Abstract

New Jersey's Pollution Prevention Law of 1990 was a landmark law to respond to the public push for more proactive regulations of toxic materials. This paper will evaluate the effectiveness of New Jersey's Pollution Prevention Law and its implementation. The results will be analyzed using a qualitative method, using the NJ Department of Environmental Protection's Release and Pollution Prevention Report data which encompasses all chemicals qualifying as toxic to human health, the environment, or both. The analysis aims to evaluate the effectiveness of the law by evaluating if the amount of chemicals has decreased in the state as per the intent of the law. The results indicate the success of the law is mixed, with some categories seeing increases and others seeing decreases. The results suggest there are improvements that could be made both in the policy itself and the implementation of the policy to see further positive results.

Literature Review

The literature review will encompass three main topics, all providing background or demonstrating the importance of New Jersey's Pollution Prevention Law of 1990. The first section will consist of an overview of the federal Emergency Planning and Community Right to Know Act and how it relates to New Jersey's Pollution Prevention Law. The second section will discuss the concept of Community Right to Know including its benefits and shortfalls. Finally, the last section will discuss the importance of policy implementation, particularly if the goal of the policy involves an equity lens.

EPCRA and NJ's Pollution Prevention Law of 1990

In 1984, over 2000 people were killed from a toxic release at a pesticide plant in Bhopal, India (Broughton, 2005). Just one year later, 150 people were injured from a toxic release of gas in Institute, West Virginia (Ward, 1990). These incidents were not isolated; between 1980 and 1985, there were over 6000 accidents involving hazardous materials in the United States (Diamond, 1985). These events, particularly the lack of emergency response adequacy and the resulting strong grassroots movement, are widely considered the basis of Congress passing SARA Title III, also known as the Emergency Planning and Community Right to Know Act (EPCRA) (Christiansen & Urguahart, 1992; Wolf, 1996).

Only within the last few decades have government officials recognized that proactive prevention of pollution is both economically and environmentally preferable to cleaning up and controlling it (Atcheson, 1990). Pollution control, the reactive policy of dealing with pollution after it's been released into the environment, is more expensive for both businesses and government, is less effective at removing pollution, and creates the idea that there is an "acceptable" level of fixed pollution (Cole, 1992; Johnson 1992; Kareff 1995; Falkenberry,

1995). Research shows proactive pollution prevention regulations are stronger motivators for industry to implement their own prevention measures, as opposed to pollution control laws which are more costly and tend to reduce industry competitiveness (Johnson 1992).

Federal Policies

The EPCRA first required publication of the Toxics Release Inventory (TRI). The report found that in the United States, 4.57 billion pounds of toxic chemicals had been released into the environment in 1988 (S. Rep. No. 526, 1990). For context, the most recent TRI report found that 3.04 billion pounds had been released, despite having a wider range of chemicals required in reporting and far more facilities reporting (Environmental Protection Agency 2022).

The ECPRA is made up of two parts. The first requires states to provide for emergency planning in the event of chemical releases from an industrial facility (Anderson & Lawler, 1995). The second requires mandatory annual reports from industry concerning chemical inventories and releases, and the public availability of these reports, also known as Community Right to Know (Christiansen & Urguahart, 1992). Both of these policies signaled a shift towards proactivity both in notifying the public about hazardous materials in their community as well as in case of an emergency (Purifoy, 2013; Wolf, 1996).

New Jersey Policies

New Jersey was one of the first states to both require public reporting of toxics inventories and releases as well as one of the first states to create a mandatory pollution prevention planning program; notably, these were only for stationary sources of toxics at facilities, not mobile sources such as trucks or trains (NJ Department of Environmental Protection, 2012). The state's Pollution Prevention (P2) Act of 1991 establishes an Office of Pollution Prevention, requires industry pollution prevention plans and reports to be made public,

and creates enforcement mechanisms (N.J.S.A. 13:1D-35). It also requires the NJDEP to prepare reports on P2 trends in the state. The P2 plans must include both an inventory and analysis of the use and release of hazmat along with targeted production processes and sources of these hazardous materials, including goals for reduction. The P2 Act differs from the federal ECPRA in that it targets production and process chemicals and releases as well, not just end-of-production, defined as nonproduct output (Aucott et al., 1996). The idea behind including nonproduct output not only fills in the gaps in the federal law, it also creates more competition, as a facility may notice if they have more nonproduct output per dollar revenue than their competitors (Konar & Cohen, 1997).

One additional nuance of the state law is that although any facility covered by the P2 Act is required to submit plans for pollution prevention as well as annual updates summarizing their progress, there is no requirement or enforcement to implement the plan (Aucott et al., 1996). Since the P2 Act measures outputs from all along the production process, it is assumed that facilities would become more aware of the economic benefits of pollution prevention and take those measures voluntarily (NJ Department of Environmental Protection, 2012).

Community Right to Know

While no policy can address all hazardous materials issues, it is obvious that both the Federal and the State efforts to directly regulate industry and improve environmental quality do not always achieve their goals (Purifoy, 2013). However, Community Right to Know (CRTK) helps fill in some of those gaps. In fact, a former EPA administrator called CRTK policies "among the most important weapons in efforts to combat pollution," and another said the TRI was "among our most potent environmental weapons" (Wolf 1996). Some researchers argue that this information can serve as de facto regulation, replacing direct government regulations (Konar

& Cohen, 1997; Palenchar, 2008). Additionally, publishing CRTK information increases the public's awareness of their environment and can lead to improvements in public health and environmental regulations (Christiansen & Urguahart, 1992; Palenchar, 2008). However, others argue that initiatives like the federal TRI serve as simple pollution accounting systems and do not reduce pollution in any real way (Hearne, 1996). In fact, federal policies like EPCRA may actually increase environmental injustice, as the information they provide lacks context, is often outdated, and is oversimplified, and the communities who would be most affected by the industrial risk are left most exposed (Durham-Hammer, 2004).

CRTK has also been viewed as a market-based incentive, and industry firms who saw a decrease in value after publication of their toxics were more likely to decrease their emissions voluntarily (Konar & Cohen, 1997). However, other research finds that facilities covered under these kinds of laws try to fight current and additional environmental regulations, often using campaign contributions to politicians to influence their vote (Cho et al., 2008). Another common industry tactic to fight CRTK policies is concerns over revealing trade secrets or threatening national security; most research agrees that these arguments are largely unfounded and the proven benefits of CRTK outweigh the unproven risks (Anderson & Lawler, 1995; Echeverria & Kaplan, 2002; Palenchar, 2008; Reilly, 2014).

Implementation and Social Equity

At the genesis of the study of public administration, an emphasis was placed on an administrator needing to be efficient or economical, but has since shifted to add in the need to achieve social equity (Frederickson, 1990). While policy implementation was largely considered a background issue in public administration, recent efforts to include social equity have led to the realization of gaps in implementation (O'Toole, 2000).

Ideally, CRTK laws help citizens enforce the law, but citizens first need access to quality information and context before they can take action (Palenchar, 2008; Shapiro, 2005; Webler & Tuler, 2006). In fact, one study found that the implementation of the ECPRA law in New Jersey was severely lacking in most categories, particularly in citizen empowerment (Best, 1990). As stated above, the reports provided in CRTK initiatives often lack the context necessary for the communities most at risk to correctly process and act on the information; they must rely on external experts to interpret, thereby removing the empowerment the law intended to place within the community (Cole, 1992; Durham-Hammer, 2004). These communities are often made up of poor people and people of color, and both groups are more at risk of environmental dangers and have diminished political and economic power to resist industry intrusion than wealthy white people (Cole, 1992). CRTK laws are intended to not only disclose information, but to remove the vulnerability created by the nondisclosure of the information (Steinzor, 2002). CRTK should not only give citizens information about their community; it should also empower them to hold industry accountable (Rest, 1990). Without proper implementation of New Jersey's P2 Act, that empowerment disappears.

Methodology

In this section, the methodology of the analysis of the Release and Pollution Prevention Report (RPPR) data will be discussed. While attempting to analyze the effectiveness of NJ's P2 Act, this paper will use a secondary data analysis of publicly available data to compare 2009 levels of pollution with 2019 levels of pollution, as well as plotting yearly data from 2009-2019 comparing number of facilities with amount of pollution. This data is self-reported by industry and contains all facilities subject to the federal SARA Title III guidelines. However, this data is not easily digestible or contextualized when provided as a standalone spreadsheet. Additionally,

this data is self-reported by industry. The findings of this analysis will be presented in a table comparing 2009 to 2019 levels as well as a line graph comparing number of facilities and total material in pounds.

This analysis will attempt to address the following question: What are the gaps in the implementation of New Jersey's Pollution Prevention Act? The P2 Act was intended to create more transparency around the amount and nature of toxics and pollution in the state of New Jersey. However, recent years have found the P2 Act falling short of that goal, particularly with the lack of Release and Pollution Prevention Report analysis being published and presented to the citizens of New Jersey. This analysis provides important context for the average citizen who may not have specific knowledge of industry terms and may not be able to accurately compare trends over time. This is an appropriate data analysis and presentation of data since it is a replication of a seminal 2012 report on New Jersey's RPPR data from 2000-2009. The intent of this study is to provide more transparency around RPPR data, provide context for interested parties, compare trends in pollution prevention, and test if New Jersey is meeting its goal of reducing pollution.

This study will be using a quantitative analysis framework to determine the trends in the RPPR data as well as a qualitative analysis of the implementation of the law based on current literature. The RPPR data is submitted annually to the New Jersey Department of Environmental Protection (DEP) by facilities that are subject to the federal SARA Title III guidelines, also known as the EPCRA. According to both federal and state laws, this information is intended to be available to the public and easily accessible to achieve the goals of the law. However, this information is difficult to access and to obtain in a format that is digestible and understandable for the average citizen. Additionally, it does not appear that CRTK or RPPR data appears in its

entirety anywhere through the DEP's data portal, which as of the writing of this paper is undergoing issues confirmed by DEP. Therefore, this information must be obtained via direct correspondence with DEP through email, invoking the Open Public Records Act if necessary.

As of the writing of this paper, the DEP's website contains a report titled "Community Right To Know And Release And Pollution Prevention Report For Reporting Year 2009 And An Analysis Of Materials Accounting Data For Reporting Years 2000 To 2009." This study will attempt to replicate the analysis of the RPPR data from reporting year 2009 for subsequent years, specifically comparing 2009 data to 2018 data, using a similar time frame to the previous report. The previous report focused on three main categories: Use or Throughput, Nonproduct Output, and On-Site Emissions. This study will focus on those three categories and add two more: Starting/Ending Inventory and Average Use or Throughput per Facility. The analysis will consist largely of comparing 2009 and 2018 data using the formulas in the example table given below. Additionally, the analysis will include line charts to show trends over the time frame of certain categories. The findings of the analysis will be presented in five tables and three figures covering the categories stated above. This study is reliable and replicable due to the bureaucratic nature of the collection of RPPR data and the requirement that it is made publicly available.

While this data is the best available data, there are still potential shortcomings. The RPPR data is self-reported by industry, so it is always possible it is inaccurate. However, since there are no punitive measures for not complying with pollution reduction initiatives, it seems unlikely industry would falsify these reports in a significant way. Additionally, despite the ideal of bureaucracy and the desire for politics to remain separate, the reasons for the shortfalls in implementation of the law may not be as simple as literature may think. Because the DEP is the agency charged with implementation, and lies within the executive branch, the politics of the

governor will always influence it. The causes of shortfalls could be political and more difficult to capture in a quantitative or qualitative analysis.

Example Table

Comparison of 2009 and 2018 Category Data

	2009	2018	Change (in pounds)	Change (%)
Name of Category	A	B	(B-A)	(B-A)/A

Findings

In this section, this paper will describe the findings of the research. The data will be presented in several figures and tables. These figures will contain similar data to the 2012 analysis by the New Jersey DEP of materials accounting data for reporting years 2000 to 2009; this study will compare accounting years 2009 to 2018. The findings are broken up into three main categories based on the 2012 study, all of which are either directly pulled from RPPR data or can be calculated from it. The first is a supercategory called "Use," defined as the sum of the categories "Consumed," "Shipped as or in Product," and "Nonproduct Output." Three line charts will show trends of Use, total number of facilities, and average use per facility over time. The next category is Nonproduct output, which is its own category on the report, and will include the top 10 reports from 2009 and 2018. The third category is On-site Releases, another standalone category which is broken into subcategories including stack air emissions, fugitive air emissions, discharged to surface waters and ground waters, and on-site land disposal. This study found that overall use has decreased, NPO has increased, and On-site Releases have decreased. Other categories with particularly high increases or decreases will also be presented, including Starting

and Ending Inventories. An analysis of these findings will follow each figure. Any data presented in pounds is rounded to the nearest whole number.

Use or Throughput

The first category deemed essential to understanding the amount of qualifying materials is Use or Throughput. Table 1 includes the three categories that make up the supercategory of "Use," including Consumed, Shipped as or in Product, and Nonproduct output. Consumed is defined as consumed during a chemical reaction, Shipped as or in Product is defined as part of the products consumers end up with, and Nonproduct Output is defined as any materials that are not a part of a product, such as fuel. These three categories together are known as "Use." Here the findings from 2009 and 2018 are compared, and the differences in those findings are presented both as a change in pounds and as a percentage change. A detailed description of these categories can be found in the Appendix.

Table 1

Comparison of 2009 and 2018 materials accounting data

	2009	2018	Change (in pounds)	Change (%)
Consumed	3,112,760,249	1,909,023,973	(1,203,736,276)	-39%
Shipped as or in Product	14,103,555,958	10,527,035,215	(3,576,520,743)	-25%
Nonproduct Output	139,144,325	290,441,499	151,297,175	109%
Total "Use"	**17,355,460,532**	**12,726,500,687**	**(4,628,959,845)**	**-27%**

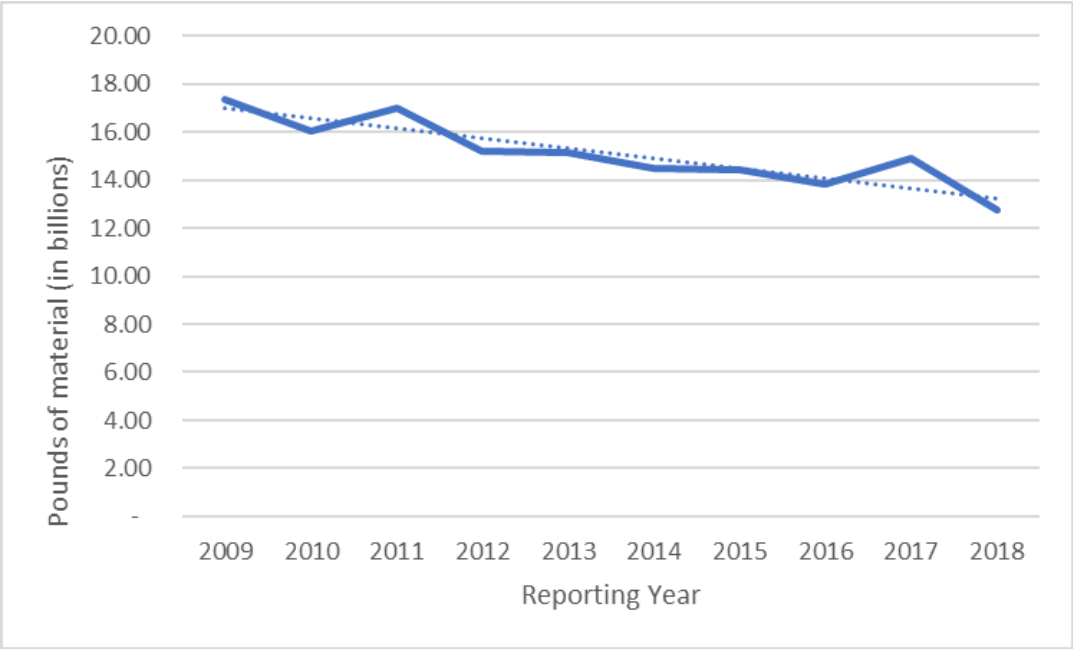
NJ Department of Environmental Protection. Release & Pollution Prevention Reports, Reporting years 2009 & 2018. Retrieved November 2023.

From this comparison, we can determine that there was a decrease in overall use. This means overall, there are fewer pounds of toxics being used in qualifying facilities in the state of New Jersey. Both Consumed and Shipped as or in Product went down by 39% and 25% respectively, but Nonproduct Output increased by 109%, more than doubling during this time.

As overall Use decreased, so did the number of facilities; in 2009, the number of reporting facilities was 424. In 2018, this number decreased to 336, showing a 21% decrease in the number of facilities. While both of these conclusions appear to show a decrease in use for those concerned about the amount of toxics, a different picture is painted when looking at the average use or throughput per facility. Figure 1 shows the total substance use or throughput for each accounting year from 2009-2018. Figure 2 shows the total amount of reporting facilities for each accounting year from 2009-2018. Finally, Figure 3 shows the average use or throughput per facility for each accounting year from 2009-2018.

Figure 1

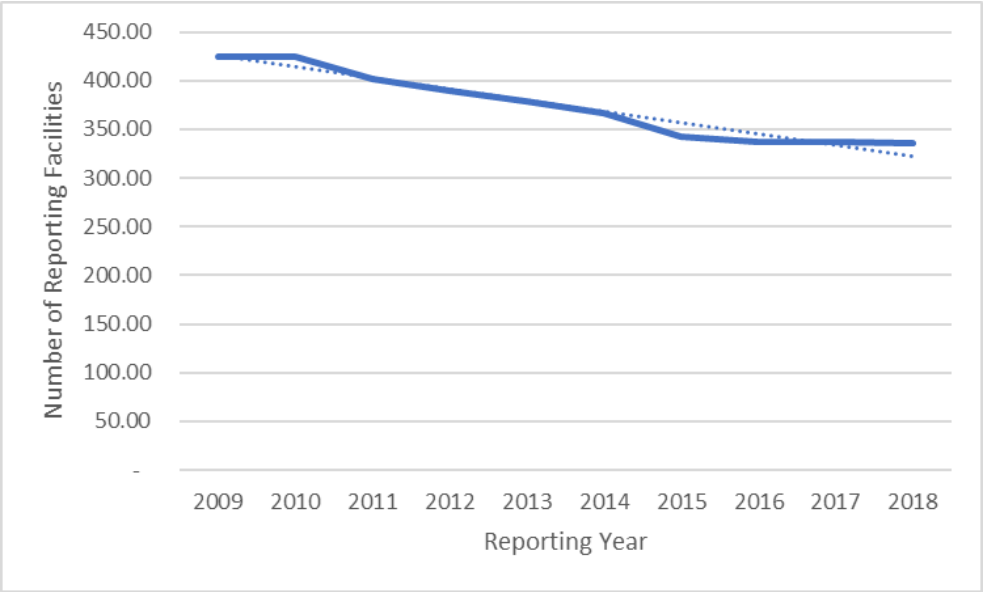
Total substance use or throughput in pounds over time



From Figure 1, the reader can gather that the total substance use is trending downwards over time.

Figure 2

Number of Reporting Facilities Over Time



From Figure 2, as stated above, the number of reporting facilities is also trending downward.

Figure 3

Average Use Per Facility Over Time

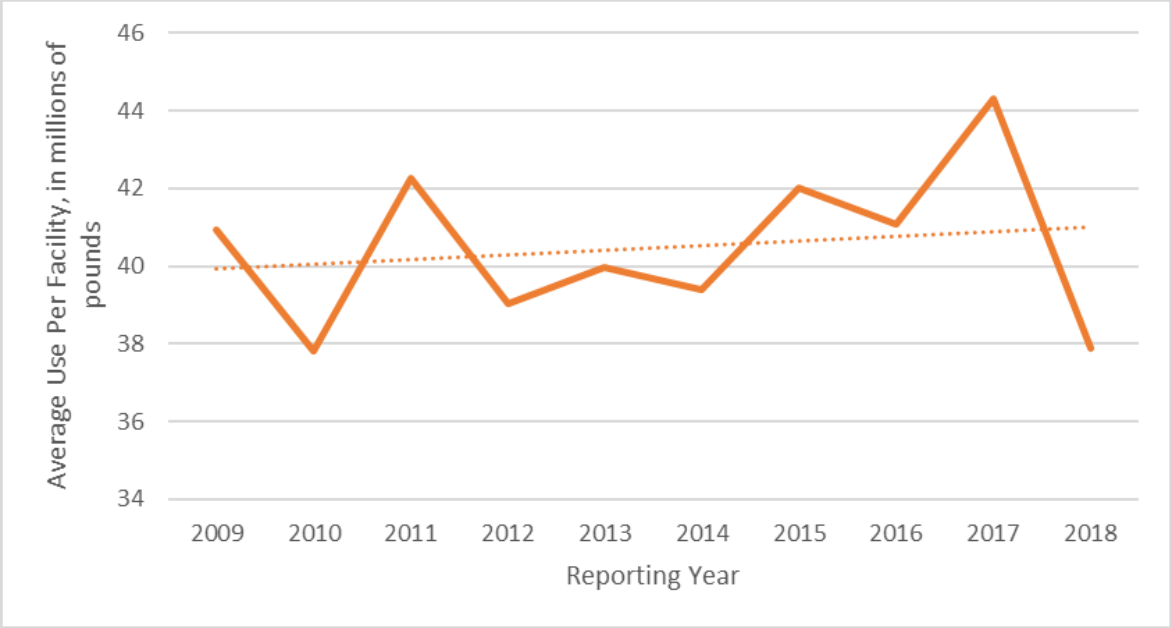


Figure 3 shows a slightly different story. While both Use and number of facilities have gone down, the amount of use per facility is going up. This means that while there is overall less throughput, and fewer facilities, there is a higher concentration of materials at each facility.

Nonproduct Output (NPO)

Nonproduct Output includes the amount of qualifying materials that a facility uses to make and use their products but are not a part of the final product, such as fuel or any substance used to create a chemical reaction. As shown in Table 1, nonproduct output has increased by 109% from 2009 to 2018. This means that while these firms have reduced the amount of toxics they are directly using to make and use in their products, these facilities have increased the amount of toxics they are using indirectly to make products. A further look into the RPPR data, shown on Tables 2 and 3, shows a stark difference in the top 10 amounts of Reported NPO in reporting years 2009 and 2018.

Table 2

Top 10 Reported NPO reports from 2009 RPPR Data

Facility Name	Substance Name (RPPRB)	Reported NPO (in pounds)
Amrod Corp	Copper	16,453,689
Dupont Specialty Products	Nitrate Compounds (Water Dissociable)	12,885,836
Infineum USA	Hydrochloric Acid	6,822,431
Dupont Specialty Products	Sodium Nitrite	6,517,178

Ames Advanced Materials Corporation	Methanol	4,562,420
Solvay Specialty Polymers Usa, LLC	Hydrochloric Acid	3,856,346
Ashland Speciality Ingredients GP	Nitrate Compounds (Water Dissociable)	3,697,378
Phillips 66 Company	Propylene [Propene]	2,231,600
Siegfried Usa, LLC.	Methanol	2,175,503
Ashland Speciality Ingredients GP	Ethylene Glycol	2,089,817
	Total	61,292,198

NJ Department of Environmental Protection. Release & Pollution Prevention Reports, Reporting year 2009. Retrieved November 2023.

Table 3

Top 10 Reported NPO reports from 2018 RPPR Data

Facility Name	Substance Name (RPPRB)	Reported NPO (in pounds)
Paulsboro Refining Company	Hydrogen Sulfide	170,076,193

Amrod Corp	Copper	22,946,588
Infineum Usa	Hydrochloric Acid	7,853,143
Solvay Specialty Polymers Usa, LLC	Hydrochloric Acid	7,432,153
Ames Advanced Materials Corporation	Methanol	5,384,673
Ashland Speciality Ingredients GP	Nitrate Compounds (Water Dissociable)	4,528,101
Equistar Chemicals LP	Titanium Tetrachloride	3,318,422
Ames Advanced Materials Corporation	Nitrate Compounds (Water Dissociable)	2,642,060
Ashland Speciality Ingredients GP	Ethylene Glycol	2,567,138
Dupont Specialty Products	Hydrochloric Acid	2,480,680
	Total	229,229,151

NJ Department of Environmental Protection. Release & Pollution Prevention Reports, Reporting year 2018. Retrieved November 2023.

Comparing Tables 2 and 3, the data shows a notable increase in the reported nonproduct output of the top reports. It's important to note also that these rows are only one chemical report;

the facility itself could have additional nonproduct output of other chemicals. This table simply shows the reports with the most NPO. This shows that in 2018, one facility used one chemical at over five times the rate of the top NPO report of 2009. While that one NPO report is not responsible for the entirety of the increase, it is clear that the total NPO of the top 10 reports is much higher in 2018 than it was in 2009. The total NPO of the top 10 reports in this time increased by over 370%. Additionally, since the total number of facilities went down but the total NPO went up, this means there are fewer facilities creating more NPO, leading to a higher NPO per facility ratio. A higher ratio means the materials are more geographically concentrated.

On-site emissions

On-site emissions are byproducts of chemical reactions that are released within the location of the facility. Table 4 shows the data from 2009 compared to 2018. There are several categories of types of emissions, including Stack Air, Fugitive Air, Surface Water, Ground Water, and Land Disposal on Site. A description of these categories can be found in the Appendix.

Table 4

On-site emissions

	2009	2018	Change in pounds	Change %
Stack Air Emissions	3,620,735	1,681,295	(1,939,440)	-54%
Fugitive Air Emissions	718,851	421,097	(297,754)	-41%
Surface Water Discharge	5,839,609	3,741,317	(2,098,292)	-36%
Ground Water Discharge	13	8	(5)	-35%
Land Disposal on Site	170,641	4,320	(166,321)	-97%
Total On-site Releases	10,349,849	5,848,037	(4,501,812)	-43%

NJ Department of Environmental Protection. Release & Pollution Prevention Reports, Reporting years 2009 & 2018. Retrieved November 2023.

This table shows that all types of emissions decreased during this time period. This means there were fewer toxic materials released into the environment around these facilities.

Starting Inventory and Ending Inventory

The last categories that will be discussed in this section are Starting Inventory and Ending Inventory. These categories capture the total amount of all materials that the facility has on-site at the beginning of the reporting year and end of the reporting year, respectively.

Table 5

Comparison of Starting and Ending Inventory in Reporting Years 2009 and 2018

	2009	2018	Change in pounds	Change %
Starting Inventory	852,504,272	1,630,310,242	777,805,970	91%
Ending Inventory	618,187,424	2,180,224,684	1,562,037,260	253%

NJ Department of Environmental Protection. Release & Pollution Prevention Reports, Reporting years 2009 & 2018. Retrieved November 2023.

As shown in Table 5, Starting Inventory and Ending Inventory both increased by 91% and 253% respectively. That means starting inventory nearly doubled while ending inventory more than tripled. These categories exist outside of the "Use" category. This means the amount of chemicals kept on site have increased over time, although the amount consumed and shipped out have decreased.

Conclusion

In this section, the potential implications of the findings will be discussed along with limitations and any future recommendations. First, the section will discuss the implications of the findings, starting with the decreases in overall use and in on-site emissions. Second, this section will discuss the implications of the increases in nonproduct output, average use per facility over time, and starting and ending inventory. A discussion of the limitations of the research will follow, along with recommendations for further research and for policymakers. All of these discussions will weave in analyses and recommendations from the 2012 New Jersey DEP study.

Implications of Findings

It is clear from the results of the study that the success of the P2 law is mixed. The fact that overall use has decreased is a positive for the goals of the law, although the rate of decrease has slowed since the 2012 study, which saw an unadjusted rate of decrease of 42% for the years 2000-2009. Fewer toxic materials are moving through New Jersey than in 2009. However, a new category was added in this study: average use per facility. While both factors that went into the new category saw a decrease–use and number of facilities–this new category saw an increase from 2009 to 2018, which means there is an increasing amount of materials moving through each facility though the pure number of facilities are decreasing. The 2012 study stated that factors that may contribute to a reduction in reporting facilities can include certain materials being removed as qualifying, closure of the facility, or usage being lowered below regulatory thresholds. A higher ratio of materials per facility means the materials are more concentrated. More concentration can be viewed as a positive since it can be more easily contained in a safe area; it can also be a negative since there would be an increased risk due to increased amount of toxics in one area. However, it would likely depend on factors outside the scope of this study, including where the facilities are sited and what kind of materials existed within it.

The 2012 study also found that there was a 10% reduction in on-site emissions, compared to this study's 43% reduction. The reduction is in line with other studies that found the national TRI report saw a reduction in releases as well (S. Rep. No. 526, 1990; Environmental Protection Agency 2022). On-site emission reductions are likely one of the most immediate concerns for surrounding communities and therefore this reduction is one of the most positive outcomes; New Jersey's environmental justice (EJ) law was created to address the concerns of air emissions from polluting facilities (New Jersey Environmental Justice Law, 2020). However, while the amount of on-site emissions have decreased, the fact is there are still many thousands of pounds of materials being released into the environment. The EJ law says that any facility that demonstrates it cannot avoid increasing air pollution shall be denied an operating permit. This EJ law is an example of how new laws can build on the 1990 P2 law, which notably lacked any enforcement mechanism. However, the EJ law still falls short in that it only addresses air pollution, not the other kinds of releases such as land and water.

NPO had a 61% reduction in 2012 study; in this study, it increased. The reduction could be a factor of this study's numbers being unadjusted for production; however, even the 2012 study had no more than 17 percentage points difference between adjusted and unadjusted numbers, so it is unlikely that adjusting this study's numbers would drastically change the result. An increase in NPO is notable because it includes but is not limited to on-site emissions; this means the categories included that do not include on-site emissions increased even more dramatically. More research will be needed to determine how and why this category saw such a dramatic increase.

Starting and ending inventory both increased as well, meaning there is an increase in the amount of materials being stored on-site in the state. This is concerning for the goals of the law

since it means that while the amount of materials being moved through the facility and shipped out have decreased, the facilities are storing more materials overall. Since these are not mobile sources of concerning materials like a truck or train would be, concerned parties can at least know precisely where these materials are by finding the corresponding facility name and location. However, since the P2 law lacks any enforcement mechanism, there is no current policy in New Jersey that can require these facilities to decrease how much inventory they are storing on-site. The pure amount of inventory can be a concern particularly to surrounding communities; simple knowledge of where the inventory is, what it is, and how much may not be enough to assuage concerns, although it is the first step. Finding out exactly what threats these materials pose to surrounding communities is an important step in arming them with the knowledge they are owed under the Pollution Prevention Law.

Recommendations for Further Studies and Policymakers

While this study attempted to replicate the methods in the 2012 New Jersey DEP report, many parts of that report remain to be replicated. Most notably a summary of the Community Right To Know analyses, such as the most commonly reported substances, the top 10 industries that make up the RPPR reports, and where the facilities are located should be created and published. The 2012 report also breaks down the types of materials and includes analyses of them such as carcinogens, PBTs, and dioxins, all which have a disproportionately harmful impact on human and environmental health. It is also possible new materials have become qualifying materials that were not included in the past reports, so there may be new materials of concern that have been brought to the forefront due to newly available science and research. An evaluation of these new materials should follow.

An additional analysis not included in this report due to the law not existing yet is an analysis of where the facilities are overlaid with New Jersey's environmental justice communities. As stated above, a reduction in on-site emissions does not mean the facilities are not increasing the amount of air pollution and therefore may be exempt from the punitive effects of the law; communities may be able to use this kind of analysis to determine where to put their efforts to deny a certain facility its permits in the future if it has not shown it will not increase air pollution. A final note to researchers, particularly the New Jersey DEP that put out the original study, is that this kind of analysis should be done on a somewhat regular basis. It is clear from both the 2012 study and this one that solely looking at the reports and data–which is what the DEP recommends on its website–does not tell the full story. Researchers at the New Jersey DEP should consider this analysis essential to the implementation of the P2 law, which had the goal of helping concerned citizens most affected by these materials be well-informed about the kinds of materials in their community. This recommendation is in line with previous research that showed New Jersey's P2 law was lacking in citizen empowerment and most communities at risk would need to rely on experts to interpret, which removes the empowerment the law intended to place within the community (Best 1990; Cole 1992; Durham-Hammer 2004).

This study also shows the P2 law has been effective in certain categories but insufficient in others. It is clear there is room for policymakers to help further reduce the amount of toxics in the state. First, the P2 law only captures stationary sources of toxics and does not include mobile sources such as trucks or trains. While trucks tend to be less of a worry since they usually remain on major roadways and are limited in how much material they can carry, trains can carry much more inventory and their tracks are often closer to homes and schools (Bagheri et al 2014; Oggero et al 2006). An amendment to the law may need to be considered to include these mobile

sources. Additionally, the P2 law notably does not have an enforcement mechanism. While the EJ law addresses one major category–air releases–it does not address any of the other categories such as total NPO or inventory. An amendment to the EJ law may need to be considered.

The findings of this study do align with a conclusion drawn in the 2012 study; these facilities may have already achieved the reductions that are easiest for them without being cost-prohibitive. The P2 law requires facilities to submit five-year plans; that means these facilities have gone through at least five five-year planning cycles since the law was implemented. It's possible that these facilities cannot achieve further reductions without affecting their financial bottom line and further voluntary reductions are unlikely to occur. The 2012 study states that planning efforts may need to instead turn to looking at other ways these facilities can take on environmentally-friendly initiatives such as reducing energy, water, and solid waste. Further research will be needed to determine if that is a valid assumption and a worthwhile effort for future policymakers.

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Appendix

Materials Accounting Data Elements

(Source: NJ Department of Environmental Protection, 2012)

- starting inventory is the total quantity of the substance already on site as of the beginning of the year;
- produced is the total quantity of the substance produced on site during the calendar year;
- consumed is the total quantity of the substance consumed in production processes during the calendar year;
- shipped as (or in) product is the total quantity of the substance shipped off the facility site during the calendar year in a form suitable for final use, as intermediates subject to further processing leading to final use, or even shipped in its "raw" form as found in inventory;
- ending inventory is the total quantity of the substance remaining on site at the end of the calendar year;

- nonproduct output is the quantity of the reported substance that was generated prior to storage, out-of-process recycling, treatment, control or disposal, and that was not intended for use as a product;
- stack air emissions are emissions that were released into the atmosphere from a readily-identifiable point source such as a stack, exhaust vent, duct, pipe, or other confined air stream, and storage tanks;
- fugitive air emissions are emissions that were not released through stack, vents, ducts, pipes or any other confined air stream;
- surface water discharges are releases to streams, rivers, lakes, oceans, and other bodies of water;
- groundwater discharges are releases such as spray irrigation on land, discharges to infiltration basins, and discharges to subsurface systems;
- on-site land releases (at the facility) are releases including, but not limited to: 1) surface impoundments, 2) on-site landfills, and 3) land treatment (land spreading), including other activities such as incorporating wastes into soil for treatment;
- chemical throughput is the total quantity of the substance that is introduced into processes, chemically reacted or converted, blended into mixtures, or generated as a non-product output that is released to the environment, managed on site, or sent off site for further management or disposal.