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Table of Contents

Executive summary

Portland, Oregon's airshed contains 19 toxic compounds with levels that exceed Oregon's benchmarks (Learn, n.d.). In Portland, the cancer risk for some toxics is over 100 times the benchmarks in some census blocks (Flatt, 2007). Neighbors for Clean Air (NCA) which is an environmental non-profit organization, formed when it discovered that almost a third of Portland neighborhoods' air quality ranks in the bottom one percent nationally (Learn, n.d.), and ranks third for cancer risk (US Environmental Protection Agency, n.d.). NCA is concerned about the health impacts caused by exceeding these benchmarks, so it is currently working to pass HB3492 in the Oregon legislature. The bill is intended to include toxic air emissions in the current Oregon Toxics Use Reduction Act. Due to the proposal that the bill requires businesses to create plans and develop technically and economically practicable ways to reduce their toxic air emissions, the bill can be seen as an increase of stringent air quality regulations. However, the bill has already begun to receive industry pushback regarding its perceptions as a job killer and an increased cost for business.

We decompose our paper into three sections to answer the following questions:

1. What are the impacts of air emission regulation on economic growth?
    a. Which methodology should be used in this field?

The first section of this report presents literature reviews for the impact of air regulation to economic growth and recommends a proper methodology to apply in a research in air emission. Based on the findings the literature, there is no exact conclusion for the impacts since several researchers indicate different connections between air emission regulation and economic growth; no significant change, decrease, and increase in economic growth (Thomas, 2009). To measure the economic growth, several indicators have been used including employment, location decision, house prices, gross domestic product, per capita income, and etc. However, the main indicators that related to the bill are employment and location decision, since these indicators are able to reflect the argument of industry lobbyists, that environmental regulations are a job killer. In addition, analyzing the methodology of literature is very important in order to determine which researches are legitimate. We recommend generalized method of moments (GMM) to be an appropriate method that should be used to conduct research in this field. GMM is a method for estimating parameters in statistical models that is able to exclude the external effects from other influenced variables. The recommendations to this model are to completely include control variables such as labor productivity and level of labor skill (Brunnermeier and Levinson, 2004), market size, and availability of infrastructure. In addition, to use an appropriate comparison group, and to complement with longitudinal model are very useful.

2. What are incentives for businesses to voluntarily reduce their pollution?

This section will attempt to look at the individual business perspective to understand why businesses would voluntarily incorporate pollution prevention measures or over-comply with

environmental regulations. Many businesses have voluntarily adopted pollution prevention or environmental protection programs since the 1990s (Carroll & Shabana, 2010; deLeon & Rivera, 2010; Goldstein, 2007), suggesting that there must be some benefit to business from reducing environmental impacts. The Porter Hypothesis comes from a paper by Porter (1991) that has been used to convince businesses to accept environmental regulations. The Porter Hypothesis attempts to find a mutually beneficial solution that protects environmental and human health while also showing that it is in a firms' best interest to essentially account for its external costs (Ambec et al., 2011). This concept has evolved over the last couple of decades, but not all industries yet realize the benefits or the importance of combined environmental, social, and economic goals.

The literature shows that businesses undertake voluntary pollution prevention measures for the following reasons:

- Improve efficiency, reduce costs, and reduce risk
- Encourage innovation and increase competitiveness
- Response to stakeholder pressures, marketing and image protection
- Avoidance of regulatory burdens or a proactive response to anticipated regulations
- Internal factors such as management/corporate values, mission

While voluntary pollution prevention is a key to limiting harmful pollution in the air we breathe, the role of government regulations should not be dismissed, either (Harrison & Antweiler, 2004). There are barriers to pollution prevention. Barriers include lack of financial or technical capability for risk-taking, or that the amount of money to be gained from voluntary pollution prevention is actually very small, or that the gains are overstated (Andrews, 1998). Voluntary pollution prevention programs typically lack strong accountability mechanisms (deLeon & Rivera, 2010). Studies on the effectiveness of voluntary programs have had mixed results, with the research tending toward the conclusion that voluntary environmental programs are not actually very effective (deLeon & Rivera, 2010). This calls for a need for further research on effectiveness of voluntary air pollution regulations. Additionally, quantitative data on pollution prevention programs was elusive in the research, suggesting the need to fill another research gap.

3. What is the regulatory implication to further development of Oregon air emission statute through the comparison analysis on other three states: California, Texas and Massachusetts?

The last section of our paper is to find the answer through case study on some role model states, meanwhile, some unsuccessful regulated state for air pollution also come into our research scope demonstrated as an informative regulatory contrast to the strong regulated places. We found that even if the role model states provide us a relatively holistic regulatory process and effective mechanisms with respect to air toxics control; even if those state are implementing effective air control policy respectively, these regulations are not homogenous between them. Different

mechanisms within regulations work for different places and therefore come out certain disparity of regulatory efficacy among their each jurisdiction. What are those implications for our state Oregon? "An efficient mechanism should allocate environmental resources (air, water) to demands in correspondence to the relative value that each use affords at the margin, and generate the highest aggregate value from the resource" (Swanson, 2008). From the case studies, we found that the more quantified and sound scientific evidence for the risk assessment and risk management process will help decision-makers determine which adequate regulatory approach to use to control air pollution at the plant level. Public access to the air toxics exposure information and citizen participation can be improved furthermore. Enforcement agencies need to be more aware of how the public value on this particular issue and without adequate regulatory power there will be immeasurable and invisible negative impact on the public health. Fundamentally, it is way too important for us not to rule out the industrial polluters and political lobbyists in the limiting factors. We advocate that they should develop themselves more social responsible and more sustainable to the society except for just using commend-and-control method from the official power.

I. Introduction

Almost a third of Portland, Oregon neighborhoods' air quality ranks in the bottom one percent nationally and no Portland neighborhood ranks better than the bottom 37% nationally, according to an EPA model that compares the health risk of industrial air pollution in urban areas across the country (Learn 2013). According to the EPA National Air Toxics Assessment, Portland's population is ranked 3rd for cancer risk—ranking just below Los Angeles, CA and New York/New Jersey (US Environmental Protection Agency 2013). Portland's air shed contains 19 toxic compounds with levels that exceed Oregon's benchmarks, or "health-safety goals" (Learn 2013). Current benchmarks are set at a level where the risk of cancer is one in one million (Flatt, 2007, p. 153); in Portland, the cancer risk for some toxics is over 100 times the benchmarks in some census blocks (Learn 2013).

Toxic air pollutants (also commonly referred to as air toxics) are often human-caused (arsenic and lead are also naturally occurring) and come from a variety of sources, including vehicle exhaust and industrial emissions associated with manufacturing, chemical processing, and electricity generation. Air toxics are suspected or known to cause human health risks including cancer, reproductive problems, and other health risks including asthma (US Environmental Protection Agency, 2012). The EPA lists six criteria air pollutants, which are defined as the most common air pollutants found in the U.S. and are regulated by the Clean Air Act: carbon monoxide, sulfur oxides, nitrogen oxides, ozone, lead, and particulate matter ("Six Common Air Pollutants | Air & Radiation | US EPA," 2010). However, under the Clean Air Act, there are currently no federal ambient air quality standards for regulation of the hundreds of other air toxics. Rather, the federal standards (NESHAPS) regulate on a technology basis (Oregon Department of Environmental Quality, 2012).

Our client is Neighbors for Clean Air (NCA), a nonprofit advocacy organization based in Portland, Oregon that focuses on the problem of urban air and public health. NCA is especially concerned with children's health relating to Oregon's air quality standards and programs for toxic emissions. NCA works to collaborate with elected officials and businesses to promote effective policies to protect public health, with children's health a main priority. NCA is currently promoting House Bill 2336 in the Oregon Legislature, which urges the state to create a program designed to strengthen air emissions regulations and update air permit limitations to reduce toxic air pollution from stationary sources. The bill especially hopes to require that the permitting process have more transparency and accountability.

HB 2336 (draft) Industrial Emission Modernization Bill

The overall goal of the bill is to provide more accountability and transparency in the air pollution regulations, especially regarding the Title V permitting process.

1. To require an audit at the time of Title V permit renewals (every five years) to determine ways that the permit holder might reduce their toxic air emissions. The audit must be included for the state agency to review.
2. Make more governing bodies aware of the process by requiring the DEQ to provide copies of permit applications to local governments. An accountability mechanism is drawn into the main purpose of the bill.

II. Background

The literature review will briefly examine research on effectiveness of U.S. air emissions policies at the federal and state level, as well as define some of the common terminology of different types of air pollution regulation.

The Clean Air Act

The Clean Air Act (CAA) is the overarching federal law intended to reduce air pollution for the purpose of protecting public health and welfare from airborne health hazards at the national level. The US Environmental Protection Agency (USEPA) develops and enforces the Clean Air Act. Since its introduction in 1970, the Clean Air Act was most recently amended in 1990 to address acid rain, ozone depletion and toxic air pollution (US Environmental Protection Agency 2012).

Process

Under the Clean Air Act, the USEPA sets federal limits on air pollution. State, local and tribal governments can set stricter limits, but must not set limits that are less than those set by the USEPA. The USEPA has power to enforce the Clean Air Act (US Environmental Protection Agency 2012; Potoski 2001). The USEPA sets minimum criteria for state policies in each of the following policy areas:

- Ambient air quality standards (amount of pollutants in the air)
- Emissions standards (the amount of air pollutants released by a source)
- Monitoring emissions and ambient air quality
- Enforcement
- Issuing permits (Potoski 2001, 336)

States develop State Implementation Plans (SIPs), which describe how the state will meet the minimum criteria. It is generally the state, local, and tribal governments' responsibilities to

monitor air quality, inspect facilities, and enforce Clean Air Act regulations (US Environmental Protection Agency 2012).

The following is a brief overview of each criterion, including important definitions.

National ambient air quality standards (NAAQS) are a measure of the amount of pollutants in the air. These standards are designed to "govern the amount of dangerous pollutants that are allowed in the air people breathe" (Potoski, 2001, p. 336). National Ambient Air Quality Standards (NAAQS) are set by the USEPA for the six major criteria air pollutants that pose serious health risks. States may exceed the NAAQS limits (Potoski, 2001, p. 336).

Emissions standards regulate the allowable limit of air pollutants released by a source. Emissions standards are governed by the USEPA's New Source Performance Standards for new and renovated air pollution sources. By requiring restrictions beyond the USEPA's New Source Performance Standards, states can choose to exceed federal levels (Potoski, 2001, p. 336).

Monitoring emissions and ambient air quality is used to determine whether or not air quality standards are being met. States are required to establish ambient air monitoring programs. If a state chooses to exceed federal level ambient air standards, it can establish additional monitoring stations. Ambient monitoring is a lower profile program than ambient air quality standards or emissions standards. The stringency of any of these three strategies can signal a state's regulatory climate (Potoski, 2001, pp. 336–334).

Oregon's Air Emissions Standards

In Oregon, the Environmental Quality Commission (EQC) oversees the Department of Environmental Quality (DEQ), which is responsible for modeling and monitoring to measure air toxics concentrations. In actuality, this testing is done and self-reported by permitted sources through Title V permits. There are also regional air pollution authorities, and the regional authorities must meet or exceed the EQC's established standards as well as be approved by the EQC. Benchmarks and established ambient standards are based on health risk, and regulation occurs through the Title V permitting process (Flatt, 2007).

Air toxics of particular concern in Portland include cadmium, chromium-6, manganese, and naphthalene ("Mapping toxics in Portland's air," 2011). See appendix for map put this in appendix.

III. Research Questions

1. What are the impacts of air emission regulation on economic growth?
    a. Which methodology should be used in this field?
2. What are incentives for businesses to voluntarily reduce their pollution?
3. What is the regulatory implication to further development of Oregon air emission statute through the comparison analysis on other three states: California, Texas and Massachusetts?

IV. Methodology

Our research design will be a policy analysis with a primary focus on the literature and case studies from which we can draw conclusions about the proposed Oregon air emissions policy's expected effectiveness and its impact on industry. Our research will initially focus on local, state, and federal air pollution regulations. There are three fields we divide up to analyze: First, the case studies for economic impacts on the industry; second, the business pollution prevention and program evaluation case study; third, the political regulatory process of air emission regulation in California, Texas, and Massachusetts. After the primary literature review and research, to gain the understanding of how the regulation performance on the three areas, we summarize previous research on the effectiveness of regulations in reducing air pollution, the economic impact the regulations have on manufacturing industries, and business voluntary pollution reduction. The three state statute case studies will focus on air pollution regulation processes, strengths, and weaknesses. Furthermore, we use comparative analysis on cross-state study to assess the current regulation Oregon through compare the comparable statute resource in California, Texas and Massachusetts. A comparison of different policies and similar conditions as well as observation of responses to actual policies can offer guidance on how the policy will impact Portland businesses or Oregon's economy. Our final goal is to inform of the public agency about the research implication to the Oregon's air emissions policies.

V. Data Sources

In order to address our three research questions. First, for economic impacts, we research and list the possible impacts of air emission regulation of federal state and local level to economic growth. We reviewed several academic articles which were provided by federal agencies think tank, and foundation to have an insight understanding of the impact.

Next, we intrigrate many academic researches and International Standards Organization (ISO) to answer the why business should voluntarily invest in cleaner air. For the case study in this part, we use the case of the Natural Resources Defense Council (NRDC) and the Dow Chemical Company to show how business could receive profit in air quality investment.

Finally, for information of air regulation in California Texas, and Massachusetts, we rely on state and local agencies such as California Environmengal Protection Agency, San Diego County Air Pollution Control District, Massachusetts Department of Environmental Protection, and Texas Commission on Environmental Quality, 2013. Plus, we include some of academic research to fulfill the detail and process of these state programs and compare and analyze the regulation in Oregon to these states.

The Case studies for Economic Impacts

This section summarizes academic literatures regarding the impact of an increase air emission quality to economic growth. The purposes are to review the methods that the literatures applied to their estimates and select the best methodology among those literatures. In addition, we provide recommendations for the selected literature on how it could be improved and used for the future research in this field.

I. Background and Introduction

The proposed bill will require businesses to create plans and develop technically and economically practicable ways, for the purpose of increasing air quality. Generally, an increase to the stringent air quality standards creates extra costs for businesses by requiring more pollution abatement activities (Morgenstern, Pizer, & Shih, 2000). However, the additional costs do not always lead to a decrease in economic growth, as industry opponents usually claim. Indeed, additional regulations may cause three possible economic impacts. There are many studies that have found different results concerning economic impacts, which include: 1) no significant change in economic growth, 2) decreased economic growth, and 3) increased economic growth. Furthermore, these studies used various indicators to calculate economic growth.

For the first possible impact, the research of local air regulation in The South Coast Basin in California used labor demand to calculate that there was no significant impact on economic growth (Berman & Bui, 1998). Similarly, another study that calculated the economic impact in The South Coast Basin concerning the same regulation as Berman and Bui also found that the regulations do not have a significant impact on economic growth. However, this study used employment growth and payroll growth as the indicators for economic impact (Thomas, 2009). The study for the Toxics Release Inventory in Massachusetts estimated the economic impacts of air regulations by using house prices as its indicator. The last study showed that an introduction of a new air quality regulation does not have an effect on housing price (Bui and Mayer, 2003).

Another possible impact from the proposed bill is a decrease in economic growth. The research of the behavior change in entrepreneurial activity due to non-attainment status[1] found a negative impact on economic growth using net businesses birth as its indicator, which is the difference between the number of new businesses and the number of businesses that shut down (Lowe & Islam, 2009). In addition, another study from the EPA about Gross Domestic Product (GDP)

[1] Non-attainment status is the status given to indicate that an area has higher pollution levels than the National Ambient Air Quality Standards (NAAQS). In general, businesses located in non-attainment area are required to use higher technology than those in attainment status. Attainment status will be given to an area than does not exceed the standard and does not require using the same technology as businesses in non-attainment area.

projects that the Clean Air Act will have a negative impact (US Environmental Protection Agency, 2011). The case study that used total factor productivity (TFP) to estimate the effects of air quality regulations on manufacturing plants also found that stricter air quality regulations are associated with a decrease in TFP (Greenstone, List, & Syverson, 2012).

The last possible impact is an increase in economic growth. The projection of the impact of Mercury and Air Toxics Standards conducted by EPA shows an increase of overall employment (US Environmental Protection Agency, 2011). The calculations in Mercury and Air Toxics Standards were taken from the result of Morgenstern et al. (2000) which shows the positive relationship between environmental spending and job creation. Another study indicates an increase in per capita personal income and wage per worker when calculating the effect of non-attainment status for achieving the ozone air quality standard.

II. Case study: Impact of Air Quality Regulations on Entrepreneurial Activity

After reviewing these studies, we decide to choose one study that we believe is the most legitimate. The *Impact of Air Quality Regulations on Entrepreneurial Activity* is the study that we are focusing on to analyze its methodology. The authors of this study are Scott E .Lowe and Samia Islam, who are professors at the Department of Economics of Boise State University.

Lowe and Islam (2009) estimated the impact of non-attainment designation for ozone for each major U.S. metropolitan statistical area (MSA), which must have a population of at least 50,000 people (Appendix A). They used net business birth as a unit of analysis for the impact of non-attainment designation on economic growth. Lowe and Islam used data from the U.S. Small Business Administration Office of Advocacy (USSBA) for their calculations. The analysis of the paper contains two parts: 1) the impact of non-attainment designation to overall businesses and 2) the impact of non-attainment designation on businesses of all sizes (small, medium, and large). For the second part, small businesses are defined as businesses that have less than 20 employees; medium businesses have 20-499 employees, and large businesses have 500 employees or more.

Methodology

The entrepreneurial activity is set as a dependent variable in this estimation. Generalized method of moments (GMM) was used to estimate the impact of non-attainment status in this research. GMM is a method for estimating parameters in statistical models that is able to exclude the external effects from other influenced variables. After running an economic model, the authors translated the results from the coefficient for each variable to net businesses birth. In order to calculate the solely the impact of non-attainment status to net businesses birth, the authors listed and included the control variables that could influence business births and deaths in the United States in their model of estimation. The control variables with each hypothesis are the following:

- Regional consumer price indices (CPIs)

To include CPI in the model is very important because it is able to control the effect of economic to businesses activities. The CPIs shows whether the economic condition in that area is in recession, inflation, or stable. The business activities could slow down if businesses have to face an unstable economic situation. The authors hypothesized that MSAs that are located in the area that CPIs are unstable will have less entrepreneurial activity compared to the MSAs in more stable economic climates.

- State-level minimum wage and sales tax rate

MSAs that are located in states with higher minimum wage or sales tax rates will increase costs for existing businesses and will discourage new businesses from investing in those MSAs. In contrast, states that have lower minimum wage or sale tax rates will have lower costs and have more incentives for new investments from businesses. The authors hypothesized that an increase in minimum wage or sale tax will decrease the entrepreneurial activity in those MSAs.

- Per capita income

Per capita income is often used to measure the wealth of the population, in other words, it represents the average income of that population. On average, per capita income will be higher in non-attainment areas than attainment area. Since per capita income could be considered an opportunity cost for entrepreneurial activity, MSAs that have higher per capita income will have lower entrepreneurial rates (especially for smaller businesses) than areas that have lower per capita income. The authors hypothesized that an increase in per capita income will lower entrepreneurial activity in those MSAs.

- Population growth

This control variable is controversial. Population growth can be either positive or negative to the net business birth in MSAs. Some studies have found that it has positive relationship with entrepreneurial activity. However, the authors found evidence that lower population growth lead to higher business growth. Therefore, they hypothesized that population growth will have a negative effect. In other words, an increase in population growth will decrease entrepreneurial activity in those MSAs.

- Average retail price of electricity to commercial and industrial consumers

The price of electricity is a cost to businesses, so as the price becomes higher, businesses will have a lower incentive for entrepreneurial activity. The authors hypothesized that an increase in the price of electricity will decrease entrepreneurial activity in those MSAs.

- Index of economic freedom

The authors included this variable because each state has different state-level barriers to new business formation. An increase of economic freedom, or lower barriers to new businesses, will

raise entrepreneurial activity. The authors hypothesized that an increase in degree of economic freedom will increase entrepreneurial activity in those MSAs.

- Loans and Leases

Loans and leases are variables that help new businesses form, and they also offer opportunities for businesses that are going to shut down. So, more availability of loans and leases have a positive effect for new and existing businesses. The authors hypothesized that an increase in availability of loans and leases will increase entrepreneurial activity in those MSAs.

- Natural disasters

Areas that often encounter natural disasters such as hurricanes, earthquakes, and floods will not attract new business formation and will cause existing businesses to relocate. The higher the probability for natural disasters, the lower businesses net birth will be. The authors hypothesized that an increase in natural disasters will decrease entrepreneurial activity in those MSAs.

All of the above control variables that were used in this GMM model are cross-sectional data because they were taken from a single point in time, 1990-2003. The author did an average over the 1990-2003 timeframe and put them in as one number for each control variables. The descriptive statistic of the control variables are listed in the Appendix B.

Results

The results of the GMM model are shown in Appendix C. For all sizes of businesses, the results showed that the coefficients of most variables demonstrated the same direction of impact as hypothesized, except for sale tax rate. The study found that the impact of non-attainment area for ozone will cause significantly negative effects on entrepreneurial activity in an MSA. The coefficient of non-attainment status was -0.417. For this study, it meant that the impact of non-attainment designation in this year will lower entrepreneurial activity by 0.417% in the next year. "This coefficient, when measured across an average MSA (with an average of annual net growth rate of 1.3% and 14,820 total businesses) translates into a net loss of 62 businesses in a single year following the non-attainment designation (p.19)". Likewise, consumer price index, minimum wage, per-capita income, population growth, industrial energy rate, and natural disasters have negative impacts on entrepreneurial activity in an MSA. On the other hand, sales tax rate, economic freedom, and availability of loans and leases have positive effects on entrepreneurial activity. However, the hypothesis of sales tax rate conflicted with the results, and the author did not give any possible explanations for this occurrence.

When classifying the impacts on different business sizes, the small businesses were the group that was impacted the most by the regulation. The coefficient of non-attainment status to entrepreneurial activity of small-sized businesses is -0.373. This means that the impact of non-attainment status will reduce the entrepreneurial activity of small businesses by 0.373%, which

translates into 38 out of 62 small businesses. One of the explanations for why small-size businesses were affected the most due to the regulation is because they are locally owned and do not have any support from a parent company. For large businesses, they have less negative impact than small businesses and aren't statistically significant. Meanwhile, medium businesses had a positive impact on stringent air quality. However, the author said that the coefficient estimates for O3 non-attainment for medium businesses are small and generally not significant. The authors also point out that this finding was very important in the long-term economy because small businesses are where entrepreneurial activity typically starts off.

III. Generalized Method of Moments (GMM)

For at this stage of our literature review, we are unable to comprehensively study and completely describe the knowledge of the GMM method. However, we are able to generally examine the condition of its methodology. GMM has one function and one assumption that make it capable for conducting research in this field.

- Multiple variables

The first concern when estimating the impact of air regulation to economic growth is how effectively one can isolate the effect of a specific air regulation. To include variables that influence business activities beyond non-attainment status will isolate the impact of the regulations and will make the impact of the regulation more precise. Therefore, the GMM is a suitable statistical methodology because it is able to control multiple variables that influence economic growth (Hall, 2009).

- Distribution of data

The most important assumption of using GMM is that the data does not need to have a normal distribution[2] or bell curve like in multiple regression model. Indeed, this assumption of GMM does not require a full understanding of the distribution of the data being used (Hall, 2009). As shown in Appendix B, some control variables such as event occurrence (natural disasters), and loans and leases have large standard deviations indicating that they may not have normal distributions. Therefore, in order to use these data, the GMM is a proper methodology.

IV. Recommendations

This part provides recommendations for the GMM model that was used in the study, *Impact of Air Quality Regulations on Entrepreneurial Activity*. We expect that using our recommendations would give a more accurate estimate of the impact of air regulation to economic growth and would make this study more legitimate. There are three recommendations that we will suggest

[2] "The data tends to be around a central value with no bias left or right, and it gets close to a normal distribution (Math is Fun, 2012)" (Appendix D).

for when a researcher would like to use this study as a model in order to continue doing research in this field.

1. Our first recommendation is to include more control variables in order to better isolate the impact of non-attainment status. There are still some dependent variables that could influence business activities in this model, which makes it less legitimate. We think that the authors did not include some important control variables that would improve the study's legitimacy. As Morgenstern et al. (2000) stated, environmental factors, including air regulations, are not the main factors that influence businesses' decisions of investing in new business. In fact, it is labor and geographic issues that are significant. By completely including control variables in the model, we will be better able to isolate the effect of non-attainment status. The following are three potential labor and geographic control variables, followed by our hypotheses:

- Labor productivity and the level of labor skill

The labor productivity and the level of labor skill are the variables that should be considered as control variables when doing a research about environmental regulation impact (Brunnermeier and Levinson, 2004). The authors indicate that some studies show a positive coefficient on wage to business birth because they fail to control productivity and skill of labor. Instead, an increase in wage should act like an increase in environmental spending for improving air quality if those studies would have included labor productivity as a control variable. Our hypothesis is that an area that has higher labor productivity would attract businesses to that area.

However, the level of skill could be either positive or negative based on whether a particular business needs skilled or unskilled labor. As Chapple and Makarewicz (2010) indicated, "firms that require skilled labor tend to locate in places that have amenities skilled people find attractive: good schools, cultural and recreation opportunities, high-quality housing, and transit. Businesses that rely on low-wage labor, by contrast, tend to locate near large groups of immigrants and in places with plentiful rental housing (p.16)".

- Market size

Market size shows the number of consumers in a given market. A larger market size means that it has more consumers than other market. So, it would be easier for a business to access and deliver their products to a consumer. In addition, that area will have economies of agglomeration that could benefit businesses by reducing their costs since its suppliers and consumers would be located in the same area (Brunnermeier and Levinson, 2004). Therefore, it is necessary to include the market size of that particular product as a control variable in to the model. We hypothesize that an area that has larger market size will make starting new business easier, and will keep existing business in operation.

- The availability of infrastructure

The availability of infrastructure is another geographic issue that could influence business activities and location decisions. Although the research already included the price of electricity, it does not address the impact of availability of infrastructure to business activities. The availabilities of infrastructure that should be included are: reliability of electricity and liquid fuel supplies, clean water, and sufficient roads. Poor quality of infrastructure could increase costs for operating businesses and prevent economic growth (Winiecki, 2008). We hypothesize that an increase in quality of infrastructure services available to businesses will incentive business activities.

2. Our second recommendation is to construct a comparison group. This is another useful way to make this research see the differences between the effect of attainment and non-attainment status. The areas that are classified as non-attainment are treatment groups, and the areas that are classified as attainment are comparison groups. The result from our comparison group is able to show the coefficient of attainment status. Therefore, we are able to see the different in these two coefficients which lead to a percent change in business activity. If the coefficients are similar, it means that there could be something wrong with the model. In contrast, if the coefficients are opposites of each other, then the model could be legitimate. However, there are three crucial concerns that one should be aware of when choosing the areas to be comparison groups, which are: regions, industries, and time. In short, we need to find areas that implement the same type of regulations, contain the same type of industries, and enforce the same time of regulations in order to find the most similar compared group. The ability of conducting the research with proper comparison groups in regions without local regulation is the robustness of the estimates (Berman & Bui, 1998).

However, it is difficult to determine which area will be the best for using a comparison group. The two studies have different results, although both studies estimated the impact of the same air regulation, the South Coast Basin of Southern California. In the first study, Berman and Bui (1998) claimed that they used the right comparison group and found that air regulation in the South Coast has a slightly positive impact on employment. The authors said that the South Coast refineries faced much higher abatement investment costs than refineries in Texas and Louisiana did. These regions have less stringent state regulations and no local air quality regulation, plus the South Coast, and Texas and Louisiana are in a similar type of industry. In contrast, another study from Thomas (2009), who used Chicago and Detroit as comparison groups, found that the regulation in the South Coast has a slightly negative impact on employment growth and pay roll growth.

3. The last recommendation is to use the longitudinal model. The longitudinal model is another method that would make this research more legitimate. To conduct the longitudinal model, we have to use longitudinal data, and put them into the GMM model. In this case study, although this research uses data over the 1989-2003 timeframe, the authors calculated the means for each

variable and then put those means in the GMM model. So, it makes the longitudinal data become cross-sectional data, and thus the method also becomes a cross-sectional model, which makes it less effective to see trends of impact. The main benefit of using the longitudinal model is that one is able to see the effect of non-attainment status in every single year from 1989-2003. If all of the coefficients for each year are negative, then it could imply that the model of estimate already completely include the most impacted control variables. In other words, that the model is legitimate. However, the coefficients that are fluctuated imply that there are some control variables that have not been included, which could affect this estimate model.

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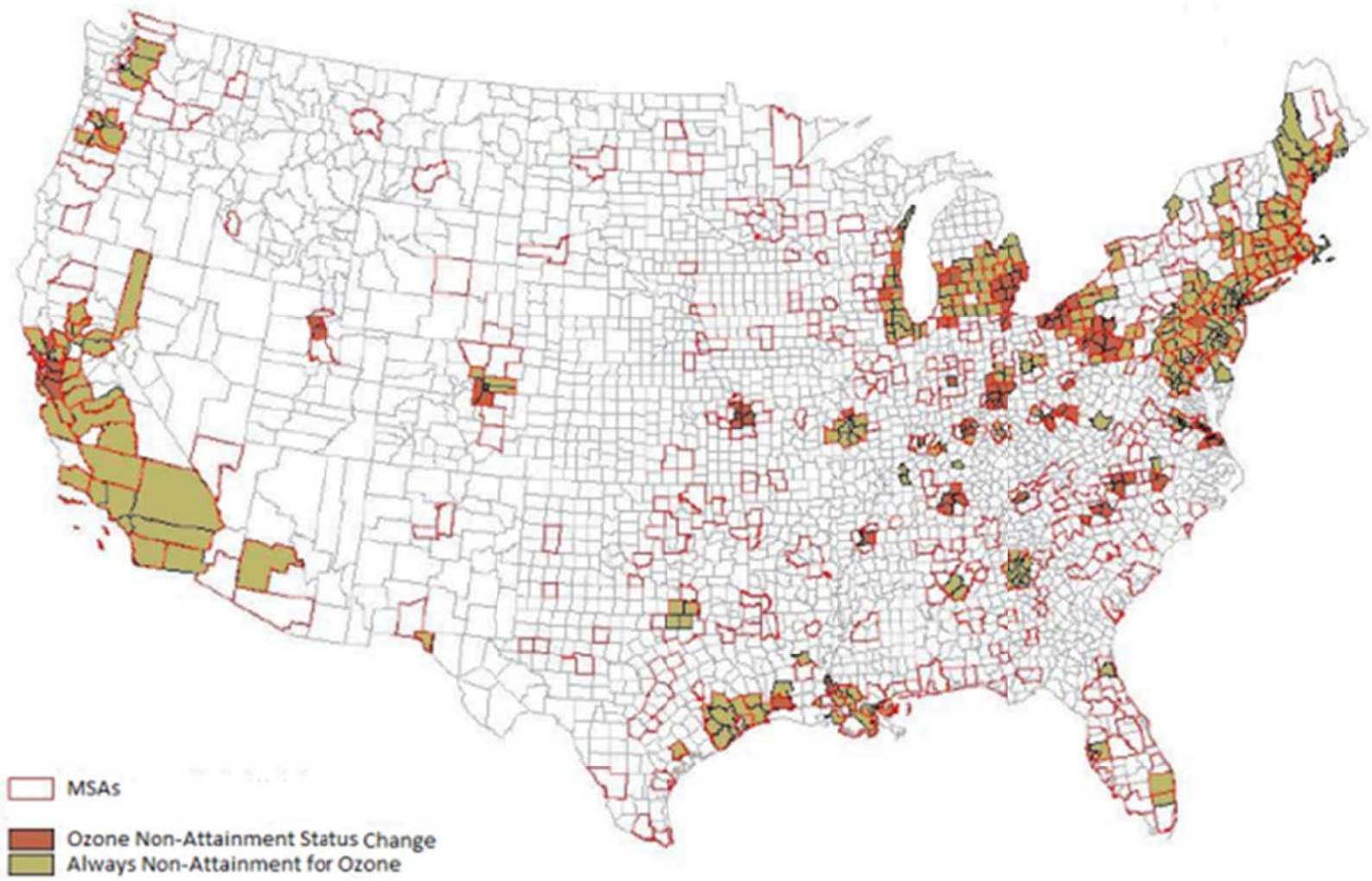
Appendix A: Ozone Non-attainment with MSAs, Lowe and Islam (2009)



Appendix B: Descriptive Statistics, Lowe and Islam (2009)

	Ozone Attainment MSAs		Ozone Non-Attainment MSAs		All MSAs	
	mean	sd	mean	sd	mean	sd
Births - Deaths / Total Businesses	1.4%	1.7%	1.1%	1.4%	1.3%	1.6%
Δ (All Births - Deaths / Total Businesses)	0.03%	1.84%	-0.11%	1.51%	-0.03%	1.70%
Δ (Small Births - Deaths / Total Businesses)	-0.01%	1.42%	0.00%	1.25%	-0.01%	1.35%
Δ (Medium Births - Deaths / Total Businesses)	0.07%	0.92%	-0.12%	0.80%	-0.01%	0.88%
Δ (Large Births - Deaths / Total Businesses)	-0.03%	0.54%	0.01%	0.49%	-0.01%	0.52%
Total Businesses	8,830	14,217	22,660	32,839	14,820	25,068
Real Minimum Wage ($/hour $1990)	3.76	0.21	3.79	0.28	3.77	0.24
Real Sales Tax (% $1990)	3.97	1.19	4.03	1.13	4.00	1.16
Real Per-Capita Income ($1990)	17.15	2.55	19.46	4.06	18.15	3.48
Real Industrial Energy Rate ($/100 kWh $1990)	3.70	1.04	4.32	1.30	3.97	1.20
Real Commercial Energy Rate ($/100kWh $1990)	5.47	1.28	6.35	1.64	5.85	1.52
Event Occurrence	5%	22%	5%	24%	5%	23%
Population	432,382	869,628	1,323,109	2,325,292	818,166	1,721,777
Unemployment %	5.41	2.02	5.64	2.40	5.51	2.19
Freedom Index	7.18	0.68	6.76	0.74	7.00	0.74
Real Commercial and Industrial Loans and Leases ($B)	15.50	24.15	27.59	34.15	26.29	38.41
Consumer Price Index (based on 1990 = 100)	151.4	15.6	161.0	13.8	155.6	15.6
N	2212		1690		3902	

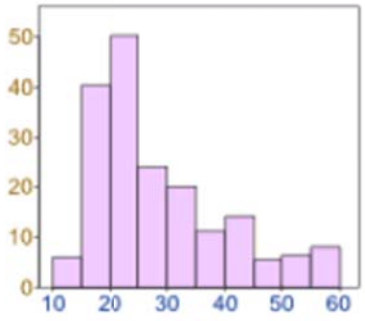
Note: The Ozone attainment year is lagged in the calculation of the change in (Births - Deaths / Total Businesses)

Appendix C: GMM Estimates (all variables in first difference), Lowe and Islam (2009)

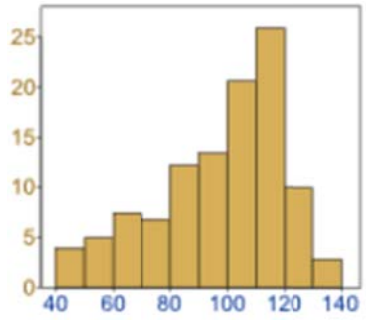
Dep Var:	(1) (all births - all deaths) / total firms))	(2) (small births - small deaths) / total firms))	(3) (medium births - medium deaths) / total firms))	(4) (large births - large deaths) / total firms))
Dep Var $_{(t-1)}$	-0.4602 (0.0253)***	-0.4324 (0.0252)***	-0.6438 (0.0242)***	-0.7287 (0.0350)***
Dep Var $_{(t-2)}$	-0.1655 (0.0245)***	-0.1467 (0.0230)***	-0.3734 (0.0235)***	-0.4513 (0.0370)***
Dep Var $_{(t-3)}$	-0.0664 (0.0216)***	-0.0747 (0.0183)***	-0.1687 (0.0589)***	-0.2161 (0.0535)***
Ozone Non-Attainment $_{(t-1)}$	-0.4165 (0.1596)***	-0.3730 (0.1368)***	0.0607 (0.0363)*	-0.0662 (0.0540)
Per-Capita Income $_{(t-1)}$	-0.2587 (0.0659)***	-0.1577 (0.0561)***	-0.0810 (0.0186)***	-0.0109 (0.0217)
Minimum Wage $_{(t-1)}$	-0.1369 (0.3131)	-0.3583 (0.2502)	-0.0273 (0.0914)	0.1545 (0.1008)
Sales Tax $_{(t-1)}$	0.1783 (0.1191)	0.1850 (0.1075)*	0.0069 (0.0415)	0.0460 (0.0363)
Industrial Energy Rate $_{(t-1)}$	-0.4178 (0.1636)**	-0.3323 (0.1263)***	0.0519 (0.0577)	-0.1828 (0.0650)***
Commercial Energy Rate $_{(t-1)}$	0.0077 (0.1306)	0.1050 (0.1017)	-0.0709 (0.0357)**	-0.0319 (0.0526)
Consumer Price Index $_{(t-1)}$	-0.0564 (0.0382)	-0.0390 (0.0348)	-0.0424 (0.0110)***	0.0187 (0.0121)
Major Catastrophe $_{(t-1)}$	-0.0006 (0.0515)	0.0637 (0.0478)	-0.0211 (0.0166)	-0.0398 (0.0208)***
Population $_{(t-1)}$	-0.1390 (0.0510)***	-0.1080 (0.0404)***	-0.0152 (0.0131)	-0.0405 (0.0204)**
Freedom Index $_{(t-1)}$	0.4656 (0.2376)**	0.0711 (0.1889)	0.1731 (0.0698)**	0.0854 (0.1038)
Loans and Leases $_{(t-1)}$	0.0059 (0.0031)*	0.0071 (0.0025)***	0.0009 (0.0010)	-0.0003 (0.0016)
Unemployment $_{(t-1)}$	0.8577 (1.7949)	1.4757 (1.4270)	0.0462 (0.5108)	-0.2356 (0.6416)

Appendix D: Distribution of data, Math is Fun (2012)

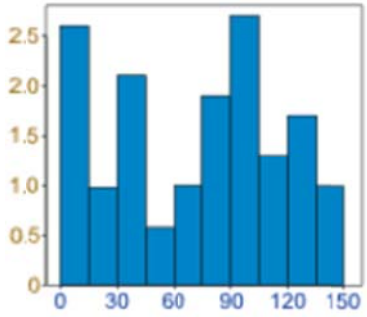
Data can be distributed into different ways.



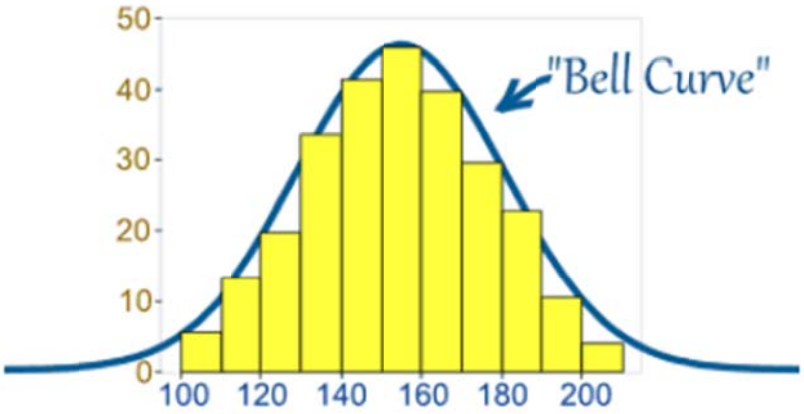
Distributed more on left



Distributed more on right



Fluctuated



When data has normal distribution, 50 percent of data is less than the mean and another 50 percent greater than the mean.

Voluntary Pollution Prevention Programs

I. Background and Introduction

Business perceptions of regulations as an attack on free-enterprise, coupled with concerns about the intrusiveness and inflexibility of regulations, have led to both industry lobbying against environmental regulations and, conversely, the adoption of voluntary environmental programs (Goldstein, 2007). The response from industry lobbyists regarding HB 3492 illustrates the need to redesign air pollution policies that both increase protection of human health and that might gain enough industry support (or at least minimize opposition) so that improved policies will be able to pass through the legislative process. Politics play an important role, and Goldstein (2007) offers insight into the political and ideological reasons behind industry lobbies against environmental regulations. [3] That research is largely beyond the scope of analysis in this paper, but a few key concepts point to the potential of voluntary pollution prevention programs as being useful for guiding public policy decisions regarding new air pollution policies. In other words, is it possible to design environmental policy programs that are less likely to be perceived as "anti-business"? Can policies be designed with a carrot, rather than a stick approach? Will they be as effective? Can policies be mutually beneficial to both industry and the surrounding communities who bear the brunt of external costs in terms of pollution?

The overarching research question for this paper is: "do environmental regulations *really* harm industry?" Many businesses have voluntarily adopted pollution prevention or environmental protection programs since the 1990s (Carroll & Shabana, 2010; deLeon & Rivera, 2010; Goldstein, 2007), suggesting that there must be *some* benefit to business from reducing environmental impacts. This section will attempt to look at the individual business perspective to understand *why* businesses would voluntarily incorporate pollution prevention measures or over-comply with environmental regulations. The research question for this section is: what do businesses get in return for adopting voluntary environmental protection standards?

This section will focus broadly on general pollution prevention programs because information regarding voluntary programs to reduce toxic air emissions is scarce. There is a wide variety of terminology regarding voluntary pollution prevention programs that will be used interchangeably throughout this paper, including voluntary environmental programs. Terminology and a brief overview of different types of pollution prevention and environmental management programs that have been discussed in the literature will be described in section two. Section three will consider why businesses might engage in these programs by examining the incentives for adoption of voluntary pollution prevention measures. Some incentives are directly beneficial (i.e. increased shareholder value and decreasing risk and cost for compliance) and some reasons are indirectly beneficial (i.e. improving image). Additionally, quantitative data on the impacts to a

[3] Tackling the question of how to design an environmental policy that will gain industry support requires understanding the political debate over the reasons behind industry opposition to regulations, in the political science or conflict resolution literature.

business' bottom line was elusive, so the focus will be on qualitative, categorical reasons and incentives for business adoption of voluntary pollution prevention programs. Barriers to pollution prevention programs will be discussed, using a case study of the Dow Chemical Company and the Natural Resources Defense Council (NRDC) to illustrate in section four. Finally, some concluding thoughts about the role of pollution prevention programs in policy making will be discussed.

The Porter Hypothesis

Traditionally, environmental regulations have been perceived as achievable only at a cost to business; that environmental protection was incompatible with the profit maximization model under which businesses operate (Ambec, Cohen, Elgie, & Lanoie, 2011). Over the past couple of decades, awareness of the interconnections between environmental and social goals and improved business performance have begun to take hold. This idea was introduced in 1991 in a paper by Porter (1991) pointing out that profitability and pollution reduction are not mutually exclusive goals (Melnyk, Sroufe, & Calantone, 2003). This concept is now known as the Porter Hypothesis, which questions the assumption that environmental regulations must always be at odds with economic growth. The Porter Hypothesis described the concept of pollution as waste and pointed out that elimination of waste (i.e. pollution) would not weaken, but would actually strengthen corporate performance (Ambec et al., 2011; Melnyk et al., 2003). The Porter Hypothesis also states that more stringent environmental regulations will cause changes in processes and investment in R&D (research and development), which leads to innovation.

The Porter Hypothesis has been used to convince businesses to accept environmental regulations, by attempting to find a mutually beneficial solution that protects environmental and human health while also showing that it is in a firms' best interest to essentially account for its external costs (Ambec et al., 2011). This concept has evolved over the last couple of decades, but not all industries yet realize the benefits or the importance of combined environmental, social, and economic goals. These three goals are recognized in the sustainability literature as the three pillars of sustainability. (Mihelcic et al., 2003) define sustainability as: "the design of human and industrial systems to ensure that humankind's use of natural resources and cycles do not lead to diminished quality of life due either to losses in future economic opportunities or to adverse impacts on social conditions, human health and the environment." Figure 1 below shows a graphic representation of the concept of sustainability.

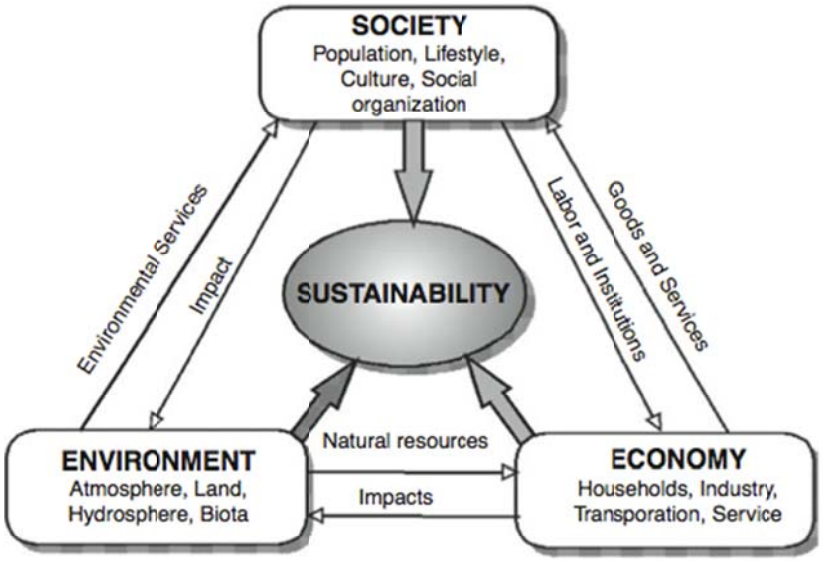


Figure 2.1 The trinity of factors and impacts determining sustainability. Adapted from Brundtland (1987), Novotny (2003) and Allan (2005).

Figure 1. Source: (Novotny, Ahern, & Brown, 2010, p. 74)

The sustainable business approach incorporates the concept of triple bottom line accounting. Triple bottom line accounting attempts to account for the full cost of doing business and measure all three aspects of corporate performance (*The Economist*, 2009). The triple bottom line approach measures a business' social, environmental, and economic ("people, planet, profit") costs and benefits and has been incorporated into many business models since the 1990s. The concept of triple bottom line is that businesses account for their environmental and social costs and benefits (externalities) in addition to their private costs and benefits by preparing three bottom lines: the "profit" bottom line takes into account monetary profit and loss, the social bottom line (people account) measures social responsibility of a business' operations, and the environmental bottom line (planet account) measures environmental responsibility. Environmental cost accounting is an emerging field that disaggregates environmental costs from overhead accounts and charges specific units and processes that produce them (Andrews, 1998).

The Economist (2009) article describes why measuring the triple bottom line (TBL) is important:

> *In some senses the TBL is a particular manifestation of the balanced scorecard. Behind it lies the same fundamental principle: what you measure is what you get, because what you measure is what you are likely to pay attention to. Only when companies measure their social and environmental impact will we have socially and environmentally responsible organisations* (The Economist, 2009).

Darnall, Potoski, & Prakash (2010) highlight the importance of and the need to change industry's mindset to a triple-bottom line approach. A triple bottom line approach (combined with environmental management standards, discussed further in the next section) can improve social and environmental conditions through environmentally responsible manufacturing processes. As a result, improved social and environmental conditions will likely lead to a society that will be healthier, contribute to the workforce in a higher-level manner through increased productivity and innovation, all while generating less waste—including toxic air emissions—and improve product quality while decreasing costs (Mihelcic et al., 2003). What can we learn from the businesses that are already incorporating these concepts of environmental and social responsibility into their business culture and bottom lines? Before we examine the incentives for adoption of voluntary pollution prevention measures, let's first take a survey of the broad range of available pollution prevention programs that have been studied in the literature.

II. Types of pollution prevention programs

Pollution prevention programs are a class of voluntary environmental initiatives (also called self-regulated or business-led agreements) that are designed to encourage, rather than mandate, improved environmental performance (Anton, Deltas, & Khanna, 2004; deLeon & Rivera, 2010). Pollution prevention programs typically constitute internally motivated institutional changes in corporate culture or management practices (Anton et al., 2004). Pollution prevention processes use source reduction or other means that reduce or eliminate the need to use hazardous materials, that substitute non-hazardous materials, or that incorporate the use of energy or materials more efficiently throughout the manufacturing process (Andrews, 1998; Bui & Kapon, 2012). Voluntary pollution prevention has many forms, including customer or supplier requirements (value-chain demands), environmental management systems and third party certification, and sector guidelines and covenants (Andrews, 1998). Some programs prescribe reduction targets, but typically there are no penalties for noncompliance (Bui & Kapon, 2012).

Voluntary programs can be industry-led, government sponsored, or jointly negotiated between industry and government (Bui & Kapon, 2012; deLeon & Rivera, 2010). The EPA has sponsored more than 150 programs that have had over 13,000 participants (deLeon & Rivera, 2010). Pollution prevention programs include Environmental Management Systems (EMS), trade association programs such as the Chemical Industry's Responsible Care Program (which emphasizes environmental management), and adoption of certification standards (International Standards Organization-ISO) (Anton et al., 2004; deLeon & Rivera, 2010). State pollution prevention programs include Community Right to Know Acts and Toxics Use Reduction Acts, with a focus on reduction of toxic releases. These programs offer technical assistance, educational outreach, grants, and awards (Bui & Kapon, 2012). Bui & Kapon (2012) evaluate the effectiveness of many state and federal pollution prevention programs on air pollution reduction, based on variations in programs, such as adoption dates and program characteristics. The diversity of programs can have various effects in terms of program effectiveness and likeliness of

adoption. A partial listing and description of some existing pollution prevention programs follows.

Toxic Release Inventory (TRI): TRI is a program for public disclosure of chemicals that provides transparency and accountability to interest groups (Andrews, 1998). TRI includes a list of chemicals, threshold levels, and which companies are required to participate. Participating companies report toxic emission levels of over 6000 chemicals to a public database annually. TRI reporters must include whether toxics are reduced at the source or recycled (Bui & Kapon, 2012). TRI data is used by state and federal regulators for inspections targets and public interest groups to map pollution patterns (Bui & Kapon, 2012). TRI and labeling laws are considered "quasi-regulatory" because they do not mandate a change in pollution levels, but instead require reporting and information disclosure regulations (Bui & Kapon, 2012). TRI is often used as a measure of environmental performance (deLeon & Rivera, 2010).

Public Right-to-Know laws and TRI are end-of-pipe strategies that report on outputs of toxic releases. Toxic Use Reduction Acts have a life-cycle approach that reports inputs, too (Andrews, 1998). Community groups can form "good neighbor" agreements to establish reduction targets (Bui & Kapon, 2012). A useful tool for community members is www.scorecard.org for TRI interpretations and information about which firms pollute the most (Harrison & Antweiler, 2004).

TRI 33/50 is a now obsolete voluntary program within TRI that was managed by the EPA. The goal was for 5000 participating chemical companies to voluntarily reduce emissions of 17 substances[4] by 33% from a 1988 baseline by 1992 and 50% from the baseline by 1995 (Bui & Kapon, 2012). Much of the pollution prevention literature analyzes the TRI 33/50 program.

EPA's Design for the Environment program provides information access and awards matching grants for technical assistance. It is federally operated, but as a joint endeavor with industry (Bui & Kapon, 2012).

Environmental Management Systems (EMS) plays a critical role in reaching environmental goals (Melnyk et al., 2003). EMS is an internally focused approach that integrates environmental management into a business' operating procedures (Melnyk et al., 2003) through a formal set of management procedures designed to direct management of an organization's environmental impacts (Darnall, 2006). It is an organizational change mechanism that can be used as self-regulation and as an effort for continuous improvement in product quality and pollution reduction (Anton et al., 2004). EMS establishes internal policies, plans, implementation actions, administrative procedures, quantifiable goals, and strategies, as well as provides resources to train workers. Firms typically undergo audits and assessments to ensure proper implementation, and to correct deviations and provides management reviews (Anton et al., 2004; Darnall, 2006). "The use of this information for external stakeholders is primarily found in annual reports,

[4] All 17 substances are also listed as hazardous air pollutants under the Clean Air Act.

focuses on the outputs of the firm, and is used to enhance firm image" (Melnyk et al., 2003). EMS typically attempts to achieve two goals: compliance (fulfilling the minimum legal and regulatory standards for "acceptable" pollution levels, or avoiding sanctions) and waste reduction. Waste reduction goes beyond compliance to reduce a firm's negative environmental or social health impact (Melnyk et al., 2003).

ISO 14001 (International Standards Organization): This international standard is a third party certification process for EMS, rather than a performance standard. Like EMS, it focuses on management strategies, including performance evaluation, life cycle assessment and product standards (Bui & Kapon, 2012; Darnall, 2006; Melnyk et al., 2003). ISO 14001 is designed to be used as a guidance tool for managers "to capitalize on the cost reduction potential of waste reduction" and has a role in overall corporate performance (Melnyk et al., 2003, p. 330). It is the most widely recognized program on a global scale and 88,800 facilities worldwide had ISO 14001 certified standards in 2005; of these, 4,671 were U.S. facilities (Darnall, 2006). ISO 14001 certified firms earn a reputation for being socially responsible. "The ISO 14001 label indicates that the company has implemented a management system that documents the firm's pollution aspects and impacts and identifies a pollution prevention process that is continually improved over time" (Darnall, 2006).

ISO 14001 and EMS may increase availability of options available to a company to reduce waste (Melnyk et al., 2003). They focus on elements of production competence and ability to design and deliver better products (lead time, quality, and cost), corporate reputation, and the associated costs and benefits of waste reduction (Melnyk et al., 2003).

Voluntary Environmental Programs (VEP) are a more generic version of environmental initiatives, but could be applied to toxic air emissions reductions. There are two types of VEPs: government sponsored, which are typically designed with greater stakeholder input, and industry-sponsored associations, which use mechanisms to enhance a firm's reputation (Darnall, Potoski, & Prakash, 2010).

The Responsible Care program, 33/50, and ISO 14001 are all designed to change industrial practices to reduce pollution (deLeon & Rivera, 2010). The key concepts of voluntary pollution prevention programs is that they go beyond mere compliance with regulations, and pollution prevention embodies the triple bottom line concept by taking external environmental and social costs into consideration. The next section examines why businesses might be enticed to voluntarily reduce their pollution beyond federally or state mandated limits.

III. Incentives and Barriers: Why would businesses participate in voluntary pollution prevention programs?

> *"Without standards I would have had to close down… Not taking part [in standardization] would have cost me my company and my livelihood… What does it cost me if I do not get involved and others define rules that are out of line with my needs, interests and experiences, but which I have to comply with because they are laid down in a standard? Hence, it is best to join in right at the start.*"--Martin Denison, Managing Director, Scuba Schools GMBH
>
> ("Why Get Involved in Standards Development?," n.d.)

Firms may undertake voluntary pollution prevention measures for a variety of reasons. The literature shows that the most common explanatory variables include stakeholder pressures, opportunities to avoid regulatory scrutiny and burdens, and for competitive advantages and efficiency purposes. The incentives for participation in voluntary pollution prevention programs can be broken down into five categories, which will be further discussed in detail below:

- Improve efficiency, reduce costs, and reduce risk
- Encourage innovation and increase competitiveness
- Response to stakeholder pressures, marketing and image protection
- Avoidance of regulatory burdens or a proactive response to anticipated regulations
- Internal factors such as management/corporate values, mission
-

Improve efficiency, reduce costs, and reduce risk

Voluntary pollution prevention is often considered a win-win situation. One reason that firms may undertake voluntary pollution prevention measures is out of self-interest: that is, pollution prevention has great potential to save money and improve a firm's bottom line (Andrews, 1998). ISO 14001 and EMS facilitate pollution prevention by encouraging substitutes and eliminating some regulated processes, reducing risk of costly environmental accidents, lowering corporate liability, and by improving access and competitiveness in the market (Darnall, 2006). Environmental management standards improve operational efficiencies through employee involvement, thus increasing competitive advantage (Delmas, 2001). Pollution prevention programs have potential for identifying cost-effective and self-enforcing strategies (Anton et al., 2004), as well as the potential to create and enhance competitive advantage (Darnall, 2006).

Pollution prevention can result in cost savings in the form of avoided costs of pollution, including costs associated with compliance, fines for violations, liability for health and environmental damages, and compensation to communities (Delmas, 2001; Hamilton, 1999). Costs associated with failure to comply with environmental regulations include fines, increased external intervention in operations, or perhaps cease and desist orders (Melnyk et al., 2003).

Firms that use environmental cost accounting discover that environmental costs account for 10-12% of total costs (Andrews, 1998, p. 188). This added cost may provide incentive to improve performance or reduce regulatory requirements (Andrews, 1998). Industries that have higher pollution levels may see greater cost savings as a result of higher compliance costs that can be avoided with pollution prevention (Klassen & McLaughlin, 1996). Other cost savings can come from the minimization of costs associated with waste and inefficient practices (Klassen & McLaughlin, 1996). Voluntary pollution prevention programs reduce regulatory costs in ways that businesses themselves are best equipped to identify (Andrews, 1998). By focusing on improvements in efficiency, they can reduce losses of valuable chemicals and energy (Harrison & Antweiler, 2004).

Melnyk et al. (2003) suggest "EMS is so essential to environmental management that no firm can achieve competitive advantages unless it has an EMS in place that has met ISO 14001 certification standards" (p. 332). ISO 14001 creates improvements beyond pollution prevention and mere compliance with regulations (Darnall, 2006). It encourages innovation, reduces risk, provides a foundation for growth, increases profitability by improving efficiency and reducing costs, and increases customer confidence ("Benefits of International Standards," n.d.). Additional benefits occur in response to rigorous internal assessments and formal structures, formalized managerial commitment, community involvement, and external auditing (Darnall, 2006). Companies can get more value from going over their operations with a fine-toothed comb and looking at operations from an efficiency angle. For example, conducting environmental reports can provide an opportunity to discover and correct ineffiencies in operations. ISO 14001 and EMS emphasize continual improvement processes where environmental considerations become an integral element in a firm's day to day operations (Darnall, 2006).

Finally, companies with EMS programs can be more attractive for insurance agencies and receive better rates due to increasing environmental risks and liabilities (Delmas, 2001). Employee health is the second most important motivating factor for firms to choose to undertake EMS (Harrison & Antweiler, 2004).

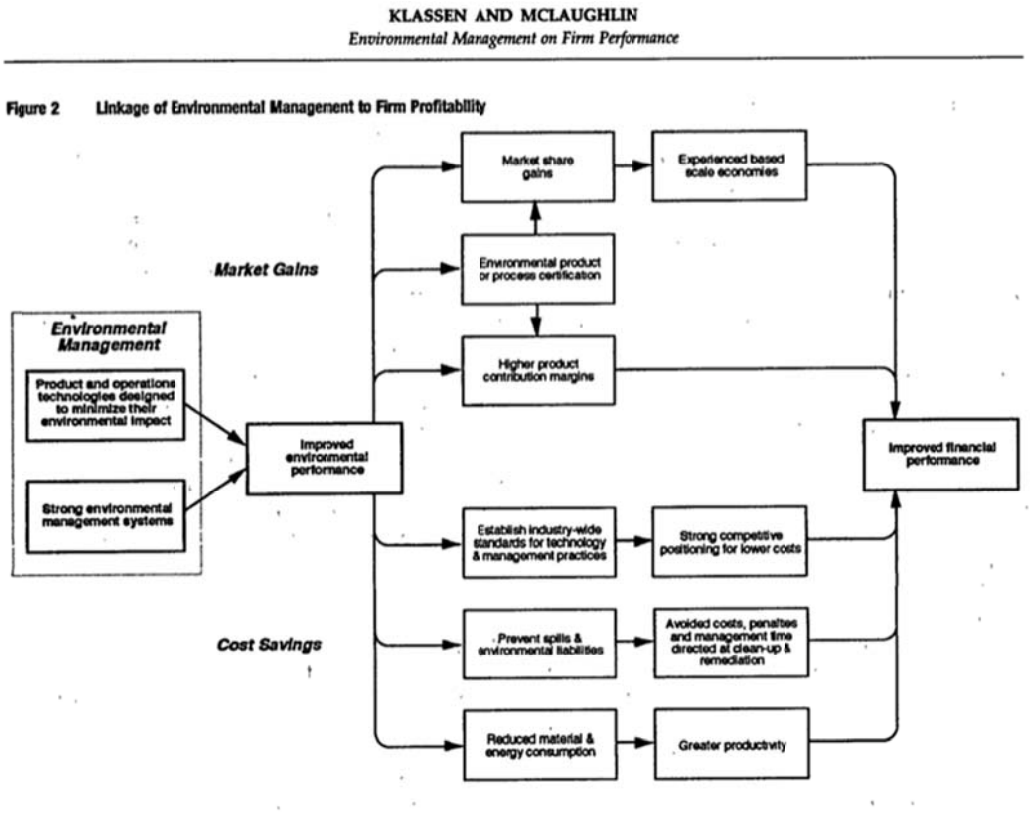
Encourage innovation and increase competitiveness

Darnall et al. (2006) challenge the idea that all firms are exclusively profit-seeking and highlight the importance of social legitimacy for long-term survival and competitiveness. Firms can gain competitive advantage by establishing industry standards in best available control technology (Klassen & McLaughlin, 1996). ISO 14001 promotes market access through shared knowledge and insights as well as better access to knowledge that facilitates trade ("Benefits of International Standards," n.d.).

Several articles found empirical evidence supporting the hypotheses that environmentally efficient companies have better financial performance and are therefore a better investment (Delmas, 2001; Deutsch, 1998; Klassen & McLaughlin, 1996; Melnyk et al., 2003). Klassen &

McLaughlin (1996) studied the link between environmental management and financial performance and found that companies had significant positive returns for strong environmental management and negative returns for weak environmental management (Klassen & McLaughlin, 1996). Higher TRI figures experienced negative (statistically significant) stock returns in 1989, and the firms whose stocks declined the most reduced their emissions in response (Bui & Kapon, 2012; Klassen & McLaughlin, 1996; Salzman & Thompson, 2010). Environmental performance measures a firm's success in minimizing its environmental impact relative to an industry average (Klassen & McLaughlin, 1996). Some investment companies, including Innovest Strategic Value Advisors, recommend stocks based on environmental records (Melnyk et al., 2003). The field of Corporate Social Responsibility has been studied by many researchers, and is taking hold in the business world because it drives better corporate performance (Lindgreen & Swaen, 2010). Good environmental management can send a signal to investors that a company's overall management is sound, creating some of the best investment opportunities (Deutsch, 1998).

Figure 3 below shows the linkages between environmental management and a company's improved financial performance.



Source: (Klassen & McLaughlin, 1996)

Response to stakeholder pressures, marketing and image protection

Institutional pressures from regulators and markets may strongly influence adoption of pollution prevention programs (Darnall, 2006). Pressure from investors based on their values or anticipation of pressures from consumers, workers, or other shareholders can also influence decisions to incorporate pollution prevention (Harrison & Antweiler, 2004). Organizations often participate in voluntary environmental programs to address stakeholder concerns (Andrews, 1998), and to obtain goodwill and standing with critical stakeholders (Darnall, Potoski, & Prakash, 2010). Stakeholder pressures can influence a firm's decision to adopt pollution prevention programs. Stakeholders include internal and external stakeholders. Internal stakeholders have a financial stake in the company; external stakeholders do not (Darnall, Potoski, & Prakash, 2010). Harrison & Antweiler (2004) describe pressures from five external stakeholders: consumers, workers, shareholders, community groups, and regulators (Harrison &

Antweiler, 2004). Pressures from consumers, investors, and public can come in the form of liability threats (Anton et al., 2004). Pressure also often comes from workers demanding wage increases for health concerns (Harrison & Antweiler, 2004). ISO 14001 can serve as an indicator to external stakeholders, including customers, communities, media, investment groups, insurance companies, and regulatory agencies (Delmas, 2001) about a company's environmental performance.

Appealing to "green" consumers (Bui & Kapon, 2012) is another incentive for adopting voluntary environmental standards. Anton et al. (2004) found that consumer pressures are especially effective in influencing a firm's decision to adopt pollution prevention measures. Market pressures have increased over the past decade or so: customers are becoming more savvy and concerned about environmental and social performances at the same time that more information is readily available about companies' environmental practices. Opportunities for environmentally friendly businesses to demand premium prices for their goods and services is becoming more predominant in response to market (Darnall, 2006). Value-chain demands such as supplier requirements for product stewardship have an influence, too. Here the structure of an industry helps the program work better; for example, when a few very large firms are suppliers (Andrews, 1998) they can provide more influencing leverage to force other companies to adopt environmental standards or pollution prevention measures.

Community-right-to-know inventories and TRI provide transparency with public reporting (Harrison & Antweiler, 2004). The availability of TRI data resulted in initial declines of toxic releases, and some studies concluded that pollutant release inventories are at least as effective as coercive discharge regulations (Harrison & Antweiler, 2004). The availability of more complete information about pollutant releases is likely to strengthen each factor of decision-making with regards to pollution prevention (Harrison & Antweiler, 2004). Firms react to scrutiny from emissions data made public (Hamilton, 1999) and TRI data can be used to pressure firms. Local and national environmental groups use public TRI data to alert workers, consumers, and investors about firms' environmental records (Harrison & Antweiler, 2004). Disclosure might lead to increased external stakeholder pressure; prior to public disclosure, non-government stakeholders lacked information about pollutant releases (Harrison & Antweiler, 2004). Andrews (1998) found that reporting and disclosure requirements have mixed benefits, but may be influenced by public image, investors, state regulators, corporate executives, trading of pollution rights, and direct economic incentives such as the polluter pays principle, including subsidies, taxes, and charges.

Firms may also engage in pollution prevention to protect their reputation (Bui & Kapon, 2012). Darnall et al. (2010) found that although decisions to join voluntary pollution prevention programs were influenced by stakeholder pressure, firms were less likely to join programs when that pressure came from environmental group stakeholders. They were more likely to join when the pressure came from community stakeholders (Darnall et al., 2010). Voluntary pollution

prevention can "enhance participants' environmental image and confer external legitimacy" (Darnall, 2006).

The magnitude of risks and political activity of exposed population influence toxic reduction decisions (Hamilton, 1999). Hamilton (1999) found "empirical evidence that incentives for firms to reduce toxic emissions depend both on magnitude of cancer risks arising from their pollution and who bears those risks" (Hamilton, 1999). We would expect regulators to pay attention to community pressures, especially from larger facilities in denser populated communities which have a greater potential for harm (Harrison & Antweiler, 2004).

Avoidance of regulatory burdens or a proactive response to anticipated regulations

The literature describes avoiding regulatory scrutiny, preempting future regulations, deterring lobbyists and boycotts (Bui & Kapon, 2012), forestalling anticipated regulation (Harrison & Antweiler, 2004), and building better relationships (Darnall et al., 2010) with regulators as motivators for engaging in voluntary pollution prevention. The Clean Air Act's requirements may also influence the decision: firms know that they must reduce their emissions, and that there is potential for increased standards. This supports Anton et al.'s (2004) hypothesis that environmental regulations motivate businesses to be more proactive in reducing their emissions (Anton et al., 2004). "Reducing these pollutants ahead of time using flexible methods is expected to lower the future costs of compliance and may also give the firm a strategic advantage relative to its competitors if its performance influences the standards that are set for other firms" (Anton et al., 2004). "Firms that move ahead of regulation to minimize the impact of their products or operations on the environment are better positioned to meet tighter standards in the future" (Klassen & McLaughlin, 1996). Stringency of state regulations was one of the most important factors in reducing TRI 33/50 chemicals and regulatory compliance was one of two most frequently cited reasons by facilities for TRI reductions (Harrison & Antweiler, 2004).

Regulatory requirements represent large costs for firms (Andrews, 1998) as higher emissions may lead to higher fines and compliance costs (Bui & Kapon, 2012). Regulatory pressures are associated with decisions to implement environmental practices. An industry's inability to adhere to regulations may result in penalty, legal sanction, costly court proceedings, environmental penalties, and fines (Darnall, 2006). Fear of legal sanction as a motivator may be a primary reason to adopt proactive environmental strategies (Darnall, 2006). The avoidance of costly penalties and fines is a good reason to engage in voluntary pollution prevention practices. Penalties and fines may also encourage companies to publicly disclose their emissions in order to reduce external suspicions and gain external legitimacy (Darnall, 2006).

Command-and-control regulations are often perceived by businesses as inflexible and economically inefficient. In contrast, EMS and pollution prevention programs offer the opportunity to engage employees in environmental issues, monitor progress, increase knowledge about operations, improve internal efficiencies and increase strategic value, increase employee

morale, reassess environmental performance as contribution to productivity and innovation (Darnall, 2006).

Third-party certifications and EMS could possibly substitute for some government licensing and inspection (Andrews, 1998). By incorporating EMS or pollution prevention strategies, companies can trade better performance for less bureaucratic burden (Andrews, 1998). EMS may improve relationships with regulatory stakeholders by signaling good intentions to exceed regulations (Darnall et al., 2010). Pollution prevention can improve relationships with regulators and ensure a firm's long-term viability. Voluntarily reducing emissions can improve ease of doing business with regulators, encourage collaboration to encourage more non-regulator ways to reduce pollution, improve trust and influence policy, signal to regulators that a firm is committed to environmental performance, avoid legal sanctions, and create increased legitimacy from regulators (Darnall, 2006). Advantages to third party certifications are to relieve industries of bureaucratic delays and to promote more rapid EMS implementation (Andrews, 1998). Firms that have successful EMS may receive regulatory relief in the form of less intensive and less intrusive monitoring by regulatory agencies (Delmas, 2001). However, some argue that relaxed standards lead to compromised environmental performance (Harrison & Antweiler, 2004).

Some studies suggest that larger and more pollution intensive industries reduce pollution more quickly when faced with government mandates, rather than if they do not (Harrison & Antweiler, 2004), suggesting a need for continued government pressure on industries to reduce pollution.

When a firm was subject to more regulatory inspections, Darnall et al. (2010) found that companies were more likely to join *industry-sponsored* programs, rather than government-sponsored programs (Darnall et al., 2010). Whether or not a firm joins a pollution prevention program depends on whether it is government or industry sponsored (Darnall et al., 2010). Regulators provide incentives for businesses to move toward self-regulation or voluntary pollution prevention through provision of technical and financial assistance and other regulatory incentives (Anton et al., 2004). Government provides a variety of incentives for pollution prevention programs, including assistance and recognition, public reporting requirements, emissions trading markets, liability, costs associated with regulation or relief from regulatory costs, subsidies, pollution taxes or charges, legal fines, or criminal penalties (Andrews, 1998).

Hamilton (1999) also found that regulatory behavior varies with risk level: regulators react to population risks, measured in total expected cancer cases. Industry's reaction to various risks from toxics has not been studied or observed extensively, but evidence suggests that some firms take these risks into consideration in production decisions. Factors influencing whether firms considered cancer risks for emission level decisions were influenced by these factors:

- Command and control regulations
- Information provisions and programs
- Liability concerns (Hamilton, 1999, p. 105).

The Clean Air Act requires inclusion of risk management plans (Andrews, 1998). Reducing environmental risk has many benefits, including improved relationships with regulators (especially if the firm has had compliance issues in the past), and the firm may not be subject to costly regulatory burdens, and may have the opportunity to influence policy-making process due to qualifying to participate in government-sponsored EMS programs (Darnall, 2006).

Internal factors such as management, corporate values, and mission

There are many internal factors for why firms may or may not adopt EMS, including closeness of contact with consumers—businesses that have closer contact with their consumers are more likely to adopt EMSs, whether it produces final goods or goods for a different part of the supply chain, size, investor sentiment, age, sales to asset ratio, location of facilities, etc. (Anton et al., 2004). Corporate roles play a part in developing corporate culture around pollution prevention programs (Darnall, 2006). Darnall et al., (2010) show that incentives to join voluntary environmental programs indicate that management and business vision is the biggest influence for decisions to adopt programs. Darnall (2006) also concludes that the parent company plays a fundamental role. The study also found that previous organization-wide pollution prevention experience doesn't actually influence a decision and that firm size has no effect (Darnall, 2006). Incentives to join voluntary programs depend on manager anticipations of preferences of key stakeholders (Harrison & Antweiler, 2004). Consumer-oriented firms were more likely to participate in the TRI 33/50 program. There has been less research on employee influence or role of unions (Harrison & Antweiler, 2004) in these decisions.

Each facility's environmental performance is a function of *internal factors* which include the nature of processes and costs and benefits of pollution control (Harrison & Antweiler, 2004). Harrison & Antweiler's (2004) study "attempts to account for these factors by controlling for facility type" (Harrison & Antweiler, 2004, p. 362). We expect that larger facilities emit more pollution and Harrison & Antweiler's (2004) findings are in line with this hypothesis. Their study uses number of employees as proxy in the absence of production sales data at the facility level (Harrison & Antweiler, 2004). However, in business accounting, employees are counted as a liability (cost), so the number of employees may be a better representation of the size of the business, but does not necessarily give a clear picture of amount of the firm's profits.

Darnall's (2006) study concluded that organizations that face strong regulatory pressure were more likely to mandate ISO 14001. Also, stronger market pressures caused businesses to be more likely to mandate EMS strategies. These decisions were based on the belief that environmental certification might increase revenue, provide a competitive advantage, improve public relations, and be a valuable marketing tool. A business' ability to access resources influenced decisions—the better the access, the more likely to engage in pollution prevention activities (Darnall, 2006).

Barriers to pollution prevention

If voluntary pollution prevention activities can improve a firms' bottom line, create competitive advantage, and save some of the costs and hassle associated with the burdens of regulatory compliance, then why has money been left on the table for so many organizations? Why is there still pushback from industry about adopting better environmental performance standards and why do standard operating procedures for so many companies remain unquestioned?

The answer could be a lack of financial or technical capability for risk-taking, or that the amount of money to be gained from voluntary pollution prevention is actually very small, or that the gains are overstated (Andrews, 1998). Other barriers to ISO 14001 or EMS adoption could be that businesses do not perceive the benefits beyond regulatory compliance or that they perceive it as risky due to the auditing process and the fear of exposure of confidential information (Delmas, 2001). Voluntary self-regulation must demonstrate that private benefits exceed private costs in the short term and that private net benefits are sufficient to motivate private environmental performance that equals or exceeds public environmental standards in order for a business to undertake the extra costs associated with pollution prevention programs (Andrews, 1998). Without the inclusion of language about accounting for social costs, these costs are unlikely to be accounted for.

Organization-wide pollution prevention mandates or EMS have many associated costs. These costs include staff time, documentation, materials and equipment, training, environmental consultants. Average costs of participation range from $239-$1,372 per employee (plus $29-$88 per employee for 3rd party audits) (Darnall, 2006). Costs depend on internal capabilities prior to EMS (Darnall, 2006). Costs associated with pollution prevention include: costs to internalize the externality as imposed by third party, administration and transaction costs (Andrews, 1998). The EPA estimates billions of dollars in costs, far more than business benefits of pollution prevention (Andrews, 1998).

Firms may have to pay higher costs in areas where residents exercise their property rights or are otherwise politically engaged (Hamilton, 1999). Pollution reduction incentives are also linked to the size of the risk, but there's no guarantee that these incentives actually reduce risk. There is incomplete information and monitoring and enforcement are imperfect (Hamilton, 1999). Pollution prevention may result only in paper reductions or "greenwash".

Deutsch (1998) posits that a lack of available information for potential investors creates barriers to environmentally and socially responsible investing. But as pointed out in previous sections, Corporate Social Responsibility is a growing field in investment strategies; the barrier may be more of an educational component—a lack of awareness—rather than a lack of information.

Environmental audits, as used for EMS and IS0 14001, can be used to ensure legal compliance. Third party certification requires clear standards. ISO 14001 requirements only guide internal goals, they do not mandate meeting or exceeding federal goals. Therefore, government monitoring is required (Andrews, 1998). Limitations to third party certifications include the added business cost. The amount that these costs prohibit third party certification may vary depending on firm size. Some industries also fear trade secret compromise from third party certifications (Andrews, 1998).

There is still much skepticism surrounding voluntary measures: are they merely symbolic public relations gestures rather than serious efforts to reduce toxic pollution (Darnall et al., 2010)? Under command-and-control regulations, governments establish allowable pollution limits and the technologies required to comply with them. It is easier to monitor and increases the ability to hold the polluter accountable. Under voluntary programs, internal information is unknown (Darnall et al., 2010) and even with mandatory reporting under TRI, this can make enforcement and accountability difficult. Do pollution prevention programs actually improve environmental performance? Studies remain unclear about the impact. Because there is such a wide variety of program types, differing responses are to be expected (Bui & Kapon, 2012). Evidence indicates that perhaps they do, but the evidence is not conclusive, indicating a need for further studies and evaluation (Anton et al., 2004).

VEPs typically lack strong accountability mechanisms (deLeon & Rivera, 2010); this likely affects the effectiveness of VEPs. Studies on the effectiveness of voluntary programs have had mixed results, with the research tending toward the conclusion that voluntary environmental programs are not actually very effective (deLeon & Rivera, 2010). This calls for a need for further research on effectiveness, as well as further research regarding how to improve effectiveness. The literature contains many gaps, including a lack of comprehensive studies (rather than the piecemeal approach that has been used) and lack of studies regarding the public policy implications of voluntary environmental programs (deLeon & Rivera, 2010).

V. Case Study

Michigan Source Reduction Initiative

A partnership between the Natural Resources Defense Council (NRDC), the Dow Chemical Company, and five community members, called the Michigan Source Reduction Initiative (MSRI) analyzes the effect of pollution prevention strategies. Pollution prevention strategies use production methods that limit the amount of toxic air pollution produced in the first place and they differ from "end-of-pipe" strategies, which attempt to clean up and capture the toxic emissions only as they are released from the smokestack (NRDC and Dow Chemical 1999). The MSRI adopted the definition of pollution production from the Massachusetts Toxic Use Reduction definition (NRDC & Dow Chemical, 1999).

The goal of the project was to reduce pollution and spur institutional changes to shift the company's thinking from a mentality of basic environmental regulation compliance to one of pollution prevention and the integration of health and environmental concerns into its core decision-making processes. The MSRI study concluded that that cost-effective pollution prevention can be implemented in industry, but that there is still much work to be done to make pollution prevention an attractive voluntary action for industries (NRDC & Dow Chemical, 1999). Thus, there is still ample room to necessitate more stringent pollution regulations.

Dow Chemical made an initial capital investment of $3.1 million, which resulted in reducing air pollution by 43% (from one million pounds to 593,000 pounds). The savings to Dow's bottom line was a cost savings of $5.4 million annually, or a 180% return on investment (NRDC & Dow Chemical, 1999).

However, despite the program's success, Dow chose not to continue the program at its other facilities because it could make a higher return on investment by investing elsewhere (NRDC & Dow Chemical, 1999). This highlights the reality that in order for businesses to choose to implement pollution prevention strategies, they must not only be profitable, but—more importantly—the pollution prevention strategies must be more profitable than other investment options. There are many barriers to creating these institutional changes, not the least of which remain business hurdle rates (the amount of profitability required by a project for a business to choose to invest in it)--highlighting the continued need for more stringent regulations. Focused pressure from environmental groups also remains critical (NRDC & Dow Chemical, 1999).

A potential takeaway from this report is the need for and potential effectiveness of working closely with an industry to identify (often simple) environmental changes that it would otherwise not consider on its own. More work is required to further the concepts of sustainability within businesses. Employee understanding of the importance of pollution prevention initiatives, and the benefits of understanding communities' concerns and interacting with these communities (NRDC and Dow Chemical, 1999) may be critical to successful pollution reduction strategies.

Many other successful companies have integrated pollution prevention and sustainability into their business models, including Nike and Interface Global. Public-private partnerships such as the EPA Common Sense Initiative for steel making and auto manufacturing exist, also (Andrews, 1998).

VI. Conclusions

Public policy plays an important role in creating regulatory and market-based pressures to induce EMS adoption. These pressures include public information disclosure (transparency) and more stringent mandatory regulations (Anton et al., 2004). Technical assistance and public recognition programs help to educate businesses about the true environmental and economic costs (Andrews, 1998) and assist in finding cost-effective solutions. Government assistance is available for companies that lack capital for EMS, including external subsidies; for government supported

technological assistance, small grants for EMS design training and consultants are available (Darnall, 2006). Many government programs offer education and technological assistance (Andrews, 1998) which is important for overcoming barriers to implementation of pollution prevention.

The literature on voluntary pollution prevention and case studies indicate that reducing a company's pollution is not antithetical to its survival, and that pollution reduction can, in fact, result in many new business opportunities. EMS techniques allow firms to "exit environmentally hazardous businesses, redesign existing product systems to reduce life-cycle impacts, develop new products with lower life-cycle costs" (Darnall, 2006).

The literature shows two lines of argument that encourage business self-regulation: 1) literature on "greening of industry" and its benefits and 2) criticism of government regulations. The "greening of industry literature shows that pollution prevention pays, and that programs such as greening of industry, Design for Environment, industrial ecology, and sustainable industry are in an industry's own best interest. The second argument pertains to over-regulation and command-and-control versus market-based incentives. This argument claims that conventional regulations that impose higher than necessary costs are therefore inefficient. They are ineffective because it just moves pollution around rather than reducing it, and it is also ineffective for reducing point-source pollution. Furthermore, a lack of resources, political will and authority make such programs unenforceable (Andrews, 1998).

It is not feasible for government to legislate internal business operations. Under a voluntary approach to pollution reduction or prevention, the government sets the framework, and industries organize own their operations to achieve the framework's goals (Andrews, 1998). Regulatory and market based pressures have an indirect impact on toxic releases, rather than a direct effect. They indirectly impact releases because they encourage institutional management changes (Anton et al., 2004). Hence, there is need for voluntary EMS programs in addition to effective government regulations. Many U.S. programs are designed to encourage EMS adoption (Anton et al., 2004).

Gaps in research include sound quantitative data about the impacts of voluntary pollution prevention on a firm's bottom line, as well as conclusive studies about the effectiveness of voluntary pollution prevention programs. Further research would benefit from studying these gaps, as well as the interactions between voluntary pollution prevention programs and public policy.

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Case Studies on States' Air Emission Regulatory Process

Abstract

Since the federal government enacted the Clean Air Act (CAA) in 1970, each state established their own institutional system that describes how the state will meet the minimum criteria of the federal Clean Air Act. According to the EPA's Clean Air Act, it is generally the state, local, and tribal governments' responsibilities to monitor air quality, inspect facilities, and enforce CAA regulations ("Understanding the Clean Air Act- State and Local Governments' Role," 2012). We picked three states, California, Massachusetts, and Texas, as policy model states for toxic air reduction regulation. Taken together, the regulation processes in the above three states demonstrate how policy and regulatory process' models not only have the commonalities but also diverge based on the institutional frameworks within which they operate.

California State was widely considered to have the worst air-pollution in the history of United States; According to the record of the American Lung Association, Los Angeles was the smoggiest city in history before the federal government passed the CAA and still remains the worst air pollution city by Ozone in the United States ("Most Polluted Cities," 2013). Throughout the 40 years of the post CAA period, the policy makers in California designed new environmental policy instruments to promote, in an economically efficient manner, a balance between the huge demand for industrial and economic growth and environmental protection. Under its rapid economic development and stronger environmental regulation and enforcement by the state agencies, California gradually formulated more comprehensive and localized regulatory approaches to control, and treated the criteria pollutants and hazardous air pollutants effectively and innovatively. At the same time in the late 80s, Massachusetts was attempting to establish systematic mechanisms to diminish the industrial hazardous discharges that had enormous health risks to communities, while not harming business and economic growth. The reconciliation between public concern and businesses' pushback finally became a fairly unique and distinct part in the history of toxic use reduction regulation and set Massachusetts apart from other states. From the deregulated to the regulated, we found that the above two states carried out quantified regulatory processes that made their regulatory power work for air pollution reduction. Meanwhile, Texas, as a state that once evaded from the federal air control regulation system, also comes into our research scope to demonstrate an informative regulatory contrast to the strongly regulated states in this context (California and Massachusetts). We found that even if the role model states provide us with relatively holistic regulatory processes and effective mechanisms with respect to air toxics control, and even if those state are implementing effective air control policies, these regulations are not homogenous between them. Different mechanisms within regulations work for different places and therefore reveal a disparity of regulatory efficacy among each jurisdiction. The following case studies demonstrate the state statutes for air emission regulations. Also, a comparison analysis is provided after the three case studies, followed by political implications for Oregon's current air emission policy.

I. California Air Toxics Statute Case Study

The air toxics regulation of California is one of the most progressive, comprehensive and rigorous legislative programs in the United States (Flatt, 2007, p.127). Traced back to the early 1980s, a statewide comprehensive air toxics program was enacted by the California Air Resources Board (CARB) (Flatt, 2007, p.123). A series of more stringent air toxics control plans were gradually formatted since then. The California office of Environmental Health Hazard Assessment (OEHHA) was established to conduct the setting standards for independent risk assessments to air pollutants ("Risk Assessment," 2007, para.1). Currently, CARB regulates a total of 748 pollutants (Clements et al., 2006, p.116). The major air toxics, a.k.a. Toxic Air Contaminant under California's air toxics law, including benzene, 1,3-butadiene, formaldehyde, etc., are the major concern for public health and risk assessment by CARB and OEHHA in California, and they are the same major air toxic pollutants for Oregon ("Toxic Air Contaminant Identification Reports," 2010).

Regulation Formation Process

1. Toxic Air Contaminant Identification and Control Act (AB 1807)

According to the official published website of CARB, the California Legislature established a two-step process to conduct the air toxics regulatory process in 1983. They were **risk identification** and **risk management**, with the aim to address the potential health effects from air toxic substances and protect the public health of Californians ("California Air Toxics Program – Background AB 1807 Program," 2010, para.3). California Legislature passed the law "Toxic Air Contaminant Identification and Control Act" ("California Air Toxics Program – Background," 2010, para.1). CARB is required to use certain criteria and consider criteria relating to "the risk of harm to public health, amount or potential amount of emissions, manner of, and exposure to, usage of the substance in California, persistence in the atmosphere, and ambient concentrations in the community [Health and Safety Code section 39666(f)]", to conduct the two-step regulatory processes which centered in air toxic identification and command-and-control regulation (as cited in "California Air Toxics Program – Background," 2010, para.2).

Step 1: Identification

The risk identification process requires to determining if a substance should be formally identified as a toxic air contaminant (TAC) ("California Air Toxics Program – Background" AB 1807 Program, 2010). The staffs of CARB draft report and assess the TAC's potential for human exposure to a substance, while the staffs of OEHHA evaluate the health effects ("California Air Toxics Program – Background AB 1807 Program," 2010, para.3). This statute allows for thorough public access and input by providing information and holding public hearings. Public workshops also function as a well-communicated information exchange platform (Clements et

al., 2006, p.117).

Risk Assessment

According to the definition in the book *Determination of Acute Reference Exposure Levels for Airborne Toxicants* written by Air Toxicology and Epidemiology Section under OEHHA, the acceptable exposure level is expressed as a "reference exposure level (REL)", which is "the concentration level at or below which no adverse health effects are anticipated for a specified exposure duration " (Alexeeff et al., 1999, p.2).

The risk assessment step involves submission of a scientific final report, which is drafted after CARB and the OEHHA staffs hold several public participation, comments and workshops. Then an independent, nine-member Scientific Review Panel (SRP) will finally reviews the report for its scientific accuracy ("California Air Toxics Program – Background - AB 1807 Program," 2010,para.3). CARB is the official authority to approve the specific scientific findings after SRP's review session. Subsequently, the CARB staff formally identifies those substances as Toxic Air Contaminants and includes them into the air toxics database ("California Air Toxics Program – Background - AB 1807 Program," 2010, para.3). The public hearing notice and draft regulation are then reported. The draft regulation includes the input from the public and the information gathered from the report. The public participation stage has been valued as much as "any person may petition the Board to review a previous determination by providing new evidence" ("California Air Toxics Program – Background - AB 1807 Program," 2010, para.3).

Step 2: Risk Management

In this step, CARB will produce the report not only includes the air toxics identification review but also gives the decision of the necessary treatment measures: regulatory, technology and calculation of the cost of pollution reduction for industry source ("California Air Toxics Program – Background" AB 1807 Program, 2010, para.4).

As with step one, the industries' accountability and public access and input are assured. The authority must hold public hearings to further determine which kind of air pollution control technology would be imposed on industries (Clements et al., 2006, p.117).

Furthermore, AB 2588 program, as a supplement to AB 1807, was passed by the legislature in 1987. ("California Air Toxics Program – Background-AB 2588 'Hot Spots' Program," 2010) California Legislature amended the AB 1807 program in 1993, targeted to specify the identification and control of TACs (AB 2728) ("California Air Toxics Program – Background-AB 1807 Program," 2010, para.5). There were specified 189 federal hazardous air pollutants as TACs and the health effects were further identified in this amended program ("California Air Toxics Program – Background -AB 1807 Program," 2010, para.5).

2. "Hot Spots" Information and Assessment Act (AB 2588)

The Air Toxics "Hot Spots" Information and Assessment Act (AB 2588) was implemented in 1987 to supplement the AB 1807 program ("California Air Toxics Program – Background-AB2588," 2010). And the center authority CARB started to decentralize to 35 districts in California to manage air toxics inventory separately, provide the notification of people exposed to significant health risks, and facilitate plants to reduce these risks. The most important element in the supplement regulation is for local air pollution control districts to provide the public with an annual progress report on the program, with its motivation and incentives for facility owners to voluntarily reduce their facility's toxic emissions ("Air Toxic 'Hot Spots' Act," 2009).

Process 1: Identification

The beginning of the process is similar to the initiative action in AB1807, which focuses on classifying the pollutant substances from manufacturers that fall in the group of polluted emission, such as the emissions of 10 tons or more per year of total organic gases, particulate matter, nitrogen oxides or sulfur oxides ("Air Toxic 'Hot Spots' Act"-The Air Toxics 'Hot Spots' Process," 2009, part A[5]).

Process 2: Emission Inventory Plans and Reports

Pollution facilities must prepare the air toxics emission inventory plans and emission inventory reports in this process, including the emission inventory plan detailing how emissions will be measured or calculated ("Air Toxic 'Hot Spots' Act-Process," 2009, part B). The implementation process will be followed by the plan and the facility owners will submit the emission inventory again after the Air Quality Management District (AQMD) reviews the plan ("Air Toxic 'Hot Spots' Act"- Process," 2009, part B).

Process 3. Risk Assessment

Potency, toxicity, quantity, and volume of hazardous materials released, and a potential receptor are the factors that will be used to determine the risk ("Air Toxic 'Hot Spots' Act"- Process," 2009, part C). The Air Quality Management District (AQMD) will rank facilities for purposes of risk assessment into three different levels of categories: high priority, medium priority and low priority ("Air Toxic 'Hot Spots' Act"- Process," 2009, part C).

Process 4. Public Notification

Those facilities that may cause potentially significant health risks as determined by the AQMD

[5] The process, followed by the subsequent subheadings, is categorized by the reference of the *Air Toxic "Hot Spots" Act,* Sacramento Metropolitan Air Quality Management District. Available at < http://www.airquality.org/permits/aths.shtml>.

must notify all risk assessment results ("Air Toxic 'Hot Spots' Act"- Process," 2009, part D).

Process 5. Risk Reduction

A comprehensive air toxics risk reduction audit and a plan to enforce risk reduction approaches will be imposed on those heavy-pollution facilities. If those facilities have failure to submit a complete audit and plan would cause civil penalties, ranging from $500 to $25,000 for each day violation ("Air Toxic 'Hot Spots' Act"- Process," 2009, part E).

According to *2010 Air Toxics 'Hot Spots' Program Report for San Diego County* (2010), all larger quantity polluters have to submit the following information:

1. Emission Inventory Reports
2. Health Risk Assessments
3. Public Notification
4. Risk Reduction Audits and Plans (*2010 Air Toxics "Hot Spots" Program Report for San Diego County*, 2010, p.1-2)

3. District Pollution Prevention Implementation Program

California's center authority for air emission control decentralizes into 35 local air districts. Each district, with the commend-and-control approach, is required by the oversight central authority CARB to adopt rules and regulations to achieve state and federal ambient air quality standards (Clements et al., 2006, p.118). In the guidance of book *The Control of the Air Toxics*, it points out "Many of the CARB's adopted control measures use pollution prevention techniques as the foundation of the regulation" (Clements et al., 2006, p.118). The CARB has adopted a large number of Air Toxic Control Measures (ATCMs) that "can be found in Titles 13 and 17 of the California Code of Regulations" (as cited in Clements et al.,, p.118). The major process can be founded as: "The District has developed toxic emission inventory reporting procedures that streamline this process while meeting the requirements of the CARB Emissions Inventory Criteria and Guidelines regulation […] Additionally, the District has merged the Toxic Emission Reports with the Criteria Pollutant Emission Reports to eliminate duplicate data requests" (*Air Toxics "Hot Spots" Program Report for San Diego County,* 2010, p.2).

According to CARB's (2011) "Hot Spots" overview, facilities have taken voluntary steps to reduce emissions of air toxics, that result can be found in a survey took from 21 facilities in California has identified voluntary reductions of over 1.9 million pounds per year in the emission of air ("Overview of the Air Toxics 'Hot Spots' Information and Assessment Act," 2011,para.5).

Program Funding Resource

"The AQMD must collect fees from all facilities subject to the Act and remit the district's share of the state costs to the ARB" ("Air Toxic 'Hot Spots' Act-Fee schedule," 2009). A local to central collective fee system serves to recover the state's implementation costs and establishes each district's share of state costs which provide for recover program costs ("Air Toxic 'Hot Spots' Act-Fee schedule," 2009).

Program Enforcement

CARB's (2012) enforcement programs are developed and implemented by providing two training programs and compliance assistance, such as technology and permit application assistance ("Compliance Training Program," 2012). The on-line air permitting training program, which is free for polluters, provides them with the opportunity to familiar with the regulatory process and compliance with the law ("Air Quality Training Program (AQTP) - Online Training," 2012). Best Available Control Technology (BACT) for addressing the problems with risk assessment and management for polluters is also provided by CARB through the beginning of the implementation to the end ("Statewide Best Available Control Technology Clearinghouse," 2008).

CARB (2012) developed an urban comprehensive dioxin study of monitoring and testing program to collect ambient data ("California Ambient Dioxin Air Monitoring Program," 2012, para.1) Under this program, the CARB establishes the Monitoring and Laboratory Division to collect data that will evaluate potential health impacts, assess control strategies, and locate specific fields for creating flow audit procedures ("California Ambient Dioxin Air Monitoring Program," 2012, para.1).

II. Texas Deregulated Air Emission Statute Case Study

Background

An up-to-date Internet green news article described Texas as the only state that has refused to implement the nationwide Clean Air Act regulation and rules, prompting the EPA to seize control of the state's permitting authorities (Treasaugue, 2011). In Treasaugue's web article dated on January 26, 2011, EPA stated the $3.2 billion plant would lack the capability to meet new federal standards for nitrogen dioxide and sulfur dioxide, and its potential environmental effect ("TCEQ thumbs nose at EPA on air permit," 2011,para.4).

Another environmental columnist Gregor (2010) in her article "EPA to TCEQ: Too Much 'Flexibility'" also critiqued the too flexible permitting system that throughout series of actions showed that Texas assisted and deregulated the industry by watering down the Clean Air Act:

> In 1995, Legislature directly revised and weakened its State Implementation Plan,

sidestepping the state's own process -- without federal EPA approval. Among other changes, those revisions altered new source review air permitting and banking and trading rules. The new SIP also authorized a flexible permit system for more than 1,000 grandfathered industrial plants (Gregor, 2010, para.1).

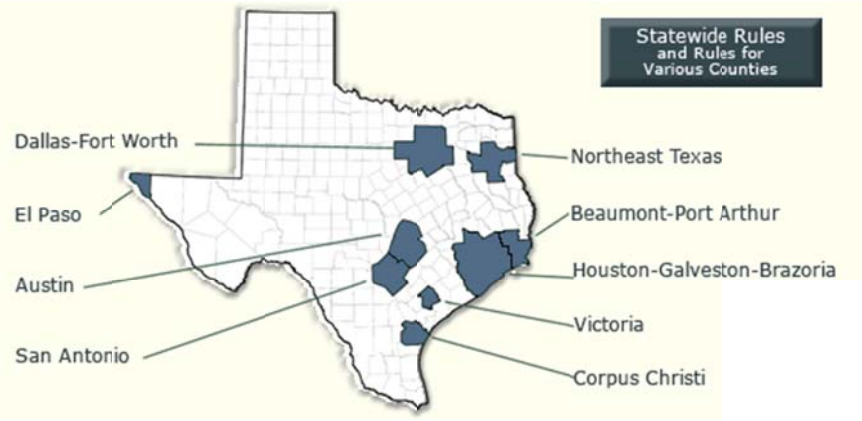
Regulatory Processes

As a state's responsibility, Texas has its own Clean Air Act to regulate the air pollution. TCEQ "implements and enforces air quality permitting in the state pursuant to authority granted by the Texas Clean Air Act (TCAA)", found in Texas Health & Safety Code, Chapter 382 (as cited in Allmon, Alvarez, Burke, Craft & Hadden et al., 2010, p.9).

The TCEQ uses Effect Screening Levels (ESLs) for air permitting ("About Effects Screening Levels (ESLs)," 2013). The Bureau of Air regulates the major non-attainment counties and areas, including: Dallas-Fort Worth, Northeast Texas, El Paso, Austin, San Antonio, Beaumont-Port Arthur, Houston-Galveston-Brazoria, Victoria and Corpus Christi ("Texas State Implementation Plan," 2013). In particular, the "Houston Ship Channel is a heavily industrialized area with several petroleum refineries and chemical manufacturing facilities that produce large amounts of volatile organic compound (VOC) sources" (Clements,et al., 2006, p.104).

Picture 1: The Air Pollution Non-attainment Areas and Counties in Texas

(*Source*: *"Texas State Implementation Plan"* The Air Bureau of Texas Commission on Environmental Protection, 2013)



There are two types of permits that TCEQ issued to approximately 1,700 major air emissions sources in Texas (Allmon et al., 2010, p.11). The two air permitting programs are: **New Source Review (NSR) permits** which authorize the construction or modification of a facility; and **Title**

V Federal Operating permits which authorize continued operation of existing facilities (Allmon et al., 2010, pp.12-15).

The air emission policy proposal written by the working group for a non-profit organization called Alliance for Clean Texas (Allmon et al., 2010), defined the function of Title V Operating Permit Program is "requires major sources and certain minor sources to obtain a permit that consolidates all applicable air requirements in a single document"(Allmon et al., 2010, p.15).

The general effectiveness, enforceability and flexibility of air permits issued by the TCEQ has attracted much attention from Alliance for a Clean Texas (ACT) and they submitted the air policy proposal which tried to solve those series of significant NSR- and Title V Operating permit-related problems.

The Alliance for a Clean Texas (2010) found that the process of determining the scope and review for air permits in Texas didn't meet the criteria entirely under EPA's standard. Basically, the process can be found in the TCEQ's (2008) government document:

> The TCEQ staff conducts a preconstruction technical review during the air permitting process. This review ensures that the operation of a proposed facility will comply with all the rules of the TCEQ and intent of the TCAA, and not cause or contribute to a condition of air pollution. A review of an air permit application involves an assessment of best available control technology (BACT) and human health and welfare effects related to emissions from production and planned maintenance, startup, and shutdown (MSS) activities. (*How to Determine the Scope of Modeling and Effects Review for Air Permits*, 2009, p.1)

In a word, EPA didn't approve of the TECQ's BACT that supposed to meet their criteria and claimed it as inappropriate approach to conducting the permit review.

TCEQ Air Permitting and Enforcement Issues

Firstly, according to the ACT's (2011) argument, EPA determined the TCEQ permitting system provision components do not comply with the FCAA and EPA's NSR- regulations, and therefore, the State Implementation Plan (SIP) is not fully approvable; Within TCEQ enforcement procedures, whose rules and policies do not assure compliance with the Federal Clean Air Act, the operating permits also fail to comply with federal law ("Legislative Recommendations: Air," 2011, para.4).

Further, EPA didn't think TCEQ provide as much opportunities for the public access to the

permitting procedure, review and comments as other states did (Allmon et al., 2010,p.17).

Due to the lax administering system beyond the regulation itself inside of the TCEQ, probably most of the incentive for deregulation came from economic wealth and growth incentive. Several policy recommendations raised up by the ACT/TCEQ Sunset Review Policy Working Group (2010) would make the permitting program stronger by making the process more predictable, more effective and clearer. [6]

Deregulation Effect on Industry and community

With the lax permitting system, industries questioned about how to properly comply with the federal law while the state agency still kept ambiguous rules. For example, Gregor (2010) critiqued that there were too many industries' complaints against TCEQ; industrial air-quality monitoring, measuring, reporting, and noticing were out of regulated order in Texas ("EPA to TCEQ: Too Much 'Flexibility'," 2010, para.4).

TCEQ air permit practice allows industry facilities to avoid the permits and the renewals, "as long as a facility stays under its overall 'cap' as self-reported", which involves no auditing third party (Gregor, 2010, para.3). On the community side, the deregulation system also failed to let the industry facilities provide public access to their pollution prevention reports.

III. Massachusetts Toxic Use Reduction Case Study

Pro-Business Permit Efficiency System

- Toxics Use Reduction Act (TURA 1989)

With the ultimate goal of mitigating serious health problems caused by toxic sources and at the same time benefiting businesses that produce byproducts from the toxics, Massachusetts passed the Toxics Use Reduction Act (TURA) in 1989 ("TURA Overview," 2011). Currier and Atten (1997) concluded in their benefit and cost analysis of TURA which contains two points that affect businesses:

- Reduction in toxic or hazardous byproduct generation.
- Reductions in toxic chemical use by input substitution, product reformulation, production unit redesign (modification), production unit modernization, improved operation and maintenance, and recycling, reuse or the extended use of toxics.

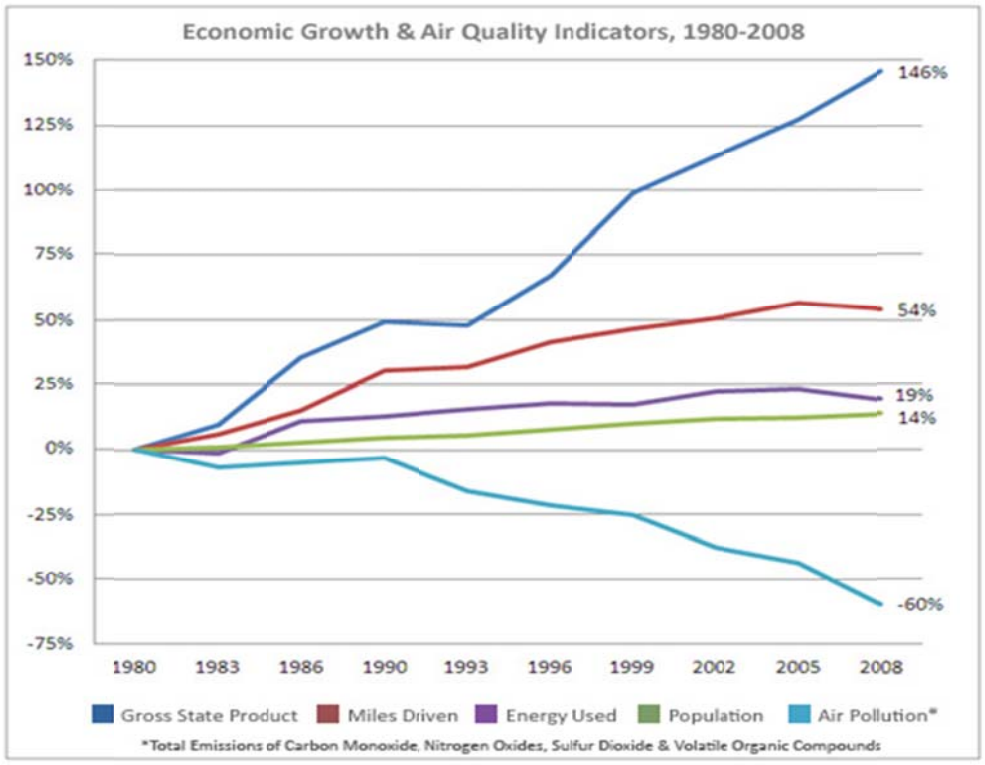
[6]For further policy recommendation issues in Texas air toxics regulation, please see the article "TCEQ Air Permitting and Enforcement-improving Texas' air quality through the sunset review process" by Allmon, Eric, Ramon Alvarez and Erin Boeke Burke,et al. ACT TCEQ Sunset Review Policy Working Group and Air Alliance Houston, 2010.

(Currier & Atten, 1997, ES-1, para2)

From regulatory approaches and effectiveness perspectives, the TURA model, which is a nation-wide and even international model, is considered to be "an effective blend of mandatory and voluntary components"(Massey, 2011, p.505).

According to Massachusetts Permit Efficiency Initiative and Speed Business Initiative (2011), Massachusetts Department of Environmental Protection (MassDEP) has been considered to execute the most pro-business approaches but has some of "the most protective and complete standards of any of the states" (Flatt, 2007, p.138). The regulations passed by the Massachusetts legislature demonstrated in an increased trend in both the public health and economic growth.

Chart.1 Economic Growth & Air Quality Indicators, 1980 - 2008



(*Sources of Data*: Cleaner Air & Economic Growth. Massachusetts the Executive Office of Energy and Environmental Affairs, 2013)

The "Permit Efficiency Initiative" program has issued Air Quality Permits in a way that shortens the decision time to issue permits. Air Quality Permits were selected for in-depth review because "they are generally associated with significant economic development opportunities, have a history of customer concerns about decision delays, are relatively high-volume, and more than 20% of the permit decisions exceeded the 180-day goal in 2006"("MassDEP's Regulation at the Speed of Business Initiative," 2007, para.3). Furthermore, these permits also require a resource

intensive "Best Available Control Technology" (BACT) analysis.

Implementation: Training, Funding, and Research Programs

Enacted in 1989, The TURA program activities are implemented by three agencies: **MassDEP**, **the Office of Technical Assistance and Technology** (OTA), and the **Toxics Use Reduction Institute** (TURI). In order to support the scientific researches and findings, TURI not only establishes multi-disciplinary researches in the hazardous use field, but also continues to support Massachusetts industries, companies and communities through various funding programs and through organizes education and training programs, and provides technical support in industrial toxic use reduction ("Toxics Use Reduction Institute Overview," 2011).

Air Toxic Use Reduction Gap

The primary purpose of TURA is to "promote industrial hygiene, worker safety, and protection of the environment and public exposure to toxics" (as cited in Massey, Elizabeth, & Heather, 2010, Appendix I/p.35). Thus, we found that although the improved protection of human health and the environment is due to the contribution of the TURA planning and reporting processes, the air toxics use reduction, with its aim to reduce human exposure to toxics as well as lessen environmental contamination, is still not being included in the explicit policy scope in the TURA. We found those analyses from facilities neither indicate air toxic use reductions nor monetize the benefits that would likely reduce human health and ecological risk. That is because the lack of evidence for historical data, including isolating, measuring, and then monetizing impacts from the air emission facilities.

IV. Cross-State Comparison Study

1. The relationship between regulation and air emission reduction

Ringquist (1993) argued in her article "Does regulation matter?: Evaluating the Effects of State Air Pollution Control Programs", that there are two themes existing in the politics of air quality. The first theme is that regulation does significantly affect air pollution emission levels (Ringquist, 1993, p.1022). The strong California and Massachusetts regulation cases demonstrate the relationship between state program strength and reduced pollutant emission. The second theme is that enforcement matters. In particular, federal enforcement involvement at the state level can impact the effectiveness of the pollution control programs and progress in reducing air pollution emission (Ringuist, 1993, p.1035). Texas air emission authority's evaded permitting enforcement from federal regulation tells us that the federal enforcement presence is very important to effectiveness of air pollution reduction. In Mark Stephan, Troy D. Abel and

Michael E. Kraft's article[7] (2007) related to the air toxics reduction and regulation developed the argument that pollution severity, educational attainment, regulatory stringency, and policy liberalism had statistically significant effects on pollution releases. From the angle of policy liberalism, we find in the above three case studies that states with more liberal overall policies, such as California and Massachusetts, also see the greatest reduction in pollution releases in comparison to Texas which is considered one of the most conservative in overall policy. Moreover, we may apply our case studies to the research finding that "the measure of regulatory stringency yielded a statistically significant but negative sign" (Stephan, Abel and Kraft, 2007,p.13).

2. *Policy leadership and policy diffusion*

What is the most effective regulatory model of *policy leadership* for air pollution control that is not harmful to the state's economic growth? Tim Swanson (2008) pointed out that "An efficient mechanism should allocate environmental resources (air, water) to demands in correspondence to the relative value that each use affords at the margin, and generate the highest aggregate value from the resource"(p.4). Evidently, there are some policy commonalities among the three states that demonstrated the effectiveness of pollution reduction; we recognize them as the following points:

Commonality:

- Federal command-and-control mechanism
- Market-based (tradable permit/ cap trade) or other financial incentives (tax/ price)
- Self-reporting (i.e. Toxic Release Inventory Program)
- Technical Assistance
- Providing air quality training programs and compliance-training programs
- Best Available Control Technology (BACT) (but not approved by EPA in Texas)

Policy diffusion from state to state, especially in terms of some financial incentive regulatory methods, is the supplement to the major federal regulation approaches, like command-and-control. Each of these common policies might be crucial to continued social advancement and development. From the perspective of economics, Tim Swanson (2008) gave us the reason and argued: "economists conceive of the introduction of environmental regulation as any mechanism that has the capacity to result in the effective restriction of access to the resource (i.e. a limit, quota, price or tax). […] but its more important role is to allocate the resource between competing demands" (p.3).

3. *Role for Science in the regulatory and policy-making process*

[7] Toxic Releases and the States: Multilevel Analysis of the Relationship between State Politics and Policy and Improvements in Pollution Releases, Prepared for the 2007 State Politics and Policy Conference. University of Texas, Austin, Texas, February 23-24, 2007

Air toxic emission regulation is a key policy area that has witnessed an increasing alignment of risk and regulation, from the federal Toxic Inventory to each respective state that established their own standard. The reason underlying this policy approach is because the scientific examination and accuracy of standards for toxics emission are the biggest factors related to public health and its concern (Turaga, n.d. pp.5-6). For instance, as the air regulatory processes enacted and improved in California, the risk-based regulation with a focus on risk assessment and risk management plays the more important role in the regulatory formation and decision-making processes. Rama Mohana R. Turaga (n.d.) pointed out that "risk-based" decision-making has been the "dominant paradigm guiding regulation of toxic pollutants in the United States"(p. 5). In decision-making processes, she also suggested that in the residual risk regulation in the California case, the air toxics regulation decisions should be made by the two following factors:

1. Assessment of maximum risk to exposed individuals (i.e., maximum individual risk)

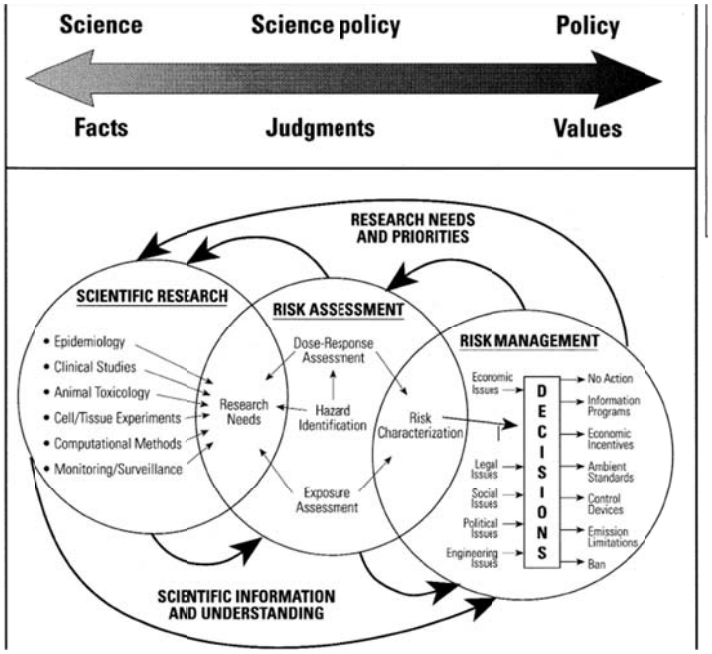
2. Reduction of population risks taking into account the costs of controls

(Turaga, n.d.,p.10)

Therefore, in terms of determining the specific risk level and providing risk management, science plays very important role in the regulatory decision making process. Sexton (1995) recognized that science help with "improve the quantity and quality of scientific information," furthermore, it also "enhance our ability to interpret the available scientific database for risk assessment, risk management, and risk communication decisions"(p.214).

"In the process of regulatory decision-making, there is a direct interface between science and policy"(Sexton, 1995, p.213). The hazardous air pollutant in previous three state regulatory processes provides an illustration of political consensus about the need for scientific regulatory decision-making processes despite the lack of costs and benefits analyses.

Picture 2: Risk Assessment and Risk Management in the Science Policy Making Process



(*Source*: Science and Policy in Regulatory Decision Making: Getting the Facts Right about Hazardous Air Pollutants from Journal of Environmental Health Perspectives, 1995, p216)

In further decision-making for the regulatory and legislative process, Oregon's current air toxics reduction standards and monitoring data collection progressively need science. Science is used here in its broadest sense to encompass research and development, technical and research support, monitoring and data collection, review and interpretation of technical investigations, and assessments of health and environmental risks. In this sense, in the new regulation, with its enforcement agencies either within Oregon's Department of Environment Quality or third party review auditing companies, the science will play a more important role in the decision-making process through integrating more scientific data and evidence on risk assessment and risk management.

4. *TURA (Massachusetts) vs. HB3492 (Oregon)*

Both Massachusetts and Oregon haven't included the air pollution measures in the legal documentation. Like the Toxic Use Reduction Act of Massachusetts, the state of Oregon passed the Oregon's Toxic Use Reduction and Hazardous Waste Reduction (TURHWR) Law in 1989 ("Toxics Use and Hazardous Waste Reduction Law Requirements," 2011). However, despite a two decades track record of comprehensive approaches to reducing pollution at its source, both states haven't yet included hazardous air pollutant treatments. HB 3492 aims to expand this existing law to incorporate the above vacant solution. However, the cost and benefit to economics and business sides are lacking the support from the historical data evidence. Nevertheless, this most recent Oregon air toxics' proposed bill focus on expanded law that will

incorporate the hazardous air pollutants would expect to bring the economic benefits to businesses in reduced material costs, reductions in fees, and more health protective work environments for their employees ("House Bill 3492," 2013).

V. Implication for Oregon Current Air Regulation

Since Oregon's Toxic Use Reduction and Hazardous Waste Law passed in 1989 and created one of the nation's first laws mandating pollution prevention planning for certain facilities, the debates from industries, communities, and government agencies never stopped with the ultimate goal of bettering the environment while maintaining economic health. The ongoing request of modifying and developing the law demonstrates that a more comprehensive regulatory approach needs to be taken into consideration by Oregon legislature. We would like to examine the following points from the existing policy approaches in Oregon: the enforcement effectiveness in various government voluntary programs, and community advocacy and public education for the purpose of providing policy framework and political process conciseness to the decision-makers for improvement of air regulation in the future.

1. Management-based Regulation

Oregon is the only state that requires all domains of regulated entities, including the Toxic Release Inventory Reporters, Large Quantity Generators (LQGs), and Small Quantity Generators (SQGs), to report their progress of pollution prevention programs annually since 1991 (Bennear, 2007, p332). However, through Bennear's (2007) evaluation of the traditional command-and-control methods, she found that regulating the air toxics is more pronounced by using innovative management-based regulation (MBR)(p.327).

This alternative policy approach requires that each regulated entity reviews its production processes and develops a set of goals and procedures that will reduce risk. In Bennear's (2007) examination of the effectiveness of MBR method, she used panel data for over 31,000 manufacturing plants of 14 states that adopted such regulations for toxic chemical control in 1990s (p.335). Her results indicated that the management-based regulation had a measurable positive effect on the environmental performance of the manufacturing plants both in a period and might be still keeping effect in a long term (pp.335-342). The study from Bennear (2007) demonstrated that plants subject to MBR are more likely to engage in source reduction (also known as pollution prevention program) activities.

2. Pollution Prevention Regulation Efficiency

The district pollution prevention program in California is a model for using decentralized regulation that obviously reduces operation costs and demonstrates a set of emission reduction options for industry sources, and improves the community relations. Furthermore, it improves public health and reduces the risk of diseases related to the air toxics, such as asthma , lung

disease, cardiovascular disease and cancer for vulnerable populations, according to the EPA's (2010) the health concern report ("AirCompare-Health Concerns").

Although Oregon is listed as one of the four major states that enforced the pollution prevention programs in the early 1990s, compared to California and Massachusetts, the effectiveness of Oregon's pollution prevention regulation seemed to not have an explicitly positive effect on regulated industries at the plant level (Bennear, 2007, p.332). The deep reason for the failure of Oregon's innovative regulation method can be seen as:

1) **Information asymmetry:** "The basic tenet of this regulation is that it corrects for informational asymmetries that may exist. One of the most pervasive examples of this is the Emergency Planning, Community Right to Know Act (EPCRA)"(Bui & Mayer, 2003, p.693). The new increased air emission reduction policy should include those environmental data that the state agencies can provide in order to increase the reporting requirements for polluting plants. Creating the public access to collect and maintain the database of industrial air pollution can be used as informal regulatory tools because they can not only hold accountability of increasing community awareness but also relatively low-cost (Bui & Mayer, 2003, p.693).

2) **Third Party (Audit) Review:** Oregon doesn't have a set of complete and effective policies for third party review. This process should be included in the regulation, and promote auditors and employees of plants to take more initiative to review their procedures for emission reduction. Below shows the use of MBR comparison between three innovative states:

Table 1: Description of State Pollution Prevention Program

Description of State Pollton Prevention Programs						
	Types of Facilites Required to Plan	Toxic Use Reyorting	Progress Reports	Public and Third Party Review	Program Imple	Planning Date
California	LQGs (Large Quantaty Generators)	No	Every Four Years	Third Party	1989	1991
Massachusettes	TRI Reporters	Yes	Annual	Third Party	1990	1994
Oregon	TRI Reporters LQGs (Large Quantaty Generators) SQGs	Yes	Annual	No	1989	1991

3. Technical Assistance

According to the Oregon Toxics Use and Hazardous Waste Reduction (TURHWR) law, Oregon state sets up Toxics Use and Waste Reduction Assistance Program (TUWRAP) under the Department of Environment Quality (DEQ) and sponsored by EPA to provide free technical assistance (*Measuring TUWRAP's Influence: Final Report*, 2004, background-para.1-3) TUWRAP staff statewide can help a facility to "identify ways to reduce its toxic substance use

and hazardous waste generation, obtain compliance assistance or provide training services, assist completing or updating the facility Reduction Plan, and assist with DEQ monitoring and modeling reporting" ("Toxics Use and Hazardous Waste Reduction Law Requirements," 2011, p.5).

Beyond the technical services required by the law, The Portland Air Toxics Solutions project of the DEQ (n.d.) provides the "Interactive Maps of Portland Air Toxics 2017 Modeling Study" to the public ("Interactive Maps of Portland Air Toxics 2017 Modeling Study," n.d.). This transparent technical study provides the estimates of Portland's expected pollutant, by using analysis of monitoring information and computer models ("Interactive Maps of Portland Air Toxics 2017 Modeling Study," n.d.). The interactive map model can estimate cumulative annual concentrations of 19 pollutants for 2017. Those assessed 19 pollutants through information computer modeling, with eight of the 14 pollutants that are above clean air health benchmark and can cause the most risk, are: 1, 3 butadiene, benzene, diesel particulate, 15 PAH, naphthalene, cadmium, acrolein, and formaldehyde ("Fact Sheet: Portland Air Toxics Solutions Report and Recommendations," 2012, p.3). The major areas that contain the worst air toxics are found in the interactive map "emissions of metals including manganese, nickel and cadmium are concentrated in or near industrial areas" ("Portland Air Toxics 2017 Modeling Study," 2011, p.1).

How can we know if Oregon's Hazardous Waste Technical Assistance Program is effective or not? In the DEQ officer Wendy Wiles's (n.d.) report regarding the program evaluation, "The Evaluated Effectiveness of Oregon's TA Program Final Report,"(as cited in Wiles, n.d.) there are five major measurements to answer the effectiveness of the TA program:

1) Impact on compliance

2) Environmental outcomes

3) Costs relative to compliance inspections

4) How to measure effectiveness

5) How can TA be integrated with the authorized program

(*The Evaluated Effectiveness of Oregon's TA Program Final Report 2004*, as cited in Wiles, n.d.)

4. *Voluntary Pollution Reduction Programs*

Using the command-and-control method regulation, like raising the penalty level might not be an appropriate tool to control the toxic air emission reduction. This may just be effective on a short-term basis but not for a long run self-reporting and review process effective to the regulated polluting plants. A survey (2004) designed by the Environmental Management Project of Portland State University, targeted these Voluntary Environmental Programs (VEPs)

participating in selected manufacturing, construction, accommodation and transportation sectors in Oregon to evaluate the participation and effects on VEPs' effort and outcome (Jones, 2007, p.6). The result showed the voluntary pollution reduction program was not effective compared to other states and furthermore need to have more strength in self-reporting and monitoring mechanisms, and it is important for regulatory agencies to play an important role in pollution reduction compliance performance (Jones, 2007, p.38). In Jones' (2007) report, all the surveyed facilities were asked to self-evaluate their air emission compliance situation by the measurement of "any changes in generation, and whether or not the facility was in compliance with regulations." The result that Jones (2007) figured out were "68% percent reported meeting regulations, 29% reported exceeding regulations, and 3% reported working toward compliance. Regarding changes in hazardous emissions, 84% reported no change, 6% reported increases of at least 1%, and 10% reported decreases of at least 1% "(p.30).

We encourage not only market-based and management-based regulation which should still attract more public access to the pollution prevention plans and construct a compact of the third party review policy, but also other more aggressive self reporting programs may be considered to take measures to treat the air toxics.

5. Pro-business Implementing Approach

Establishing "Permitting Assistance and Management Office" and creating "Speed of Business Initiative" encouraged the business to take responsibility and initiate the self-reporting and evaluation process. Once the regulatory decision made by MassDEP, especially speeds up for those important development industries, the business initiative addresses substantial efficiency and effectiveness of resource management of regulatory process in Massachusetts ("Regulation at the Speed of Business Initiative," 2013)

Secondly, TURA reduces the industrial toxics use and protects the environment while maintaining the economic growth of Massachusetts firms by enforcing the TURA effectively (Dauncey, 2005). Not just depending on or limiting the enforcement agencies, Massachusetts established the Office of Technical Assistance and TURI to provide direct on-site assistance to businesses, which makes the permitting process easier to understand and more efficient (Dauncey, 2005, para.7). That would be a practical enforcement model for establishing an enforceable and far-reaching influence and allows the agencies to effectively respond to industry difficulties and barriers to compliance with our policy.

Thirdly, MassDEP permit review section entitled "MassDEP Enforcement Regulations, Guidance and Policies for Business" has a policy, which encourages self-reporting of violations. That policy provides for mitigation of penalties, so long as any economic benefit of noncompliance is recovered and certain other requirements are met. This offsetting process and permit policy is a creative and innovative approach for business compared to other states' penalty regulation.

6. Financial and Funding

There are fewer leading enforcement agencies that are substantially addressing the air toxics issues in Portland than in other states. The root cause of regulation inefficiency demonstrated the political economic deficiency. Massachusetts gives us a funding source paradigm. TURI 's current annual budget amounts to $1.2 million from Massachusetts' state financing program, which under the TURA collects the toxics use fees from industry polluters (Dauncey, 2005, p.2). Whether Oregon can establish such a supplementary enforcement entity to fund sources for facilities to reduce the air pollution continues to be a major political feasibility issue.

7. Community Advocacies and Public Education

"Information asymmetries already play a large role in regulatory models: members of Congress may vote on the details of technical policies […] and regulated firms make compliance decisions in part based on the likelihood that enforcement agencies will not detect the level of compliance" (Brehm & Hamilton, 1996, p.473). In the case of Portland's air toxics control regulation, we believe that the failure of firms to be informed about regulatory requirements should be added to the list of information problems in regulatory politics. Through strengthening communication advocacy and revealing the excessive pollution information to the enforcement agency, the noncompliance can be mitigated. Public education on the air pollution status quo and chemical toxic use reduction also has been badly needed in the Portland metropolitan area.

VI. Conclusion

The policy model state case studies provided us with an overview of different regulatory processes and the approaches within their political frames. We know that commend-and-control and centralized regulation approaches have a positive relationship in the short term with the final outcome of the national air pollution control. However, in the long run, the various market-based approaches (i.e. tradable permits, taxes, prices, subsidies, etc.) are growing through policy diffusion from the leading state to other states and finally promote a mutual beneficial status between industry and society. Meanwhile, the management-based approach is taken into consideration because of its organizational effectiveness advantage.

From the policy framework we pictured in the above three states, we realized which approach works for effective air pollution reduction and which didn't work in certain circumstances (i.e. Texas). Since Oregon is the leading model state in developing its sustainability consciousness to wide audience, including organizations, communities and individuals, the enterprises should carry out more socially responsible actions to voluntarily accomplish their annual audit tasks for pollution emissions and other pollution prevention tasks.

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