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The Massachusetts Toxics Use Reduction Act (TURA): An innovative strategy for assessing carcinogen use

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Abstract

The state of Massachusetts enacted the Toxic Use Reduction Act (TURA) in 1989. The law requires that users of toxic chemicals evaluate and plan for pollution prevention. Data indicate that shipment of toxic chemicals as product have been reduced by over 30 % and that releases of toxics have declined over 80% during the first ten years of reporting. Analysis of the data for several chemicals designated as "carcinogens" based on their potential negative environmental and human health effects was conducted. These chemicals include arsenic, cadmium, cobalt, and lead compounds. Communities were grouped as low, medium-low, medium-high, and high income levels as determined by the respective communities' median income from census data for the year 2000. The results indicate that usage is disproportionate throughout the state when grouped by income level. The need for chemical policies and procedures such as the TURA in growing urban centers will be discussed. Further, recommendations to ensure that there are not a disproportionate share of toxics usage, storage, and emissions in localized settings will be presented.

Keywords: Toxic Use Reduction; Massachusetts Office of Technical Assistance and Technology (OTA); Environmental Health and Policy; Carcinogens; Environmental Justice

1. Background

The Massachusetts Toxics Use Reduction Act (TURA) of 1989 requires companies using large quantities of toxic chemicals to report usage byproducts, and emissions. A large quantity is considered over 10,000 pounds per year according to TURI [1]. Whereas all states are required to report releases as mandated by the toxics release inventory (TRI), TURA requires input reporting. TURA data is reported on an annual basis. In addition to reporting results, companies must evaluate and plan for pollution prevention. This is done through the development of toxics use

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reduction plans on a biannual basis. Successful toxic use reduction can not only reduce the release of pollution and volume of waste but also decrease production costs [2]. There are multiple agencies involved in implementing TURA. The current partnership involves four state agencies: the Administrative Council on Toxics Use Reduction, Massachusetts Department of Environmental Protection (MassDEP), the Office of Technical Assistance (OTA), and the Toxics Use Reduction Institute (TURI) at the University of Massachusetts Lowell [1]. Each of these agencies provides an important function for ensuring that the environmental goals of TURA are met. The Administrative Council is designed to promote industrial development that improves the overall quality of life in Massachusetts by promoting environmentally sound industrial development. The Massachusetts DEP is responsible for implementing TURA and evaluating overall progress in meeting state goals. The TURI is designed to promote the development of cleaner and safer technologies. OTA provides companies with on-site technical training in order to identify areas of process improvement and pollution prevention [2],

A 1990 core group study [2] of industries and companies that were subject to reporting in 1990 and 2005 provides a clear picture of the efficacy of TURA over the first fifteen years of reporting. Data was first adjusted to account for a 9% increase in production over the reporting period. Following that adjustment, it was shown that toxic chemical use decreased by 40% over the reporting period while toxic byproducts and on-site releases of toxics decreased by 71% and 91% respectively[2].

Reibstein [3] reviewed the performance of TURA in relation to applied technical assistance to companies by the OTA. The OTA is responsible for visiting companies that meet certain criteria [2] for the use of toxins. While it is mandatory for a company that meets set criteria to report under TURA, the majority of businesses voluntarily work with the OTA to better their operations and reduce their environmental footprint. During the examined period, 1993 - 2002, 612 facilities were exempt from a visit from the OTA while 443 had been visited. The combined total of companies visited was 90% of the 1,172 companies reporting during the period 1990-2002, the entire period for which TURA data existed at the time of the study. The companies visited had entered 2,699 chemical reports, and the companies not visited had entered 2,216. A chemical report is a standardized document for chemicals used by a company that include information about the usage, by-product, and release.

The estimated number of pounds of toxins that were reduced by facilities reporting under TURA after assessing changes in production was determined by Reibstein [3]. Adjusting for production is necessary in order to avoid a false analysis of pollution production progress. For example, a company may use 10,000kg of a chemical to create 1,000 chairs one year, and 10,000kg again the following year to produce 2,000 chairs. While it may seem clear that the company has not made any decrease in use of toxins they actually decreased by 200% when production was factored. Scaling production was accomplished by multiplying the base year of a reported chemical use by the subsequent annual production ratio (self-reported by the company) which resulted in an “expected” quantity. The expected quantity was then checked against actual reported data to come up with a “best estimate”. An important part of the research concerned the company dropouts. A company can drop out any year from reporting under TURA if they cease production of a chemical to less than the government set threshold, their company operates under 10 employees or a chemical has become delisted at the discretion of the state of Massachusetts. Thus data can only provide integrity to the best quality of reported data.

Results showed that a statistically significant decline in usage for eight of the chemicals was found to be explainable by the OTA visit, and OTA visits were associated with a statistically significant decline in by-product for two chemicals. Results of an attempt to assess the reductions indicate that combined use and byproduct generation of these chemicals, between 1993 and 2002, were substantially reduced as a result of OTA visits [2]. The results from were an excellent *global* look at not only the performance of TURA but also the influence and effect the Office of Technical Assistance had on the actions of companies operating under this umbrella.

The question of which regions of the state were achieving greater reductions in chemical usage was not addressed. Nor was the question of overall usage of chemicals by socioeconomic class considered. A review of the literature by Brulle and Pellow [4] indicated unequal exposures to environmental pollution due to socioeconomic class. Pritchard [5] analyzed levels of toxic use in Massachusetts in relation to low, medium-low, medium-high, and high income level cities. The

levels of usage gauged multiple facets; the production, by-product, and release of chemicals. His intent was to determine if a relation between levels of toxic use and income existed. The chemicals chosen to investigate by included but were not limited to chromium, lead, formaldehyde, and tetrachloroethylene. Pritchard used multiple data sets from the OTA dating from 1990-2002. To determine the demographics of each city in the state, data on median annual household income and percentage non -white/white populations was obtained from the Bureau of the Census for year 2000.

There were several reasons for the classifications of income and race. First, most of the communities in Massachusetts have relatively low minority populations (less than 7 percent). Second, the research follows a similar breakdown of income and race as noted in the report by Faber and Kreig [6]. This is important because it continues their research which revolves around investigating if there is a relation between people of color, low income and environmentally burdened communities.

Table 1: Current Carcinogens List [1,7]

Chemical Name	CAS Number
ACETALDEHYDE	75070
ACRYLAMIDE	79061
ACRYLONITRILE	107131
ARSENIC	7440382
ARSENIC COMPOUNDS	1001
CADMIUM	7440439
CADMIUM COMPOUNDS	1004
CARBONTETRACHLORIDE	56235
CHLOROFORM	67663
CHLOROPHENOL	95578
CHROMIUM	7440473
CHROMIUM COMPOUNDS	1012
COBALT	7440484
COBALT COMPOUNDS	1013
CREOSOTE	8001589
DBCP	96128
DICHLOROBENZENE	106467
DICHLOROBENZENEMIX	25321226
DICHLOROETHANE	107062
DICHLOROMETHANE	75092
DIETHYLHEXYLPHT	117817
DIETHYLSULFATE	64675
DIMETHYLFORMAMIDE	68122
DIOXANE	123911
EPICHLOROHYDRIN	106898
ETHYLACRYLATE	140885
ETHYLENEOXIDE	75218
ETHYLENETHIOUREA	96457
FORMALDEHYDE	50000
HYDRAZINE	302012
LEAD	7439921
LEAD COMPOUNDS	1026
METHYLENEBISCHLORO	101144
MICHLERSKETONE	90948
NICKEL	7440020
NICKEL AND COMPOUNDS	1029
POLYCHLORINATEDBIPH	1336363
PROPYLENEIMINE	75558
STYRENEMONOMER	100425
SULFURICACID	7664939
TETRACHLOROETHYLENE	127184
THIOUREA	62566
TOLUENEDIISOCYANATEA	91087
TOLUENEDIISOCYANATEB	584849
TOLUENEDIISOCYANATEC	26471625
TRICHLOROETHYLENE	79016
VINYLACETATE	108054

Trends in usage and release were analyzed and findings of the comparison demonstrate great declines in toxics used and released in low income/high minority communities between 1990 and 2002. However, despite a narrowing of the toxics gap some high hazard chemical usage was still high [4]. This research will evaluate chemicals classed as “carcinogens” by the Massachusetts Department of Environmental Protection (DEP) for the period from 2001-2005. The use of these chemicals in the Commonwealth of Massachusetts will be analyzed based on the reported

use, by-product, and release of carcinogens from 2001-2005. The data will then be grouped such that the use, by-product, and release for each income level (high, medium, low) can be determined. The purpose of this study is to see if there is a correlation between the volume of usage, by-product, release and income level.

2. Methods

The primary source for data used in this research came from the Massachusetts Department of Environmental Protection (DEP). The office is responsible for collecting reported data from companies in Massachusetts and entering it into a database. The data was obtained was in Microsoft Access format and subsequently extracted into an EXCEL spreadsheet.

The database contained nearly 65,000 records pertaining to hundreds of chemicals and many companies. To narrow the scope of the study and because of their known hazards, it was decided to focus on the carcinogens as defined by TURI. Table 1 is a list of carcinogens on the TURI organizational site which they stated are in compliance with the United States Department of Labor Occupational Safety & Health Administration (OSHA) definition of a carcinogen [1,7]. The OSHA defines a carcinogen as any agent that can cause cancer.

Table 2 provides the 2000 poverty guidelines for all 48 contiguous states including Massachusetts. These guidelines are established on a yearly basis by the United States Department of Health & Human Services [8]. The guidelines from 2000 were used as the basis for determining income levels.

Table 2: The 2000 Poverty Guidelines for the 48 Contiguous States and the District of Columbia

Persons in Family	Poverty Guideline
1	$8,350
2	$11,250
3	$14,150
4	$17,050
5	$19,950
6	$22,850
7	$25,750
8	$28,650

Groupings for income levels of cities were made based on the methodology developed by Pritchard [5]. Table 3 shows the four groupings used and the median household income level. These categories were based on the median income levels from the United States 2000 census. Note that the “low” category covers all families that consist of eight people or less thus qualifying those communities in the poverty line. In a broader view one can also see that most of the “Medium-Low” communities also qualify under the federal and state guidelines.

Table 3: Median Household Income 2000

$0 - $29,999	Low
$30,000 - $39,000	Medium-Low
$40,000 - $49,000	Medium-High
$50,000 +	High

3. Results

3.1. Usage

The percentage of the population in Massachusetts by income level was determined by summing the number of cities reporting in 2000 that fell in each category and dividing them by the total number of cities. As can be seen in Figure 1, 65% of the communities in Massachusetts were of high income level, 25% were medium-high, 8% medium-low, and only 2% low based on the criteria previously noted in Table 2. It is clear that any company established in the state has a 90% chance of being located in a medium-high to high income level community.

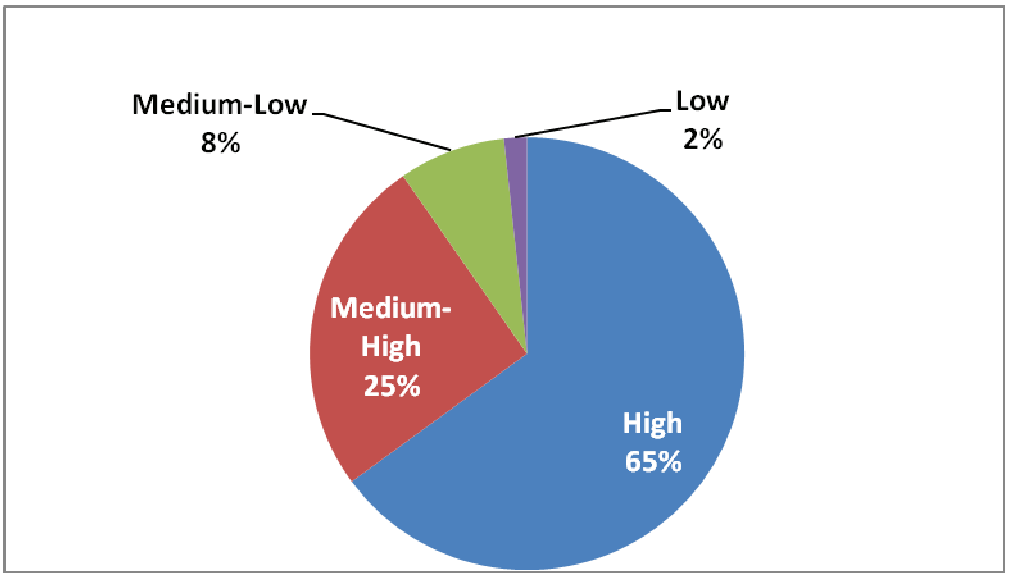

Figure 1: Massachusetts Cities by Income Level

The medium-low income group makes up just 8% of the Massachusetts population. However, when comparing the usage of carcinogens to income level, Figure 2 indicates that 64% of all usage occurs in medium-low income communities. This result comes from summing all reported usage in the given time period (2001-2005) for each income grouping.

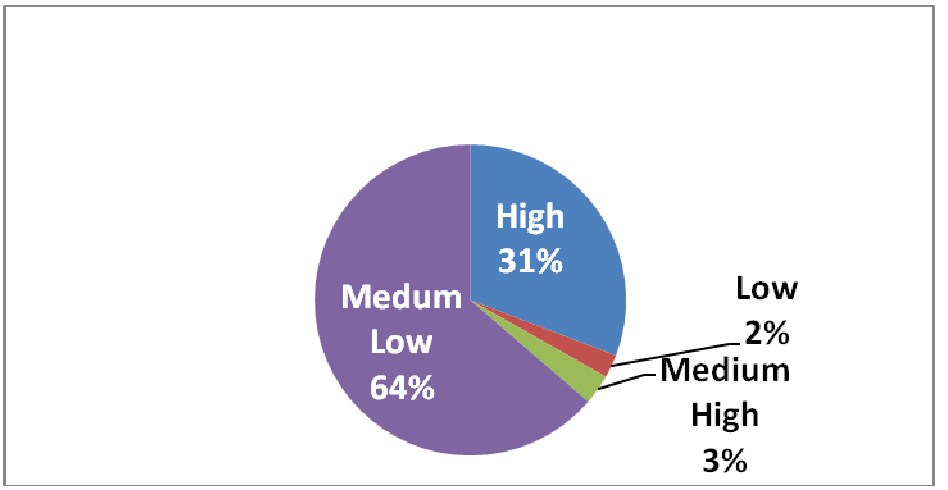

Figure 2: Usage of Carcinogens in Relation to Income Level 2001-2005

Figure 3 shows a declining trend regarding carcinogen usage. It is clearly evident that over time, fewer companies have been reporting usage of chemicals. This is a positive trend based on the data supporting the motion that reduction or efficiency in all communities is increasing over time. This is because fewer companies are reporting which means usage is under the state regulated threshold.

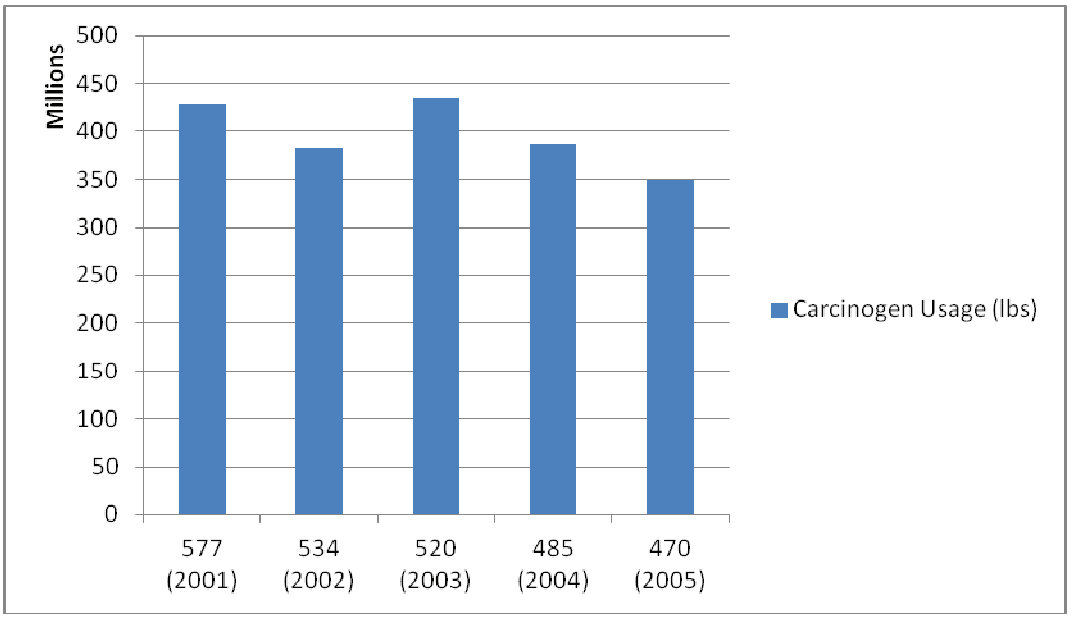

Figure 3: Usage by Year and Number of Reporting Companies 2001-2005

3.2. Byproduct

The results in figure 4 for byproduct generated by income level show 62% of all byproduct comes from high income level communities. As seen from figure 2, these communities account for only 31% of all usage. One major point of interest in Figure 4 is the low amount of byproduct generated by medium-low income communities. These communities make up 64% of all usage of carcinogens but only approximately 33% the amount of waste. This may be due to the type of chemicals being used in those particular areas or the industrial processes underway. Another major interest is the disparity in usage and byproduct generated in high income communities. As noted in Figure 2, high income locations make up 31% of all carcinogen usage while Figure 4 notes they amount for 62% of all byproduct generated. Further research in the cause of the differences is underway.

The number of companies reporting byproduct generated was also determined for the reporting period studied. Figure 5 shows that over time fewer companies are reporting byproduct data to the MA DEP. The percentage of companies reporting usage and byproduct has remained relatively constant over the reporting period studied with approximately 90% of the total number of companies reporting usage also reporting byproduct generated. Further, percentage of byproduct generated per usage has remained relatively constant- between 4-5% of the total amount used. This may indicate that while companies have been able to increase overall usage there is still room for improvement in terms of improved industrial processes, recycling of byproduct, or other management initiatives to decrease the byproduct generated.

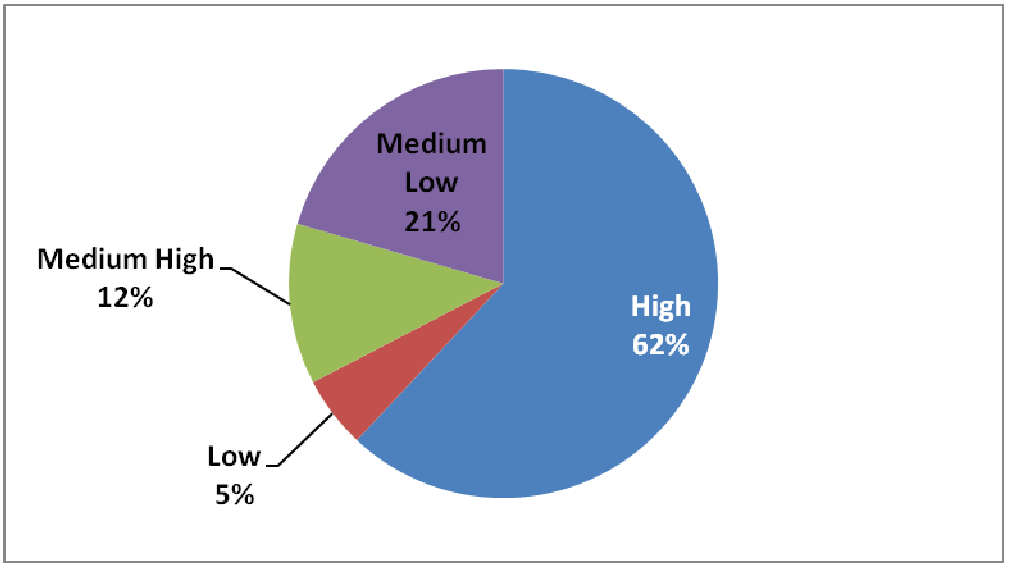

Figure 4: Byproduct of Carcinogens in Relation to Income Level 2001-2005

3.3. Release

Figure 6 shows release of carcinogens in relation to income level. Sixty-one percent of all byproduct is produced by the high income class (see figure 4) and 55% of all release is from the same communities as well. Clearly there is a disproportionate amount of byproduct and chemical release occurring in regions of the state which are high income.

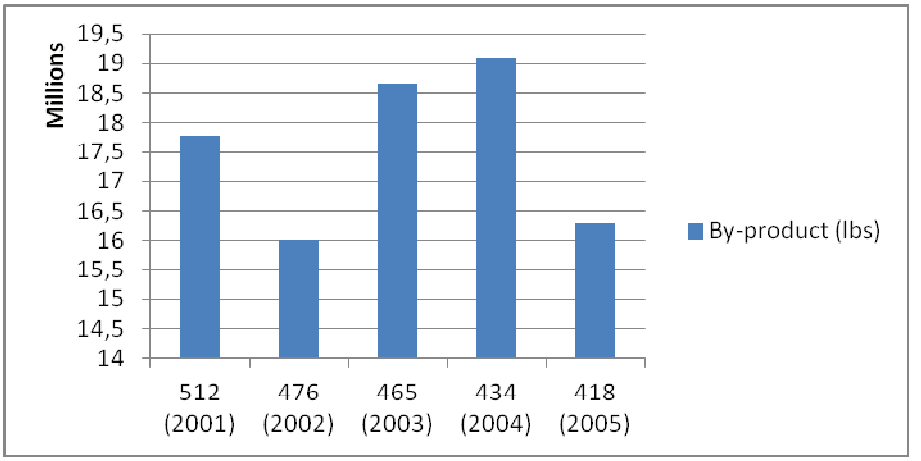

Figure 5: Byproduct Generated in Relation to Reporting Companies and Year

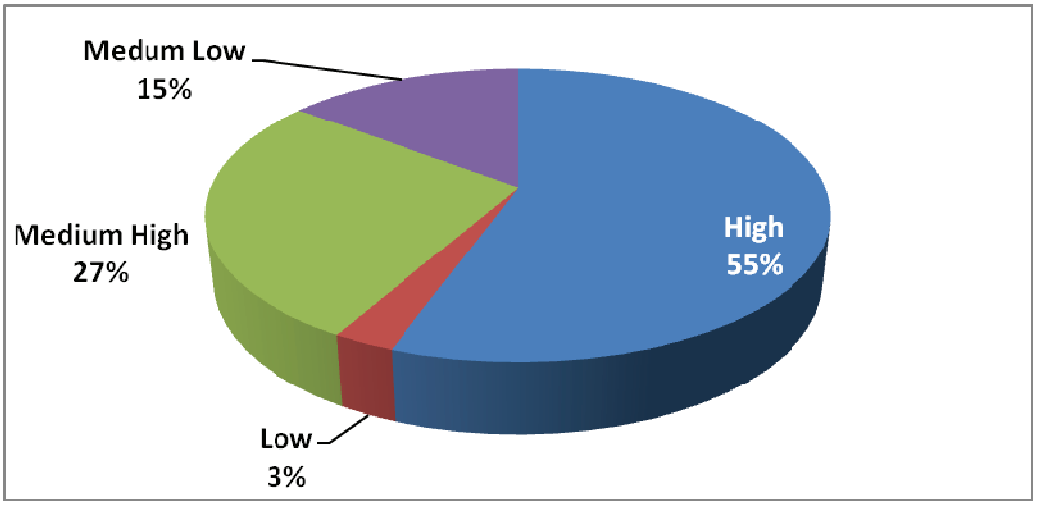

Figure 6: Release of Carcinogens in Relation to Income Level 2001-2005

Based on the data shown in Figure 7, it is clear all communities are reporting less release of carcinogens over the time of this study. High level communities saw a decrease in reporting from 2001-2002, but then an increase and plateau from 2002-2004. High income communities saw a significant decrease from 2004-2005 which is a hopeful trend as regulation continues.

Figures 3, 5, and 7 display the number of reporting companies by year for usage, byproduct, and release. In each case the number of companies reporting has declined over the period studied. This trend most likely due to a combination of factors including development of usage plans by companies, reporting requirements, usage fees and , assistance provided by the OTA to companies to reduce their usage and ultimately their byproduct and release of

carcinogenic chemicals into the environment. Note that although a company does not report one or more years does not mean that they have ceased all usage, byproduct generation, or release of a carcinogen. By not reporting one can assume however that if they are using carcinogens that they are below the standard threshold. These trends displayed over time are estimates at best but can be used as an overall indicator for what is happening in communities.

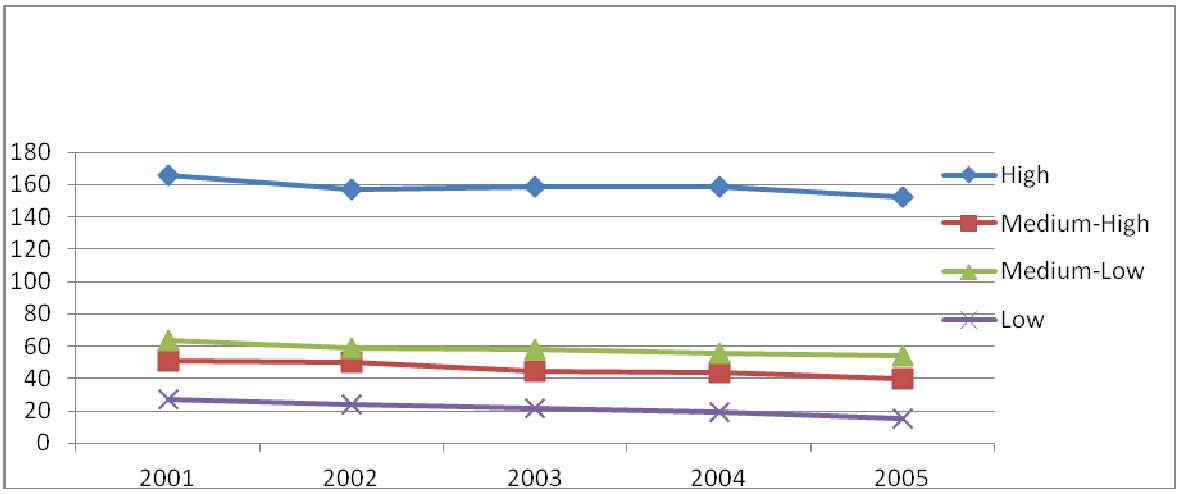

Figure 7: Companies Reporting Release by Year in Relation to Income Level 2001-2005

4. Conclusion

Since the conception of the Toxic Use Reduction Act, the goal of such law has been to improve communities and their surrounding environment. In contrast to regulations that impose emissions limits or penalties for non-compliance, the TURA utilizes alternative approaches such as planning, education, and right to know reporting in order to reduce toxics usage and the resultant byproducts. Based on the research conducted the results show clear evidence that usage, byproduct generation, and release of carcinogens has gone down during the period studied. The data indicate that usage of the carcinogenic chemicals studied is proportionally higher in the low to medium low income areas of the state. On the other hand, release and byproduct generation is higher in the high income level communities in the state over the time period studied. Further research is underway to evaluate whether or not reductions in usage, byproducts, and emission are being made across all income levels. Further, while usage has declined over the years studied it is important to continue to explore new methodologies to reduce usage, release, and byproduct generation. Ascertaining which industries and industrial processes have made significant gains since the inception of the TURA will provide insight into how to promote further reductions in carcinogenic chemical usage, byproducts and emission in the state.

The use of publically available databases provides a valuable means for both the public and academic communities to gain an understanding of their communities and the surrounding areas. The TURA database is updated yearly and with over fifteen years of publically available data, research plans include analyzing trends regarding usage, generation, and byproduct release. Additionally, the study will be expanded to include a larger range of chemicals and chemical classes. Research in order to understand the disparities that occur, by income level, in the state is also being conducted.

Acknowledgements

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