe levels of environmental performance.

6.2 How might PRTR data be used in an EMS?

PRTR data can be used in an EMS as one of many screening criteria to prioritize pollution prevention targets. This may be especially useful for companies that already are required to collect and report releases. Such companies already have much of the baseline information on measuring pollutant releases required to start designing an EMS.

An EMS provides a framework for managing all environmental aspects of a company's operations and, as such, may become a vehicle for recording and reporting under PRTR requirements. Ideally, the EMS will be designed from the start to incorporate this function and thereby avoid duplication. How can an EMS help from a PRTR point of view? If PRTR recording and reporting becomes an integral element of an EMS, then the company is better able to see what effects its releases and transfers have on its operations and the environment, and may be able to find ways to reduce or even eliminate releases and transfers.

¹¹ For more information on how Environmental Management Systems can promote regulatory compliance and environmental performance, please refer to NACEC's guidance document entitled "Improving Environmental Performance and Compliance: 10 Elements of Effective Environmental Management Systems" at www.ccc.org.

6.3 What specific EMS examples are available?

Few examples of EMSs that use PRTR data are available. Systems such as ISO 14001 are a relatively recent phenomena, and data are not yet available. Furthermore, because EMSs are voluntary, there is no requirement to publish data. An EMS generally includes targets, procedures, and decision-making processes rather than raw data or analyses of data. PRTR data can be used as a starting point for identifying priorities, and should form part of the documentation required within an EMS. In some cases, companies will identify past release rates to provide context for future goals, however these data are not always from PRTR data sources. For instance, Lockheed Martin Canada lists as one of its primary EMS goals to reduce pollution at all of its site operations. PRTR data are not explicitly referenced as useful in achieving this goal, but they would enable the company to easily monitor the reduction in releases over time.

Acushnet Rubber Company is one example of a company that has used PRTR data to develop and meet a specific EMS goal. Based on amounts reported to the TRI, Acushnet identified trichloroethylene (TCE) as a chemical used at the company at a relatively high rate. This factor coupled with the knowledge that TCE has high hazardous waste disposal costs, lead the company to set a goal to eliminate TCE from its factories. The EMS allowed them to analyze the details of their operations, identify the processes that use TCE, and, by working with suppliers, find a less hazardous alternative to replace TCE in these processes.¹²

6.4 What are the strengths and limitations of incorporating PRTR data in an EMS?

Although there are few specific examples of the use of PRTR data directly in an EMS, a number of important strengths and weaknesses still warrant discussion.

6.4.1 Main strengths of incorporating PRTR data into an EMS

- Using PRTR data can provide cost savings in two ways. First, companies may already be required to collect these data, thus eliminating duplication of the cost of data collection for an EMS. Second, the chemicals identified using PRTR data may be replaced or reduced and therefore provide cost savings to the company.
- Companies with PRTR data available may find it easier to develop an EMS.

6.4.2 Main limitations of incorporating PRTR data into an EMS

- PRTR data do not include all chemicals. Companies may overlook those chemicals that are missing or find that substantial pollutant release data collection is still required for their EMS.
- Many companies that have implemented an EMS are large multi-national corporations. Reporting of PRTR data may not be required in all countries where

¹² U.S. Environmental Protection Agency. Using Design for the Environment Concepts in Your EMS, 1998. <http://www.epa.gov/opptintr/dfe/tools/ems/bulletins/bullet01/index.html>

they have facilities. Some may nevertheless track PRTR data for all of their facilities, but this is done on a voluntary basis.