Chapter 5

Improving Mandatory Environmental Data Reporting for Comparable and Reliable Environmental Performance Indicators

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Additional information is available at the end of the chapter

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1. Introduction

Since the 1980s mandatory national environmental data reporting has become one of the predominant environmental regulations in developed countries. Mandatory disclosure of environmental data usually involves creating a publicly accessible database or register whereby regulated entities periodically track, document and report environmental data such as emission of a list of priority pollutants and their transport to other sites [1]. All OECD Member States require industrial facilities to report the amount and type of pollutants released to air, water or land and wastes transferred off-site [2].

Mandatory environmental data reporting provides invaluable information that can be used to design policies, monitor and compare the environmental performance of companies as well as industries, improve cleaner production programs, reduce releases of certain chemicals, increase stakeholder participation and public awareness, increase accountability of organizations and address global environmental issues [1,3-7].

In addition, mandatory reporting reduces market failure resulting from insufficient disclosure of information on a good that produces negative environmental externalities [8, 9]. The study in [10] argues that mandatory reporting increases welfare compared to other instruments, such as optimal taxation, if implemented in a cost-effective way. Furthermore, several studies show that disclosure of environmental information affects the capital market and subsequently firm behavior whereby information about the poor environmental performance of publicly traded companies reduces their stock price return [11-14]. This is because poor environmental performance indicates high environmental related costs and/or liability which reduce the value of the company. The stock market reaction will subsequently induce a change in firm behavior whereby companies seek to reduce emission and improve environmental performance [15, 16].

For any given mandatory environmental register to harness the above benefits and more, the register has to be designed and implemented with cost-effectiveness and sustainability considerations [7]. In addition, it has to be constantly and extensively evaluated to check whether objectives are realized, policy needs are addressed, compliance is enforceable and any inconsistencies are minimized. Designs should also be improved to accommodate an expansion of geographical and sectorial coverage, an increase in the list of priority pollutants and better measurement techniques [17, 18]. Data should be standardized so as to allow comparison across companies, industries and over time. Once the above conditions are met and a reliable register is setup, reported data should easily reflect risk to human health and the environment so as to be easily interpreted by different stakeholders such as scholars, policymakers, managers and the public [19].

The purpose of this study is to explore and evaluate the most recent of all mandatory environmental data registers, namely the European Pollutant Release and Transfer Register or E-PRTR. The E-PRTR was adopted in 2006 by the European Parliament and the Council of the European Union with the purpose of making facility-level environmental information publicly available [20]. It obliges industrial facilities operating in 32 European countries (27 EU Member States, Iceland, Liechtenstein, Norway, Serbia and Switzerland) to report data on the release of harmful pollutants to air, water and land as well as their transport to other local and foreign sites. So far, data for three years (2007 to 2009) is publicly available for over 29,000 industrial facilities releasing or transferring 91 priority pollutants. The E-PRTR database is maintained by the European Commission and the European Environmental Agency and freely available at http://prtr.ec.europa.eu/ [21].

The E-PRTR has not yet been extensively evaluated to identify weaknesses, potential strengths and improvement areas. The only reviews available are the three informal reviews prepared by the European Environmental Agency with 'the objective of assisting countries to improve data quality by providing feedback on potential quality issues and inconsistencies with other reports'. In effect, the reviews are summaries and descriptive statistics of the 2007, 2008 and 2009 E-PRTR datasets [22-24]. The reviews also include a comparison of environmental data reported in the E-PRTR with other external environmental databases; and document errors and inconsistencies.

However, the reviews fail to address important issues like: How can reporting requirements be improved to be more inclusive? Are there any inconsistencies in reporting requirements and reported data? How can the E-PRTR be used for economic, environmental and policy analyses and what are things to consider when using the E-PRTR in such studies? How can the E-PRTR be used to study and compare the environmental impact of industrial sites, even if they operate in different countries? How can the E-PRTR be used to develop measures that reflect waste recycling and treatment efforts?

The contribution of this chapter is to address the above research questions and examine factors that government officials, businesses, academicians and citizens should consider when reviewing or using the E-PRTR. The primary purpose of the chapter is to identify limitations and strengths of the E-PRTR and recommend areas of improvement. Identification of potential strengths and weaknesses will assist regulators in future policy actions as well as policy design;

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it will also encourage scholars to apply the freely available E-PRTR dataset in economic, scientific and environmental researches.

Secondly, the chapter introduces a new methodology to aggregate and normalize facility-level environmental data obtained from the E-PRTR. The normalized values will then be used to construct an *environmental performance indicator* which can easily be used to compare and rank industrial facilities across time, industry and country. Facility-level rankings within an industry can be used for policy implementation such as emission trading and allocation of quotas; industry-level rankings can be used to study the relative pollution-intensity of sectors; country-level comparisons can be used to design international environmental agreements. The environmental performance indicator introduced in this chapter captures a facility's environmental impact by reflecting abatement efforts through waste recycling and pollutant treatment techniques.

In section 2, an overview of the E-PRTR dataset is presented. In section 3 aggregation and normalization techniques are discussed and a novel measure of the environmental performance of facilities is introduced. Finally, section 4 concludes by forwarding some recommendations on what to consider when using the E-PRTR for policy and economic analyses; and how to improve reporting requirements and future data collection.

2. E-PRTR overview

The E-PRTR was adopted in 2006 by the European Parliament and the Council of the European Union with the purpose of making facility-level environmental information publicly available [20]. It replaces and improves the previous European Pollutant Emission Register which provides environmental data for the years 2001 and 2005. The E-PRTR is publicly available and can be accessed at http://prtr.ec.europa.eu/ [21]. Industrial facilities operating in 32 European countries (27 EU Member States, Iceland, Liechtenstein, Norway, Serbia and Switzerland) have reported annual data from 2007 to 2009. This chapter is based on the recently available 2009 data. In 2009, over 29,000 industrial facilities operating in 32 countries have reported to the Register. About 80% of these reporting facilities operate in 8 countries namely, UK, Germany, Spain, France, Italy, Poland, Belgium, Czech Republic and the Netherlands.

Mandatory national environmental data reporting is usually accompanied by a document which describes factors to consider when using such datasets. For instance, the US Toxic Release Inventory (TRI), which is one of the oldest and most successful mandatory disclosure requirement, is accompanied by official documents and reports which discuss factors to consider when using the TRI, limitations of available data, tools for analyzing and interpreting data, etc. [25]. However, the relatively new E-PRTR has not yet produced a document which provides caution about how to interpret and analyze data. The *Guidance Document to the Implementation of the E-PRTR* [20] is only an instruction document describing reporting requirements, characteristic of regulated facilities, what and how to report data. There are no suggestions for researchers and policymakers on how to use and interpret the data.

In this section an overview of the E-PRTR is presented along with a discussion of major limitations, potential strengths and factors to consider when using the E-PRTR data. In section 2.1 a summary of the characteristics of facilities required to report is presented along with some notes of caution while using the E-PRTR for policy design and national studies. In section 2.2 the type of required information is presented and evaluated. Section 2.3 discusses some inconsistencies between E-PRTR reporting requirements and actual reported data.

2.1. Characteristics of regulated facilities

In 2009, a total of 29,196 facilities reported to the E-PRTR out of which 938 facilities have more than one location while the rest 28,259 have a unique location. Industrial facilities engaged in 9 activities as their primary sectors are required to report to the E-PRTR. These 9 sectors, referred to as "Annex I activities" in the *Guidance Document*, are presented in Table 1 along with number of reporting facilities in each sector in 2009 [20].

Facilities engaged in the 9 activities as their primary sector are obliged to report to the E-PRTR only if their production (or processing) capacity exceeds a given annual threshold specific to each sector [20]. This indicates that reporting facilities are more or less larger facilities where small and medium facilities are not required to report. As a result, the E-PRTR would only be suitable for studies that focus on environmental damages from large point sources.

Sector	Number of reporting facilities
Intensive livestock production & aquaculture	6,104
Waste & wastewater management	7,653
Production & processing of metals	4,296
Chemical industry	2,821
Mineral industry	2,196
Energy sector	2,011
Animal & vegetable from food & beverage sector	1,990
Other activities	1,276
Paper & pulp; wood production & processing	849
Total	29,196

Table 1. Annex I activities and reporting facilities (2009)

In addition, reporting facilities represent a very small fraction of total active enterprises in most sectors and countries. For instance, consider the manufacturing sector which consists of all production activities in Table 1 except waste and wastewater management and intensive livestock and aquaculture. As can be seen from Table 2, at the national level, reporting facilities account for a very small percentage of total manufacturing enterprises active in 2009.[1] This narrow E-PRTR coverage may be because most sectors are dominated by small and medium scale facilities which are not required to report.

1 Data for total population of manufacturing enterprises active in 2009 is obtained from Eurostat statistical database [26].

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	Number of facilities in the manufacturing sector		
Country	**Total population**	**Reporting facilities**	**E-PRTR coverage (%)**
Austria	28,223	154	0.55
Belgium	38,462	525	1.36
Bulgaria	33,143	96	0.29
Cyprus	6,494	12	0.18
Czech Rep.	153,019	506	0.33
Denmark	18,336	223	1.22
Estonia	7332	45	0.61
Finland	28,401	314	1.11
France	234,398	2,164	0.92
Germany	263,464	2,703	1.03
Hungary	51,803	278	0.54
Ireland	12,776	182	1.42
Italy	444,564	1,630	0.37
Latvia	7,636	15	0.20
Lithuania	13,679	34	0.25
Luxembourg	851	23	2.70
Netherlands	53,717	510	0.95
Norway	18,704	229	1.22
Poland	233,308	974	0.42
Portugal	74,234	324	0.44
Romania	54,652	181	0.33
Slovakia	60,330	146	0.24
Slovenia	17,672	123	0.70
Spain	227,607	1,694	0.74
Sweden	55,767	374	0.67
UK	149,840	1,650	1.10

Table 2. E-PRTR 2009 coverage

As a result, reporting facilities are not a good representative of the larger population and the E-PRTR may not be suitable for broader policy analysis and national studies. This is because non-reporting facilities altogether could possibly have a higher aggregate environmental impact compared to regulated facilities.

2.2. Data facilities are required to report

Regulated facilities are required to report the name of their facility, parent company if any, location, full address, main economic activity, the release and transfer of 91 priority pollutants and name and address of competent authority of the country of operation. The 91 priority pollutants are classified into 7 groups: chlorinated organic substances, greenhouse gases, heavy metals, inorganic substances, other organic substances, pesticides and other gases. The release and transfer of each of the 91 pollutants should be reported if release and transfer exceeds a given annual threshold specific to each pollutant.

Specifically, regulated facilities are required to annually report the amount of: (1) Pollutants released to air, water and land in kilogram given each pollutant released exceeds a given annual reporting threshold. Accidental releases should be reported separately whenever available. (2) Off-site transfer of solid waste (hazardous and non-hazardous) for the purpose of disposal in tons given that the transfer exceeds 2 tons of hazardous waste and 2000 tons of non-hazardous waste. (3) Off-site transfer of solid waste (hazardous and non-hazardous) for the purpose of recovery in tons given that the transfer exceeds 2 tons of hazardous waste and 2000 tons of non-hazardous waste. (4) Off-site transfer of pollutants in wastewater (through pipes) for the purpose of treatment in kilogram given that the transfer exceeds a given annual reporting thresholds for each pollutant. Whenever hazardous and non-hazardous wastes are transferred off-site to another country for recovery or disposal, the name and address of the receiving facility along with purpose of transfer should be reported.

Table 3 reports a distribution of number of facilities with the type of required data. Close to 60% of regulated facilities have transferred hazardous and/or non-hazardous wastes off-site, possibly to a specialized waste handler for the purpose of recovery or disposal. On the other hand, only 6% of regulated facilities have transferred pollutants in wastewater through pipes to external waste handlers for the purpose of treatment.

Reported data	Reporting facilities
Pollutant released to air, water & land	14,170
Off-site transfer of hazardous & non-hazardous waste for recovery	17,363
Off-site transfer of hazardous & non-hazardous waste for disposal	17,190
Off-site transfer of pollutants in wastewater for treatment	1,769

Table 3. Data facilities are required to report

Regulated facilities are not required to identify the different types of hazardous (and non-hazardous) wastes they transfer to external waste handlers. Rather, the amount of all types of hazardous wastes is reported as an aggregated value. As a result, there are no mechanisms to differentiate facilities which generate 'acutely' hazardous wastes from facilities which generate 'slightly' hazardous wastes.

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In addition to reporting the amount of different pollutants and wastes released and transferred from individual facilities, the E-PRTR requires facilities to report the techniques used to determine reported values. Accordingly, facilities clearly indicate values directly measured and values calculated based on production or input data. When amounts are calculated or measured the technical method used to measure and calculate should be reported [20]. If direct measurements and calculations are not possible then estimations based on professional assumption are allowed. As Table 4 shows only a few values have been estimated and close to 90% of data are based on either calculations or actual measurements. Measured and calculated values are more accurate than estimated values and hence the E-PRTR dataset can be considered as a reliable source.

Reported data	Calculated	Estimated	Measured
Pollutant releases	46%	10%	44%
Pollutants transferred off-site in wastewater	15%	12%	73%
Off-site transfer of hazardous & non-hazardous waste	54%	0%	46%

Table 4. Reporting techniques

Facilities should disclose and report all required information to the competent authority of their country, which is responsible for passing the information to the European Commission. Whenever facilities have justifiable reasons they can request confidentiality not to disclose some information. Reasons for confidentiality should be based on Article 4 of Directive 2003/4/EC of the European Parliament and the Council of 28 January 2003 on public access to environmental data. The type of information withheld with the reason of withholding should be reported to the public. Some of the justifications for declaring confidentiality are: disclosure compromises public security, international relations, the ability of a person to receive fair trial, legitimate economic interest, intellectual property right, protection of location of rare species, etc. [27]. A total of 125 facilities have declared confidentiality and these are located in Belgium (106 facilities), Bulgaria (3 facilities), Denmark (1 facility), Germany (3 facilities), Luxembourg (3 facilities), Romania (2 facilities), Sweden (4 facilities) and UK (2 facilities). These confidential firms are engaged in animal and vegetable production as food and beverage (4 facilities), chemical industry (39 facilities), energy (6 facilities), mineral (4 facilities), paper and wood (1 facility), production and processing of metals (21 facilities), waste management (46 facilities) and others (4 facilities). Table 5 presents the number of facilities declaring confidentiality based on Article 4(2) of Directive 2003/4/EC.

Despite presenting fairly accurate environmental data, the absence of other important and complementary variables limits the usefulness of the E-PRTR dataset in comparative analysis. This chapter identifies at least four types of potentially useful information that are currently missing from the E-PRTR but can easily be incorporated by updating reporting requirements.

Confidential information	Number of facilities
Is off-site transfer of waste destined for recovery or disposal?	
Off-site transfer of hazardous waste (inside country)	1
Off-site transfer of hazardous waste (outside country)	3
Off-site transfer of non-hazardous waste	6
Is reported value based on measurement, calculation or estimation?	
Off-site transfer of hazardous waste (inside country)	3
Off-site transfer of hazardous waste (outside country)	1
Off-site transfer of non-hazardous waste	5
Information on host for off-site transfers	
Waste handler party name & address	124
Quantity of hazardous & non-hazardous waste transferred offsite	13
Total	125

Table 5. Confidentiality

First of all, the E-PRTR questionnaire includes sections where facilities can report optional but not required information on facility characteristics. For instance, data on production volume, number of installations, number of operating hours, number of employee data are only optional and not required. As a result only 2.6% of facilities have reported production quantities and only 9% have reported number of employees' data. Providing space for reporting the above information but making it optional is a drawback of the E-PRTR. This is because production and input data provide information on firm size which could easily be used to normalize emission and transfer data and construct easily comparable environmental performance indicators which control for size.

Secondly, essential input-use variables are not required by the E-PRTR at all. For instance, the amount of harmful chemical inputs, raw materials consumed, energy consumed, total waste generated and number of permits held, if any, are not required by the E-PRTR. This is another limitation of the E-PRTR since input variables could assistant the construction of a broad range of alternative environmental performance indicators. For instance, one could construct indicators based on emission per production or per number of employees to measure environmental impacts or else construct energy use per production to measure efficiency of resource use.

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Thirdly, there are no provisions that allow the identification of firms that use cleaner production technologies, if any. Available data on the transfer of pollutants in wastewater through pipes for treatment and the transfer of hazardous and non-hazardous wastes for recovery and disposal only indicate abatement efforts through end-of-the-pipe-type techniques. Even though cleaner technologies solve environmental problems better by preventing rather than just treating pollution, the E-PRTR provides no mechanisms to identify and reward regulated facilities which rely on these technologies [28, 29]. Future data collection can easily be improved by including questions to identify whether facilities are engaged in any source reduction activities or activities that use less natural resources.

Fourthly, the E-PRTR has no provisions for reporting abatement that takes place on-site by using end-of-the-pipe techniques. The focus of the E-PRTR is on reporting the transfer of pollutants to specialized off-site waste management facilities. For instance, facilities are not required to report on-site recycling, energy recovery and treatment. Figure 1 illustrates how the absence of on-site waste management and other variables from the E-PRTR can create biases and reduce its usefulness. The figure is adopted from the *Guidance Document for the Implementation of the E-PRTR* and modified to illustrate the limitation of E-PRTR reporting requirements [20].

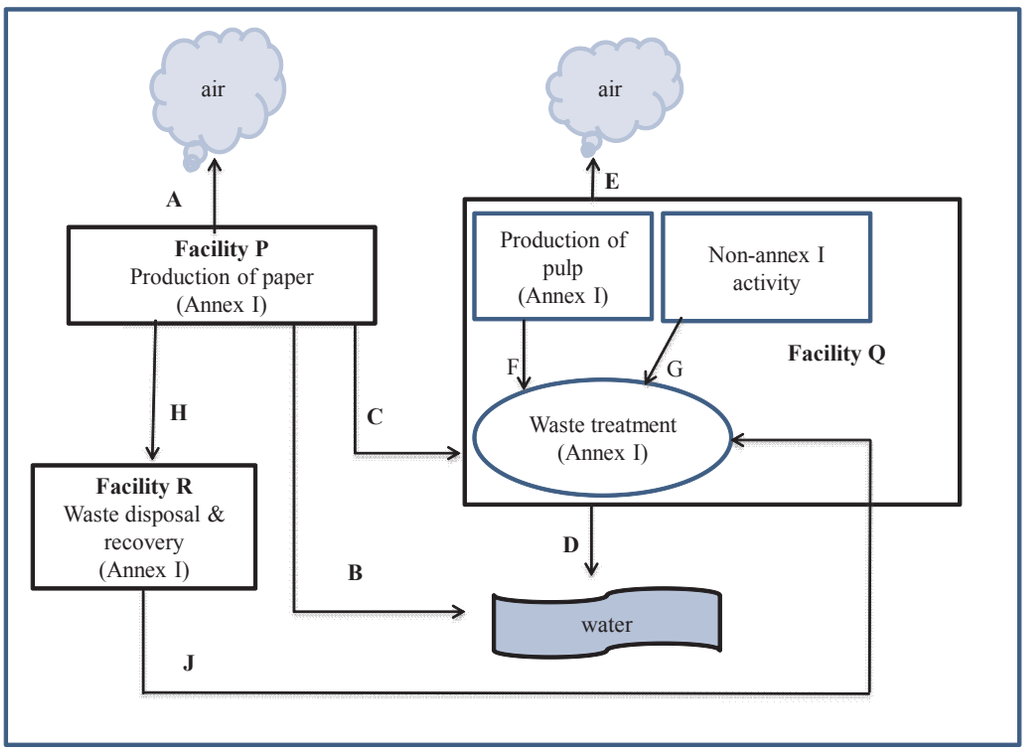

Figure 1. E-PRTR requirements and limitations

The three facilities illustrated in Figure 1 (Facility P, Q and R) are engaged in Annex I activities as their primary sector. All three facilities exceed the production threshold for their respective activity and hence are regulated by the E-PRTR. Facility Q owns a wastewater treatment plant which is also a part of Annex I activities. Facilities P and R transfer waste to facility Q for treatment and this should be reported as off-site transfer of pollutants in wastewater for treatment as amounts C and J respectively. In addition, facility P should report amount A and B as pollutant released to air and water respectively; amount H as off-site transfer of wastes. Facility Q should report amount E and D as pollutant released to air and water respectively.

At least two drawbacks of the E-PRTR reporting requirements can be illustrated using Figure 1. First of all, amounts F and G, which measure on-site waste management, remain unreported. Amount G is not reported since it originates from a non-Annex I activity. However, even though amount F originates from an annex I activity, it is not reported. It may appear as if facility Q is not abating wastes at all since it has no transfers for treatment, disposal or recovery. As a result, the E-PRTR cannot be used to identify and reward facilities which invest in their own waste management plants.

Secondly, there may be double counting of wastes in amounts H and J (assuming all amounts A to H exceed reporting thresholds). It may be the case that part of the waste that originated as H from facility P is not processed by facility R and hence ends up as J to facility Q. Take another example, the amount reported as C originates and is reported by facility P. Part of the amount indicated as C may be treated by facility Q while the rest ends up as E or D in the treatment process. However, the E-PRTR records C, E and D as if they are independent amounts and this leads to double counting. In general, the E-PRTR does not follow the fate of a given pollutant from generation to disposal or recovery and there are no mechanisms to trace the source of pollutants and wastes. As a result, the E-PRTR does not enable us to understand the true relationship between regulated facilities.

Some of the above discussed drawbacks of the E-PRTR can easily be improved by drawing lessons from other more successful mandatory environmental registers such as the US TRI. For instance, by requiring facilities to report source reducing and other activities the US TRI can better identify facilities with cleaner production. In addition, the US TRI identifies amounts F and G by requiring facility Q to report the amount of wastes/pollutants recycled, recovered or treated on-site. Furthermore, the US TRI has reporting requirements on on-site disposal and storage of wastes which can easily be replicated by the E-PRTR.

2.3. Reporting thresholds

Facilities which exceed given production (or processing) capacity thresholds in each sector are required to report to the E-PRTR only if the release and transfer of pollutants exceeds a given annual threshold specific to each of the 91 priority pollutant [20]. Reporting threshold for pollutants is given for each of the three medium of releases as air, water and land. The annual reporting threshold is given as 2 tons for hazardous wastes and 2000 tons for non-hazardous wastes. Regarding reporting thresholds this chapter identifies two inconsistencies between reporting requirements and actual reported data; and one source of lack of transparency in the construction of reporting thresholds.

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Pollutant release	Missing threshold for	Number of reporting facilities
Phenols	air	6
Fluorides	air	18
1-1-1- Tricholorethhane	water	6
Sulfur oxides	water	2
Total nitrogen	air	3
Total organic carbon	air	57
Total organic carbon	land	14
Other non-priority pollutants	-	10

Table 6. Missing thresholds

First of all, facilities are required to report to the Register only if given reporting thresholds are exceeded. However, some facilities have reported releases and transfers below the reporting threshold. For instance, a total of 311 facilities reported all values below or equal to reporting thresholds; these facilities were not meant to be regulated by the E-PRTR. This inconsistency between reporting requirements and actual data raises concerns on the effectiveness and uniformity of the implementation of the E-PRTR.

The second inconsistency regarding reporting thresholds is that some facilities reported releases of certain pollutants even though they have no reporting threshold and hence do not trigger reporting. Table 6 summarizes number of facilities which reported data despite missing threshold requirements. Whenever firms report unrequired data it is not clear what thresholds they used, if they used one. This creates inconsistency and reduces the comparability of data obtained from the E-PRTR.

The possibility of missing thresholds indicates that the E-PRTR has a potential to expand the list of priority pollutants as well as their medium of releases. For instance, emission of toluene, xylenes, fluorides, atrazine, phenols and benzo perylene to air does not trigger a reporting requirement. However, these pollutants have known human toxicity when released to air and hence should be documented and reported [30].

Another concern regarding reporting thresholds is that the basis on which the thresholds were set is neither transparent nor clearly explained. Reporting thresholds should ideally reflect the impact of pollutants on human health and the environment. In other words, highly toxic pollutants should have a lower threshold compared to less toxic pollutants. Without an expert toxicology analysis, the thresholds for most of the 91 priority pollutants seem to be based on effects and impact. It appears like 'more harmful' substances have lower thresholds than 'less harmful' substances. Nevertheless the European Commission and European Environmental Agency have not yet given a detailed explanation on how the thresholds are set [20].[2] The only

2 It is anticipated that the European Commission will carry out an evaluation of pollutant thresholds and publish a review in 2013.

indication given on the E-PRTR website is that "thresholds have been set with the intention of covering for each specific pollutant about 90% of the total mass emissions from facilities regulated under E-PRTR" [21]. Thresholds for 50 pollutants were decided in 1998-99 but never updated since; at the time not much was known about total emissions in Europe. For the rest 41 pollutants, 'pragmatic solutions' were adopted to incorporate into the E-PRTR Regulation [31]. However, the E-PRTR should not just be about total releases into the environment from large point sources but also about harm and risk per se.

Some pollutants are long-lived and persist in the environment for a longer period of time (consider benzene which can persist in the environment for a week) while others are short lived like Hydrogen Chloride which persists for about 7 hours [30]. In addition the impact of pollutants depends on the geographical and atmospheric condition, height of release, transport of pollutant as well as population density. Thus, thresholds should consider impact factors and risk rather than just considering gross emissions. For instance, copper and chromium have equal reporting thresholds of 100kg released to air. But 1 gram of chromium requires a higher volume of air of about 1 million m^3 to loss its human toxicity (through inhalation) as compared to copper which requires only 570 m^3 of air. Not only human toxicity but other impacts like ecotoxicity should be considered when setting the reporting thresholds.

Despite some of its limitations, the E-PRTR provides a framework for collecting rich facility-level environmental data for several countries. Hence, it has the potential to address the problem of lack of facility-level data on industrial wastes since most other currently available data are dominated by municipal wastes [32]. In addition, the E-PRTR reports environmental data from several countries using the same reporting rules; this provides a potential basis for comparing international data and designing international environmental agreements. The E-PRTR can also be used to develop measures that reflect the waste recycling and treatment effort of facilities.

In section 3, a procedure for aggregating and normalizing E-PRTR data is presented. The purpose of normalization is to develop a comparable environmental performance indicator.

3. Environmental Performance Indicator (EPI)

The 91 priority pollutants released to air, water and land greatly differ in their effect on human health and the environment. They also differ in their toxicity, persistent in the environment, transport and fate. Because of this heterogeneity one cannot just add the amounts of the different pollutants reported by a facility. Rather one needs to normalize the raw data by using weights that reflect toxicity as well as impact on the environment.

As discussed in section 2.3, reporting thresholds should ideally reflect the impact of pollutants on human health and the environment where highly toxic pollutants are given a lower threshold compared to less toxic pollutants. Even though the European Commission provides no detailed explanation on how E-PRTR thresholds are set, it appears like 'more harmful' substances roughly have lower thresholds than 'less harmful' substances.

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If E-PRTR thresholds appropriately reflect risk then one can use the thresholds to aggregate the several pollutants released and transferred by a single firm. This study introduces a normalization procedure whereby we calculate the percentage of a pollutant a facility has released or transferred over the given reporting thresholds. If reporting thresholds correctly reflect impact of pollutants on health and the environment, then this normalized value represents the environmental impact of a facility. A higher normalized value represents a higher impact, whereas a lower value represents a lower impact. For each firm we use the following normalization formula:

$$\sum_{p=1}^{q} \frac{X_p - T_p}{T_p} \tag{1}$$

where X is the actual amount of pollutant p released or transferred off-site, T is the given reporting threshold for a pollutant p and q is the number of the different types of pollutants a firm has released or transferred in a year.

The above formula yields a unit-free number which can be interpreted as how much above the threshold a firm has emitted or transferred. The normalized value presented in equation (1) cannot by itself be used to compare firms. This is because large sized firms have a higher normalized value while smaller firms naturally have a lower value. However, the normalized data can be used to develop an *environmental performance indicator* which controls for the size of firms.

Environmental performance indicators are quantitatively measurable results of a facility's operation that interact with the environment [33]. Environmental performance has three dimensions: preventing waste before it occurs using cleaner production; recycling, treating or reducing waste using end-of-the-pipe techniques; and using resources and energy efficiently [34, 35].

Environmental performance indicators should be comparable across time and firms, target-oriented and understandable for users [33, 36]. Furthermore, indicators should be consistent with policymakers' and regional priority. In addition, normalization schemes should reflect environmental impacts/damages, should be easily replicable, transparent, easy to interpret, and available for all relevant pollutants [37]. Developing a performance indicator requires collecting accurate data, assessing information against objectives and criteria, selecting indicators, reporting and communicating results, reviewing and improving indicators. Several studies have developed numerous normalization techniques which reflect weighting, aggregating and comparing pollutants released in different mediums based on their health and environmental impacts [38-40]. Techniques significantly vary based on type of available data, type of firm-ownership (public versus private) and sector being considered [41, 42]. Commonly used indicators capture a company's effort in using end-of-the-pipe techniques and efficient input use. For instance, electricity consumed per production, quantity of waste generated per production and quantity of waste recycled per production are possible performance indicators [36, 43].

Based on data available from the E-PRTR, we introduce a firm-level environmental performance indicator that controls for size of firms. The environmental performance indicator introduced in this chapter captures a firm's environmental impact and reflects abatement using end-of-the-pipe-type waste reduction efforts. Data and reporting requirements are not sufficient to explore efficiency of resource and energy use or abatement through cleaner technologies. Hence, the introduced indicator only reflects waste recycling and treatment efforts by using end-of-the-pipe techniques.

In this study, environmental performance of a firm is defined as the amount of waste treated and recovered as a percentage of total wastes/pollutants where total wastes/pollutants is the sum of waste disposed, recovered, treated and pollutants released to air, water and land. The following formula is used to calculate the environmental performance of any firm (say firm *i)* where all variables are normalized values

$$EPI_i = \frac{W_{t,i} + W_{r,i}}{e_i + W_{t,i} + W_{r,i} + W_{d,i}} \tag{2}$$

where EPI_i is the environmental performance indicator for firm i, e_i is normalized value for pollutants released to air, water and land, $W_{r,i}$ is normalized value for waste recovered, $W_{t,i}$ is normalized value for waste treated and $W_{d,i}$ is normalized value for waste disposed.

EPI_i yields a value between 0 and 1 where firms with *EPI* close or equal to 1 have 'good' performance as they have succeeded to abate 100% of pollution and wastes using end-of-the-pipe techniques. On the other hand, firms with *EPI* close to 0 have 'bad' performance as they have not used end-of-the-pipe techniques to treat pollutants and recover wastes. *EPI* values can be converted to percentages where $EPI_i = x\%$ can be interpreted as 'firm i has abated $x\%$ of pollutants and wastes using end-of-the-pipe techniques'.

We use equation (2) to calculate *EPI* for facilities regulated by the E-PRTR. For a total of 311 facilities the calculated *EPI* is undefined because all of the 4 normalized values used to construct equation (2) are zero. If a given facility has all zeros for all normalized values, then that facility should not have reported to the E-PRTR as it does not exceed reporting thresholds. To maintain comparability we take out the 311 facilities with undefined *EPI* values and report a ranking of environmental performance for the remaining facilities. See Table 7.

As Table 7 indicates, close to 59% of facilities have 'bad' environmental performance with *EPI* less or equal to 25%. This indicates that large point sources are not investing much on treatment of pollutants and recycling of wastes off-site. Nevertheless whether these sources are relying on cleaner technologies or not is not clear from available data. It is also not clear whether they rely on on-site waste management and recycling rather than using off-site options.

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EPI %	Percentage of facilities
0%	43.38%
0 % - 25%	15.23%
25% - 50%	7.70%
50% - 75%	6.99%
75% - 99%	11.70%
100%	15.00%

Table 7. Environmental performance of firms

The environmental performance indicator presented in equation (2) can be extended at the country level by using the following formula:

$$EPI_k = \frac{\sum_{i=1}^{n} W_{t,i} + \sum_{i=1}^{n} W_{r,i}}{\sum_{i=1}^{n} e_i + \sum_{i=1}^{n} W_{t,i} + \sum_{i=1}^{n} W_{r,i} + \sum_{i=1}^{n} W_{d,i}} \quad (3)$$

where EPI_k is the environmental performance indicator of country k and n is the number of regulated facilities in each country. Equation (3) makes use of the sum of normalized values at the country level.

At the country level, EPI_k measures the overall performance of facilities regulated by the E-PRTR where good performance is in terms of abating a larger percentage of wastes and pollutants using off-site end-of-the-pipe techniques. The EPI_k measure controls for number of regulated firms in each country as well as firm size.

Table 8 presents a ranking of countries based on equation (3). Countries such as Latvia, Lithuania, Malta, Iceland and Bulgaria have the highest environmental performance indicator. High environmental performance in these countries may be because they have high investment on off-site end-of-the-pipe technologies of recycling and treatment. The largest Member States like Germany and France also have relatively good performance ranking at 7th and 15th places with 65% and 47% *EPI* values respectively. On the other hand, countries such as UK and Switzerland are on the lower end with *EPI* values of 21% and 20% respectively. This may be because these countries rely more on cleaner production and other on-site waste management techniques rather than using off-site end-of-the-pipe-type abatement options.

One can also construct a sector level environmental performance indicator to identify sectors which use off-site end-of-the-pipe techniques for treatment and recovery of wastes and pollutants. Table 9 presents a sector level ranking based on the environmental performance indicator. 'Waste and wastewater management' as well as 'paper, pulp and wood production and processing' industries have the highest *EPI* value of above 50%. On the other hand the 'mineral industry' and 'intensive livestock production and aquaculture' have the lowest *EPI* values.

	Reporting facilities		
Country	**Number**	**Percentage**	EPI_k**(%)**
Latvia	32	0.11	91.63
Lithuania	97	0.34	81.14
Malta	15	0.05	74.14
Iceland	17	0.06	72.47
Bulgaria	182	0.63	71.28
Luxembourg	29	0.10	69.70
Germany	4,692	16.24	65.25
Poland	1,287	4.46	58.69
Austria	239	0.83	57.32
Romania	484	1.68	53.85
Ireland	332	1.15	52.68
Sweden	549	1.90	51.26
Denmark	425	1.47	48.76
Belgium	914	3.16	48.19
France	3,563	12.34	47.68
Cyprus	66	0.23	44.41
Czech Rep.	800	2.77	39.65
Spain	3643	12.61	38.13
Portugal	574	1.99	36.98
Netherlands	790	2.73	35.34
Slovenia	183	0.63	30.34
Hungary	730	2.53	28.48
Italy	2,582	8.94	27.81
Norway	724	2.51	21.11
UK	4,713	16.32	21.03
Switzerland	222	0.77	20.20
Finland	480	1.66	15.03
Estonia	101	0.35	14.17
Greece	124	0.43	8.78
Slovakia	256	0.89	8.76
Liechtenstein	1	0.00	0.00
Serbia	39	0.14	0.00

Table 8. Environmental performance of countries

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The *EPI* measure introduced in this paper is not without limitations. Although most of the weaknesses of the *EPI* measure are inherent in the limitations of existing E-PRTR reporting requirements, there are some limitations we wish to acknowledge in the application of the *EPI* in future studies. First of all, even if thresholds correctly and fully reflected risk, it may not fully capture the potential risk of pollutants released to air, water and land since *EPI* is constructed based on the presence of a given amount of a pollutant in the environment (air, water, land). We have no information on exposure to humans, how long pollutants stay in the environment and how many people live around a given facility. Secondly, even though different thresholds are given for different medium of releases (i.e. air, water and land), the medium of releases are treated equally and given identical weights when constructing *EPI*. Lastly, *EPI* does not reflect efficiency of resource/energy use and cleaner production efforts since available data is not sufficient to explore these.

Sectors	**Reporting facilities (%)**	***EPI %***
Waste & wastewater management	26.21	54.40
Paper, pulp & wood production processing & processing	2.91	51.49
Other activities	4.37	45.86
Production & processing of metals	14.71	42.58
Energy sector	6.89	32.45
Animal & vegetable products from food &beverage	6.82	29.34
Chemical industry	9.66	22.11
Mineral industry	7.52	18.11
Intensive livestock production & aquaculture	20.91	7.26

Table 9. Environmental performance of sectors

4. Conclusion and recommendations

The recently introduced Europe-wide mandatory environmental data reporting regulation, known as E-PRTR, has not yet been extensively evaluated to assess weaknesses and inconsistencies that prevent it from being widely used in economic and policy analysis. There are yet no documents that provide caution on how to use, interpret and analyze data obtained from the E-PRTR.

This chapter explores this relatively new database and underlines some factors to consider when using the E-PRTR in academic research or policy design. This study recognizes that the E-PRTR would only be suitable for researches that focus on environmental damages from large point sources. This is because reporting requirements exclude small and medium sized facilities with production capacity below a given threshold. In addition, reporting facilities represent a very small fraction of total active enterprises. Hence, reporting facilities may not be a good representative of the larger population; this limits the use of E-PRTR for broader policy analysis and national studies.

This chapter identifies some of the major limitations of the E-PRTR. Important and complementary variables are missing from the E-PRTR regulation which limits the usefulness of the E-PRTR dataset in comparative studies. Data on production volume, number of installations, number of operating hours and number of employee data are only optional and hence a very small number of facilities have responded. These data are essential in that they provide information on firm size which could have easily been used to construct easily comparable environmental performance indicators. Other input use variables such as the amount of harmful chemical inputs, raw materials consumed, energy consumed, total waste generated and number of permits held, if any, are not required by the E-PRTR. Such variables could assistant the construction of a broad range of alternative environmental performance indicators. Furthermore, reporting requirements do not identify facilities which use cleaner production technologies and facilities which use on-site recycling, energy recovery and treatment. As a result, the E-PRTR cannot be used for policies that reward facilities which invest in their own waste management plants. In addition, reporting requirements do not prevent double counting of wastes since there are no mechanisms to trace pollutants and wastes from cradle to grave. Another limitation of the E-PRTR is that it provides no mechanisms to differentiate facilities which generate 'acutely' hazardous wastes from facilities which generate 'slightly' hazardous wastes.

The chapter also identifies some inconsistencies between reporting requirements and actual reported data. A few facilities which were not meant to be regulated by the E-PRTR have reported data whereas other regulated facilities have reported pollutants which do not trigger reporting. Such inconsistencies between reporting requirements and actual reports raise concerns on the effectiveness and uniformity of the implementation of the E-PRTR as well as comparability of data. Besides these inconsistencies, there are no detailed explanations on how pollutant reporting thresholds have been constructed. As it is, it seems like these thresholds are just rough estimations.

In addition to exploring the E-PRTR the chapter also introduces a new methodology to aggregate and normalize facility-level environmental data. Normalized values are used to construct an environmental performance indicator which captures a facility's environmental impact by reflecting abatement efforts through waste recycling and pollutant treatment techniques. The indicator can easily be used to compare the environmental impact of industrial facilities across time, industry and country.

Finally, based on the evaluation of the E-PRTR summarized above, we forward the following recommendations to improve future data collection and existing reporting requirements.

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i. Reporting requirements can be improved to be more inclusive and representative by lowering production capacity thresholds and increasing the list of priority pollutants to include chemicals with known harm to health and the environment.

ii. Future data collection can be improved by making mandatory the disclosure of input and output variables such as energy use, production volume, raw material use, total waste generated, etc.

iii. Facilities which rely on cleaner production should be identified. Similar to the US TRI the E-PRTR can oblige facilities to report source reducing activities.

iv. Similar to the US TRI, facilities can also be required to report the amount of wastes/pollutants recycled, recovered or treated on-site as well as the amount of wastes/pollutants disposed or stored on-site.

v. Inconsistencies can be reduced by making reporting requirements more standardized and ensuring uniformity of their implementation. For instance, there should be mechanisms to prevent non-regulated firms from reporting and to ensure that regulated firms are actually reporting according to given guidelines.

vi. Further study on the toxicity of priority pollutants is required to understand, categorize and rank the effect of each priority pollutant on human health and the environment. This would help the construction of transparent reporting thresholds which are based on risk and impact.

vii. Waste categories such as hazardous and non-hazardous wastes can further be decomposed to differentiate the content of waste. For example, the US Environmental Protection Agency categorizes hazardous wastes into manufacturing wastes, wastes from specific industries, wastes from commercial chemical products, mixed wastes containing hazardous and radioactive components, pesticides, etc.

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References

[1] Case D. The Law and Economics of Environmental Information as Regulation. Environmental Law Institute 2001; 31 ELR 10773. http://www.vanderbilt.edu/vcems/papers/ELRVersion2.pdf (accessed 10 May 2012).

[2] Pollutant Release and Transfer Register. www.prtr.net/en/ (accessed 2 April 2012).

[3] OECD. Pollutant Release and Transfer Registers (PRTRs). A Tool for Environmental Management and Sustainable Development. PRTR Workshop for the America's, July 29-31, 1997, San Juan del Rio, Mexico. http://www.oecd.org/dataoecd/36/32/2348006.pdf (accessed 13 April 2012).

[4] Larrinaga C., Carrasco F., Correa C., Llena F., Moneva J. Accountability and Accounting Regulation: The Case of the Spanish Environmental Disclosure Standard. The European Accounting Review 2002; 11(4) 723-740.

[5] Kolominskas C., Sullivan R. Improving Cleaner Production through Pollutant Release and Transfer Register Reporting Processes. Journal of Cleaner Production 2003; 12(7) 713-724.

[6] National Environment Protection Council. National Environment Protection (National Pollutant Inventory) Measure. Australia 1998. http://www.comlaw.gov.au/Details/F2007B01123 (accessed 13 April 2012).

[7] Fung A., Graham M., Weil D. The Political Economy of Transparency- What Makes Disclosure Policies Sustainable? Ash Institute for Democratic Governance and Innovation, John F. Kennedy School for Government, Harvard University; 2004. http://www.transparencypolicy.net/assets/whatnakesdisclosureeffective.pdf (accessed 4 April 2012).

[8] Kennedy P., Laplante B., Maxwell J. Pollution Policy: The Role for Publicly Provided Information. Journal of Environmental Economics and Management 1994; 26(1) 31-43.

[9] Kleindorfer P., Orts E. Information Regulation of Environmental Risk. Risk Analysis 1998; 18(2) 155-170.

[10] Petrakis E., Sartzetakis ES., Xepapadeas A. Environmental Information Provision as a Public Policy Instrument. Contributions to Economic Analysis & Policy 2005; 4 (1).

[11] Hamilton JT. Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data. Journal of Environmental Economics and Management 1995; 28(1) 98-113.

[12] Konar S., Cohen MA. Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emission, Journal of Environmental Economics and Management 1997; 32 (1) 109-124.

[13] Konar S., Cohen MA. Does the Market Value Environmental Performance? The Review of Economics and Statistics 2001; 83(2) 281-289.

[14] Khanna M., Quimio WR., Bojilova D. Toxics Release Information: A Policy Tool for Environmental Protection. Journal of Environmental Economics and Management 1998; 36(3) 243-266.

[15] Al-Tuwaijri S., Christensen T., Hughes II KE. The Relations among Environmental Disclosure, Environmental Performance, and Economic Performance: A Simultaneous Equations Approach. Accounting, Organizations and Society 2004; 29(5-6) 447–471.

[16] Clarkson P., Li Y., Richardson G., Vasvari F. Does it Really Pay to be Green? Determinants and Consequences of Proactive Environmental Strategies. Journal of Accounting and Public Policy 2011; 30(2) 122-144.

[17] Kakkainen B. Information as Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm? Georgetown Law Journal 2001; 89(257) 1-89.

[18] Kerret D., Gray G. What Do We Learn from Emissions Reporting? Analytical Considerations and Comparison of Pollutant Release and Transfer Registers in the US, Canada, England and Australia. Risk Analysis 2007; 27 (91) 203-223.

[19] Tietenberg T. Disclosure Strategies for Pollution Control. Environmental and Resource Economics 1998; 11(3-4) 587-602.

[20] European Commission/EC/. Guidance Document for the Implementation of the European PRTR 2006. http://prtr.ec.europa.eu/docs/EN_E-PRTR_fin.pdf (accessed 13 April 2012).

[21] European Pollutant Release and Transfer Register. http://prtr.ec.europa.eu/ (accessed 12 July 2012).

[22] European Environmental Agency/EEA/. E-PRTR Review Report 2009 Covering the 2007 E-PRTR Dataset. ETC/ACC Technical Paper 2009/15. The Netherlands, 2010a.

[23] European Environmental Agency/EEA/. E-PRTR Review Report 2010 Covering the 2008 E-PRTR Dataset. ETC/ACC Technical Paper 2010/05. The Netherlands, 2010b.

[24] European Environmental Agency/EEA/. E-PRTR Informal Review Report 2011 Covering the 2009 E-PRTR Dataset. ETC/ACM Technical Paper 2011/06. The Netherlands, 2011.

[25] USA Environmental Protection Agency TRI. The Toxic Release Inventory (TRI) and Factors to Consider When Using TRI Data. http://www.epa.gov/tri/tridata/index.html (accessed 4 May 2012).

[26] European Commission Eurostat Statistical Database. http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database (accessed 12 April 2012).

[27] Directive 2003/4/EC of the European Parliament and the Council of 28 January 2003. Official Journal of the European Union 2003; 41(-) 26-32. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:041:0026:0032:EN:PDF (accessed 7 February 2012).

[28] Fikru MG. Does the E-PRTR Enable us to Understand the Environmental Performance of Firms? Environmental Policy and Governance 2011; 21(3) 199-209.

[29] Johnstone N., Serravalle C., Scapecchi P., Labonne J. 2007. Public Environmental Policy and Corporate Behavior: Project Background, Overview of the Data and Summary Results. In: Johnstone N. (ed.) Environmental Policy and Corporate Behavior. UK: OECD p1–33.

[30] Hauschild M., Potting J. Spatial Differentiation in Life Cycle Impact Assessment- The EDIP2003 Methodology. Environmental News No. 80. Danish Ministry of the Environment 2005.

[31] Air and Climate Change – Mitigation Office. European Environmental Agency. Denmark .E-mail to Bob Boyce (Bob.Boyce@eea.europa.eu) 2011 October 18.

[32] OECD. Key Environmental Indicators 2008. http://www.oecd.org/dataoecd/20/40/37551205.pdf (accessed 5 May 2012).

[33] Perotto E., Canziani R., Marchesi R., Butelli P. Environmental Performance, Indicators and Measurement Uncertainty in EMS Context: A Case Study. Journal of Cleaner Production 2008; 16(4) 517-530.

[34] Cordano M., Frieze I. Pollution Reduction Preferences of US Environmental Managers: Applying Ajzen's Theory of Planned Behavior. Academy of Management Journal 2000; 43(3) 627-641.

[35] Klassen R., Whybark D. The Impact of Environmental Technologies on Manufacturing Performance. Academy of Management Journal 1999; 42(6) 599-615.

[36] Jasch C. Environmental Performance Evaluation and Indicators. Journal of Cleaner Production 2000; 8(1) 79-88.

[37] Larsen HF., Hauschild M. Evaluation of Eco-toxicity Effect Indicators for Use in LCIA. International Journal of LCA 2007; 12(1) 24-33.

[38] Hertwich E., Mateles S., Pease W., McKone T. Human Toxicity Potentials for Life-Cycle Assessment and Toxics Release Inventory Risk Screening. Environmental Toxicology and Chemistry 2001; 20(4) 928–939.

[39] Bare J., Norris G., Pennington D., McKone T. TRACI The Tool for the Reduction and Assessment of Chemical and other Environmental Impacts. Journal of Industrial Ecology 2003; 6(3-4) 49-78.

[40] Toffel M., Marshall J. Improving Environmental Performance Assessment. A Comparative Analysis of Weighting Methods used to Evaluate Chemical Release Inventories. Journal of Industrial Ecology 2004; 8 (1-2) 143-172.

[41] Ren X. Development of Environmental Performance Indicators for Textile Process and Product. Journal of Cleaner Production 2000; 8(6) 473-481.

[42] Lundberg K., Balfors B., Folkeson L. Framework for Environmental Performance Measure in a Swedish Public Sector Organization. Journal of Cleaner Production 2009; 17(11) 1017-1024.

[43] Rao P., Castillo O., Intal PS., Sajid A. Environmental Indicators for Small and Medium Enterprises in the Philippines: An Empirical Research. Journal of Cleaner Production 2006; 14(5) 505-515.

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