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DESIGNING VOLUNTARY ENVIRONMENTAL AGREEMENTS IN EUROPE: SOME LESSONS FROM THE U.S. EPA'S 33/50 PROGRAM

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Designing Voluntary Environmental Agreements in Europe:

Some Lessons from the U.S. EPA's 33/50 Program

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Introduction

Voluntary Environmental agreements between Industry and State and Federal Environmental Protection agencies, are becoming increasingly common in Europe. Voluntary Environmental Agreements, or simply Environmental Agreement,s are defined by the European Environment Agency (EEA) as covering "only those commitments undertaken by firms and sector associations, which are the result of negotiations with public authorities and/or explicitly recognized by the authorities."[1] This implies that other voluntary initiatives such as codes of conduct fall outside the definition. Using this limited definition the EEA found that by 1996 there were more than 300 voluntary agreements at the national level in EU Member Countries.

The EEA's 1997 report on Environmental Agreements reported that all EU countries have EAs, with the Netherlands leading the way in the development of EAs with over 100. The Netherlands, along with Germany accounted for approximately two-thirds of the 300 reported agreements. The report notes that less environmentally progressive member countries such as France, Italy and the United Kingdom account for a relatively low number of EAs given the sizes of their economies.

The main findings of the EEA report were that many of the EAs surveyed in the EU did not include monitoring or reporting. The report concludes that this caused many problems including, damage to the credibility of the agreements, lack of accountability on the part of agreement participants, and finally it makes ex post evaluation of program success much more complicated.

In attempting to evaluate the success of Environmental Agreements the EEA reported the following difficulties:

1. The general absence of a quantitative baseline against which to access the programs effectiveness.
2. The lack of quantitative data prior to the agreement.
3. The lack of quantitative data on the current situation.

The EEA's study of voluntary agreements in Europe is based on findings from six case studies. The studies were chosen based on diversity. The agreements under study were from different EU countries, involved different industries, had different goals and produced different results in terms of effectiveness. One striking conclusion of the report is that that the case that involved the most

[1] EEA (1997), pg. 11.

monitoring and reporting of data (the Dutch Chemical industry's voluntary agreement to reduce toxic emissions) seemed to produce the most significant positive impact on the environment.

This paper undertakes a critical examination of the US EPA's 33/50 program. This voluntary agreement between toxic emitters and the US Environmental Protection Agency, is characterized both by an abundance of data and a seemingly positive outcome for the environment). Recently, however the EPA's claimed success has been called into question. This overview of the weaknesses of the EPA's program provides some lessons regarding the difficulties in developing an effective environmental agreement.

Overview of the TRI and the 33/50 Program

In 1986 Congress passed, and the President signed into law, the Superfund Amendments and Reauthorization Act (SARA). Title III of this act, commonly referred to as the Emergency Planning and Community Right-to- know Act (EPCRA), required companies to report releases of over 400 different toxic chemicals, many of which are otherwise unregulated. This reporting mandate applies to all manufacturing facilities that have 10 or more employees and that manufacture or process more than 25,000 pounds, or use more than 10,000 pounds or reportable chemicals. The EPA makes this information available to the public through the Toxic Release Inventory (TRI). The TRI data set, although self-reported, provides credible information regarding each reporting firm's annual toxic emission releases and transfers. The collection of the TRI allowed the EPA to track firm progress in a voluntary toxic-emissions reduction program dubbed the 33/50 program.

Formally announced in 1991, the 33/50 program had an interim goal of a 33 percent reduction in emissions and transfers of 17 (TRI-reported) toxic chemicals by 1992 and by 50 percent by 1995. Reductions were measured from a 1988 (base year). The program was voluntary in the sense that participants could make whatever pledges they deemed appropriate, firms were not required to participate, and participating firms were required only to pledge a good faith effort in meeting the targets. Failure to meet the target was not punishable in any sense, by the EPA or any other federal or state agency.

At the end of 1995 the EPA declared its 33/50 program a success. This declaration was based on the fact that total emissions of the 17 selected chemicals (as reported in the TRI) had fallen by more than 50% by 1995, when compared with the 1988 base year. The EPA's declaration of success has been criticized on several grounds by several governmental and non-governmental

organizations.[2] Much of the criticism of the 33/50 program concerns its effectiveness. While the reduction goals were achieved, the measured reductions were the sum of reductions of both participants and non-participants. In addition, simple statistical calculations showed that much of the reductions took place prior to the announcement of the program in 1991. In addition, of the total reductions reported, non-33/50 participants accounted for a large portion of the reductions. These facts raise doubts about the whether Program participation was a major factor in generating the emissions reduction.

This paper undertakes a first step in the critical examination of the effectiveness of the 33/50 program by examining reported emissions reductions by both participating and non-participating firms to various media including air, water and land. In addition we compare the reductions of 33/50 *and* non-33/50 program chemicals. Specifically we examine existing theories concerning firm motivations to reduce their toxic emissions. Using these theories we identify, and collect data, on several variables that promote or dissuade firms from engaging in emissions reductions. Using these data we then examine whether 33/50 program-participation is a significant factor leading to emissions reductions to the various media under consideration.

The following section provides some background on the 33/50 program and outlines some of the criticism leveled at the program. Section 3 provides an overview of the literature on firm and industry incentives to join voluntary environmental programs and/or engage in voluntary abatement. In section 4 we describe our data and discuss the results of our empirical examinations. Section 5 offers some conclusions and describes our plans for further investigation.

Some Doubts about the Program's Effectiveness

The EPA formally announced its 33/50 program in February 1991.[3] The program had 3 stated goals. The first was an interim goal of a 33 percent reduction in releases and transfers of the 17 toxic chemicals (listed in Table 1) from a 1988 base year. The second goal was a final objective of a 50% reduction in releases and transfers by 1995. The final program goal was to show that voluntary pollution programs work more efficiently than command and control methods. This final program goal hints at the possibility of internal bias in the EPA's evaluation of the success of the

[2] Groups voicing criticisms of the Program include Citizen Fund, the GAO, and INFORM. We will examine the criticisms in detail below.

program, and suggests the need to formally investigate whether the Program was indeed effective at producing emissions reductions.

1. Benzene	10. Mercury and mercury compounds
2. Cadmium tetachloride	11. Methyl isobutyl
3. Carbon tetrachloride	12. Nickel and nickel compou
4. Chloroform	13. Tetrachoroethylene
5. Chromium and chromium compounds	14. Toluene
6. Cyanide compounds	15. 1,1,1--Trichloroethane
7.Dichloromethane	16. Trichloroethylene
8.Lead and lead compounds	17. Xylenes
9.Methyl ethyl ketone	

Table 1: 33/50 Program Chemicals

The 17 program chemicals were chosen based primarily on the following criteria: (1) their threat to the environment and public health, (2) the potential for high exposure, (3) volume of production and release, (4) potential for pollution reduction and prevention.[4] Given these criteria, it is not surprising that in general one should see greater reductions in 33/50 than non-33/50 chemicals. In some sense the chemicals were selected to generate success.

The EPA not only carefully selected the chemicals to be monitored as part of the 33/50 program, they also (especially initially) carefully selected potential program participants. That is, unlike their Green Lights program, which is open to any US business, the EPA's initial invitations to join the 33/50 program were restricted. In February 1991, the EPA invited the ``Top 600'' emitters of 33/50 program chemicals based on their reported releases and transfers for 1988. These firms accounted for 75% of reported releases and transfers of 17 program chemicals in 1988. The second group of invitees (5,000 firms) was invited to join the program in July 1991. Firms included in this invitation released some 33/50 chemicals but were not among the ``Top 600''. Firms in the final group were invited to join in July 1992. These firms, some 2,500. Did not report any emissions of 33/50 program chemicals in 1988 but did do so in subsequent years.

[3] 1991Much of this section is based on summaries of the 33/50 program written in Davies and Mazurek (1996), EPA (1994), INFORM (1995), General Accounting Office (1994a) and Maxwell, Lyon and Hacket (1988)

[4] Davies and Mazurek note, these 17 (out of a total of 320 monitored) chemicals comprised about one quarter of the total TRI releases and transfers in 1988.

It is interesting to note the participation rates of the three groups of invitees. Of the initial group, some 60% of the firms agreed to join the program. Participation rates for the second and third groups were substantially lower, 15% and 12% respectively. 1,300 of the 8,100 firms invited to join the 33/50 program accepted their invitation, some 16%.

The 33/50 program was purely voluntary, and had much less stringent requirements than many European environmental agreements that are also characterized as voluntary.[5] Invitees were recognized as participants when they pledged to the EPA in writing a corporate-wide commitment to a numerical reduction of any of the 17 program chemicals through 1995. However, there were no requirements for company commitments to conform to the overall goals of the program. Some companies pledged reductions of all 17 chemicals while other pledged reductions for only a subset of them. A small number of companies made commitments to reduce some non-33/50 chemicals. Also, the companies were allowed to pledge a commitment to whatever reduction they deemed appropriate for the firm. That is they did not have to commit to a reduction schedule that mimicked the 33-50 nature of the program.[6] In addition, as noted in the previous section, failure to meet their pledges carried no sanction from 33/50 program administrators, the EPA in general or any other federal or state agency.

In return for their pledge to join the 33/50 program firms received from the EPA informational support on pollution prevention in the form of workshops and conferences attended representatives of industry, government, academia, and public interest groups. Technical assistance on emerging pollution prevention technologies, and waste management control practices (tailored to the needs of specific industries) was also offered to 33/50 participants. Closer connections with regulators, and positive publicity were also features of the 33/50 program. The EPA published media relations, documents and newsletters that highlighted 33/50 participants which were successful in producing reducing their toxic emissions reductions. While this information was publicized to media outlets, they would have been read most attentively by environmental groups, and federal and state regulators.

Since its conclusion in 1995 the EPA itself has declared the program a success. The interim goal of a 33% reduction in emissions and releases of program chemicals was achieved a year ahead of schedule. The same was true for the overall program goal of a 50% reduction (releases and

[5] See Lyon and Maxwell (1998) for an overview and comparison of voluntary environmental programs in the US and Europe.
[6] Davies and Muzurak (1996) note that the EPA even abandoned the spirit of corporate-wide reduction commitments allowing firms to join if anyone of its production facilities made a reduction pledge.

transfers of program chemicals had fallen by 51% by 1994 from the 1988 base year). As far as achieving its goal of showing that voluntary programs work faster than command and control regulation, the EPA points to the following two facts. Participant companies reduced their chemical emissions at faster rates than non-participants, and program chemicals were reduced faster than other TRI chemicals.

Two views may be taken with regard to the program's success. The positive view is that the program achieved considerable success given the very weak, to almost non-existent sanctions for firm failures to meet their own goals. However if one recall the careful way in which both chemicals and invited companies where chosen, their ability to self-select into participation, and the EPA's publicly stated *goal* of program success, one might take the view failure to meet goals was almost impossible.

A particularly important criticism of the program concerns the use of 1988 as its base year. The program was initiated in 1991, but TRI data show that facilities began reducing their emissions at least by 1988.[7] In fact Citizen's Fund (1994) reports that 83 percent of all facilities reporting to the TRI had begun reducing their chemical emission by 1988. This suggests that the use of 1988 as a base year is in appropriate in analyzing the Program's impact. Davies and Mazurek (1996) found participant reductions of program chemicals over the period 1991 to 1994 were 27 percent compared to a measure of 51% using the 1988 base year.

In addition to this simple criticism regarding the base year, a more complex one of self-selection also arises, which in turn makes evaluation of the Program's effectiveness difficult. While firms were no under direct pressure to meet specific reduction goals, pledges were public knowledge. The implication is clear that only companies pledging reductions some where close to, or exceeding, the program's goals would receive and positive publicity. This fact coupled with knowledge of their own emissions performance means that it is highly unlikely that participants would not outperform non-participants. The crucial question left unanswered however is whether program participation prompted participants to undertake greater reductions that they would without participating.

Another criticism the EPA faced was that, in its calculations of emissions reductions, it included both participating and non-participating firms. Both the GAO (GAO 1994) and INFORM (INFORM 1995) found that non-participating firms accounted for approximately 38 percent of the reductions

[7] Since data was first collected in 1987 it must be left to speculation whether emissions were on a downward trend prior to 1988.

in emissions of program chemicals. These facts weaken the EPA claim of the Program's success in achieving its stated goals.

Finally the 33/50 program has been criticized for its focus on emissions reductions generally, rather than on source reductions specifically. The EPA reports only a 1 percent reduction in 33/50 chemicals in production related waste, and a 9 percent increase in non-33/50 chemicals found in production related waste.

The various criticisms of the 33/50 program cast considerable doubt on its effectiveness as a tool with which to achieve emissions reductions.

In the subsequent section we review the relevant literature on firm motivations for engaging in voluntary pollution abatement. In addition, we provide an overview of existing studies of voluntary abatement and 33/50-program participation based on the TRI data set. Having reviewed this literature we propose several factors which should be included as emissions-reductions-motivating factors which we will include in our empirical investigation in section 4.

Studies of Self-regulation, 33/50 and the TRI

Several theories have been postulated to explain the voluntary abatement initiatives of corporations. Lyon and Maxwell (1998) provide a comprehensive overview of alternatives theories and empirical investigations of this type of self-regulation.[8] These theories include efficiency enhancement, green marketing initiatives, and regulatory preemption.

The first theory, efficiency enhancement, evolves out of the “win-win” environmental literature most closely associated with Porter (1991). This theory advocates that pollution emissions occur because of inefficient production, and investments (human and physical) which increase the efficiency of production will result in lower pollution emissions as a happy by product. The most frequently cited example in the “win-win” literature is 3M Corporation's “Pollution Prevention Pays” program begun in 1975. Under this program line workers became involved in identifying opportunities for waste reduction. Between 1975 and 1990 3M claims to have cut its total emissions by 50%. At the same time the company claims to have saved over $500 million dollars. These savings are claimed to have arisen from reducing raw material usage, and disposal costs. While these cost savings are in the spirit of the “Porter hypothesis,” a significant proportion of the estimated saving also arose from reduced regulatory compliance costs and the avoidance of tort

liability which are less in the spirit of Porter. The avoidance of liability and potential liability can be a strong motivation for corporations to alter their activities.[9]

As noted in the previous section, raw data indicate that the source reductions, associated with manufacturing efficiencies, are unlikely to have had a role to play in reduction of toxic emissions. While releases and transfers of 33/50 program chemicals fell by 42 percent between 1991 and 1994, the amount of these chemicals found in production related waste fell by only 1 percent over the same period.[10] The notion that firms may have engaged in toxic emissions reductions in order to avoid liability is an interesting one. As Konar and Cohen (1998) point out, emissions of all chemicals tracked by the TRI are perfectly legal. However, if firms took the collection of the TRI and/or the implementation of the 33/50 as a signal of future regulations or laws, which might eventually involve tort liability, then there may be some motivation for toxic reductions emanating. These motivations then would be more correctly place under the third category of motivations of emissions reductions- the avoidance of future regulations.

One of the most common hypothesis for corporations to engage in voluntary reductions is that of green consumerism. This hypothesis has been considered formally by Arora and Gangopadhyay (1995), and Bagnoli and Watts (1995). Their models are based on the models of vertical differentiation of Gabszewicz and Thisse (1979), Shaked and Sutton (1982) and Ronnen (1991). Most models of vertical differentiation predict that, left unregulated, some firms will engage voluntarily in product quality enhancements in order to maximize product differentiation and therefore reduce price competition.. Thus if toxic emissions reductions specifically or cleaner production processes generally are known to and valued by consumers, these models provide an explanation for voluntary abatement.

Whether TRI reductions can be linked with green consumerism, is an interesting question. Especially with regard to the 33/50 program. There are several aspects of the program which call into question the green consumerism hypothesis. The first is that firms at all stages of production joined the program and engaged in voluntary emissions reductions. Second, many firms engaging in emissions reductions did not join the program, forgoing the free publicity. This suggests that many firms placed a low value on the publicity they would receive from joining the Program. Finally, although the EPA produced some publicity for participant companies this information was not widely disseminated to the general public. It is highly unlikely that

[8] This section is based on their overview, and focuses on the implications of the literature for the study of the effectiveness of the 33/50 program in particular.
[9]This is especially the case in the United States where extremely large court awards for proven damages are not uncommon.
[10] EPA (1996).

environmental experts not actively associated with the 33/50 program could name with certainty more than 10 (or of the total 8100) Program participants, let alone a member of the general public. Further asking the public to understand and keep track of 33/50 toxic reductions, and use this information while making product purchase decisions is highly dubious.

It is more likely to be the case that program participation was widely known to state and federal regulators. In addition, it is believable that these individuals would have some idea what companies were the states largest toxic emitters, and those that were making significant progress in terms of emissions reductions. Environmental groups are also much more likely than the general public to keep track of TRI emissions and 33/50 program participation.

Knowledge of toxic emission levels of firms by state regulators and environmental groups may not have much impact on corporate sales to consumers, however corporations may feel pressure to clean up due to possible future regulatory or enforcement actions. Convincing evidence exists which suggests that regulatory pressures do motivate firm decisions to engage in voluntary actions. In their 1997 report on voluntary environmental agreements in Europe (EEA 1997), the European Environmental Association consistently sights better relations with regulatory agencies as a prime motivator for the various voluntary agreements under study.

Maxwell, Lyon and Hackett (1998) propose the preemption of future regulations as a motivation for firm and industry engagement in voluntary pollution abatement. They show that voluntary abatement may be profitable for an industry (or firm) if it can be used as a substitute for stricter relations which would arise from the traditional legislative process. Voluntary abatement works in their model because it mollifies consumers (who have a diminishing marginal utility of consumption) weakening their demands for incremental mandatory abatement. At the same time, is strengthens firms' commitments to fight against incremental legislation.[11] If consumers face costs of entering the political process, then voluntary abatement by industry can preempt them.

Hanson (1996) develops a model of voluntary agreements motivated by preemption. In his model however, it is the legislature that is preempted by a voluntary agreement between the government's environmental agency (e.g., the EPA) and the industry organization. Thus, in both Hanson (1996) and Maxwell *et. al.* (1998) legislation is preempted and it is the threat of this legislation which motivates the voluntary efforts on the part of the industry.

[11] This occurs because firms have already engaged in voluntary pollution abatement, and as such, the marginal costs of further abatement to them are higher than they would be without voluntary abatement.

Thus the theoretical literature leaves us with three basic motivations for voluntary environmental efforts on the part of industry. First, the efforts are motivated by efficiency enhancement/cost reduction due to tort liability reductions or simply because cleaner production methods are cheaper. Second by revenue enhancement via green consumerism, and finally voluntary efforts are motivated by the desire to preempt future, and more costly, regulation. We turn now to a short overview of previous empirical studies of the 33/50 program or the TRI in general.

The works of Arora and Cason (1995) deal with firm motivations to join the 33/50 program. They find generally that large firms, which are large polluters, are more likely to join the 33/50 program. The authors interpret this as support for the 33/50 program. The implicit assumption here is that participation in the 33/50 program works to motivate reductions in toxic emissions beyond the levels that would have been undertaken absent participation. Since the findings are taken as support for voluntary programs in general, the implicit assumption is that voluntary programs (even those without explicit firm level targets) work to induce firms to undertake abatement efforts which exceed a business-as-usual scenario. This hypothesis, however, is never tested directly by the authors.

Studies that examine directly TRI emissions reductions are Konar and Cohen (1998), Maxwell, Lyon and Hackett (1998) and Hamilton (1995). Of these, both Konar and Cohen, and Hamilton examine the impact of the TRI release on the stock market performance of reporting firms. By examining abnormal returns on the day of the intital release of TRI information on 1987 releases (June 19, 1989), Hamilton finds that polluting firms lost an estimated $400 million dollars in value. Konar and Cohen using a similar methodology find, interestingly, that the highest polluters did not experience the biggest abnormal returns. This suggests, as one would expect from financial market theory, that traders reacted most to the unexpectedly high releases rather than the simply quantities of chemicals released.

Konar and Cohen find, by comparing 1989 and 1992 emissions of the 40 firms experiencing the largest negative abnormal returns (Top 40): 21 lowered their ranking (in terms of being the top polluter, measured as TRI emissions per revenues), 7 remained unchanged and 12 increased their rank. The authors also found that in 1989 the Top 40 firms had TRI emission per dollar revenues nearly twice as high as the weighted-average of the non-Top 40 firm. By 1992 the top 40 firm had cut their emission per dollar revenues nearly in half brining them in line with the non-Top 40-weighted sample. Finally, the authors found statistically significant evidence that the Top 40 firms improved more than their non-Top 40-weighted counterparts in environmental performance measure other than toxic reductions.[12]

[12] For example, in terms of average spill volumes per dollar revenues,Top-40 firms exhibited greater (statistically significant) reductions over the sample period than their non-Top 40 counterparts.

It is interesting to note that in examining the action of the largest 40 TRI emitters (per dollar revenues) the authors found no statistically significance of emissions reductions between 1989 and 1992.[13] It is interesting to contrast this finding with the findings of Arora and Cason (1995) that the largest emitters were more likely to join the 33/50 program. These two findings, taken together, also cast some doubt on the effectiveness of the 33/50 program in prompting emissions reductions.

Summarizing, Konar and Cohen find that firms with the largest negative abnormal returns on the day of the first release of TRI emission information could be characterized as follows. First, they were large, but not the largest TRI emitters. Second, they subsequently reduce their TRI emissions more that other firms in their industry. Third they significantly greater attempts at improving their general environmental performance than did non-Top 40 firms. Finally they had a lower chance of receiving higher fines from the government in subsequent years.

The Study of Konar and Cohen provides much support for the notion that the release of new information about polluting activities brings subsequent pressure on firm managers to improve poor environmental performance. The study does not, however, address the question of what the forces driving stock price devaluation and managerial responses are. An answer to this question is key to understanding whether 33/50 participation is a significant factor contributing to voluntary reductions or whether it only appears significant because of the self selection bias associated with the program.

Two empirical studies attempt to bridge the link between concrete (costly) voluntary actions, and the motivations behind those actions. Hart and Ahuja (1996) examine whether TRI reductions between 1989 and 1990 contributed positively to firm financial performance in the 4 years subsequent to 1989. Maxwell, Lyon and Hackett (1998) aggregates TRI data to the state level and examine whether reductions in TRI releases over the period 1987-92 were prompted by state-level differences in regulatory threats.

The main hypothesis underlying the Hart and Ahuja paper is closely related to the so-called Porter hypothesis. That is the collection and release of TRI information will refocus management efforts on pollution control and, as a result, firms may find less polluting means of production that are also more profitable. Using various methods of financial performance (i.e., return on assets, equity, capital and sales) the authors find some support for the fact that firms which cleaned up

[13] Note that there are very few firms that appear both in the Top 40, and the list of the 40 largest TRI emitters.

the most, subsequent to the initial release of TRI data, experienced greater than average returns in subsequent years. While their results generally support the Porter hypothesis, the authors point out the one major difficulty in their interpretation---namely, the direction of causality between the returns and the emissions reduction performance. It is not clear whether the reduction in emissions resulted in better financial performance or whether firm which were financially stronger undertook greater emissions reductions. It is interesting to note that the measure of financial performance that yields greatest support for the hypothesis under test, return on sales, is the one that shows the greatest response to reductions in regulatory fines.

The authors find that all control variables enter with the expected signs. They also find, as expected, that the 89-90 emissions reductions impact negatively on financial performance in the initial period, but have a positive but diminishing effect on financial performance in subsequent periods. The strongest measure impact of the emissions reduction occurred in regressions in which the dependent variable was ROS which allows captures the impact emissions reductions would have on compliance costs. Finally the authors find, using a split sample based in emissions, that emissions reductions impact the bottom line much more significantly for large polluters than for smaller polluters.

Maxwell, Lyon and Hackett (1998) come closest to directly examining the link between actual costly voluntary efforts and the reasons behind those efforts. They aggregate the annual TRI data on releases to the state level, over the period 1987-92. The authors contend that emissions reductions are motivated by regulatory threat. They consider releases of the 17 33/50 chemicals, viewing the Program as one indication of the EPA's concern regarding the specified chemicals and the invited firms.

Using several State-level control variables they examine whether a greater prevalence in environmental group membership within a State acts as a force motivating emissions reductions.[14] They find that most control variables enter with their predicted sign, with pressure variables including 1987 releases, income, education, water area population and the number of greens serving to induce greater emissions reductions. The value of 1987 shipments enters with a significantly positive coefficient, indicating that large industries with perhaps more political influence and therefore coming under less regulatory pressure, clean up less.

[14] Their control variables include the annual value of shipments for the 7 high polluting industries under consideration, per capita income, population, education level, the percentage of republican voters, land area, and water area. A dummy variable for California is also included. The data suggests that California is a special case, with abnormally low Chemical releases given the size of its economy.

While Maxwell, Lyon and Hackett conduct their analysis using the 33/50 program chemicals they do not make a distinction between 33/50 participant firms and non-participants. Consequently they cannot address the question we consider here, namely whether 33/50 participation was effective in promoting emissions reductions. ****** In the subsequent section we take an initial step towards a formal analysis of the effectiveness of the 33/50 program. We do so by examining releases and transfers of 33/50 and non-33/50 chemicals by program participants and non-participants.

Empirical analysis of TRI Emissions Reductions

In this section we will address our two main points of inquiry, namely whether the 33/50 program is a significant factor contributing to 33/50-chemical emissions reductions, and whether the program diverted efforts away from emissions of non-33/50 chemicals. To examine these two questions we obtained data on annual releases of toxic emissions by firms reporting to the EPA's TRI for the years 1988-1994.[15] The emissions data was broken into several categories including releases into air, land, and transfers off-site.[16] For each category we broke the data into emissions by 33/50-participant companies and non-participant companies, allowing us to address the first question. Finally, for each category we examine reductions of 33/50 chemicals and non-33/50 chemicals, allowing us to address the second question.

The theoretical work on voluntary reductions suggests that Program participation may be one of possibly several factors motivating firms to engage in emissions reductions. Indeed, if the Program is effective at all, it is likely to be because participation simply heightens the importance of these other factors. For example, if the underlying reason for a firm to engage in voluntary emissions reductions to avoid future regulations, then joining might serve to raise the likelihood of regulatory avoidance in the event of strong emissions reductions. In this way the marginal return to emissions reductions efforts rises, and Program participants will undertake reductions than the would had they not joined the program.

Broadly speaking, the motivating factors can be placed into 3 categories. First, factors which heighten the threat of future regulations should voluntary efforts fail. Second, external factors that make voluntary emissions reductions less costly, or even profitable, such as green consumerism.

[15] Although TRI data is available for 1987, the data reported in this year is considered to be unreliable. And was therefore not used.
[16] We conducted empirical examinations of water releases, but found generally that our explanatory variables were unable to explain the water reductions.

The final factor motivating voluntary emissions reductions is the internal or innate profitability of "greener" production methods.

We examine the effectiveness of the 33/50 program as follows. We regress percentage emissions reductions on several explanatory variables which proxy for the motivating factors just discussed, and on a dummy variable indicating participation in the 33/50 program. To account for the criticisms mentioned above, we examine for each category of emissions reduction (e.g., reductions of 33/50 chemical emissions to the air) the percentage reduction between 1988 and 1994, and also between 1991 and 1994.

Factors motivating firms to engage in emissions reductions may occur at the firm (financial health, past emissions levels), industry (distance from end consumers in the production stream), state (existing state regulations and regulatory behavior) or national (threat of future regulation) level. For the present study we examine state and national motivating factors, leaving firm and industry factors for future studies. Doing so allows us to examine the complete TRI data set. If, for example, we wished to include factors such as firm financial performance, previous studies have shown that the number of firm omitted due to lack of data is severe.[17] The drawback, of course, in not using firm and industry characteristics is that if these characteristics motivated firms to undertake voluntary reductions efforts and to therefore join the 33/50 program then 33/50-participation dummy variable will capture the significance of these variables as well. This mean the tests are biased against rejecting the hypothesis that the 33/50 program had no effect on voluntary emission reduction efforts.

Since we use mainly state level variables as explanatory variables, we aggregate percentage emissions reduction by participants and non-participants to the state level. Our explanatory variables are taken from Hall and Kerr (1991), and various annual issues of the *Statistical Abstract of the United States*. The main explanatory variable of interest is the dummy variable indicating participation in the 33/50 program. The other explanatory variables included are as follows. Income is the average state-level median income over the sample period. Theories of voluntary efforts suggest that since a clean environment is a normal good, emission reductions should be greater in states where consumers are wealthier.[18] Education, as measure by the percentage of the population within each state holding a Baccalaureate or higher degree would also be expected to be a factor pressuring firms to engage in emissions reductions. The

[17] For example of the 1300 firms participating in the 33/50 program, Arora and Cason were able to include only 189 participating firms in their study of the decision to join the Program when they included firm level characteristics as explanatory variables.

percentage of the state workforce that is unionized may serve to lessen voluntary reduction efforts since union may assist firms in blocking future legislative efforts. Envprog, represents the number of existing state environmental regulations in 1987 which promoted pollution reduction efforts by firms. Rtkaid (right-to-know aid) is a dummy variable indicating states that had in 1987 legislation reducing the costs borne by consumers and environmental groups to discover information on the polluting activities of firms. The coefficient sign for these two variables can be argued from either side. For example, existing programs and right-to-know aid may indicate the states willingness to legislate firm activities in the future and thus one would expect them to have a significantly positive effect on emissions reductions efforts.[19] However, one could also argue that these factors had, by 1988, already lead to cleaner production making further emissions reductions efforts more costly for firms. Pop (State population according to the 1988 census) may be expected to contribute positively towards emissions reduction efforts. Controlling for State land area as we do, a larger population would raise the marginal value of emissions reduction efforts raising the likelihood of legislation should voluntary efforts fail.

Land and Water area (the latter measure as surface area within a state) are also included, and would be expected to have opposite impacts on voluntary reduction efforts in some cases. For example if one measures releases of toxic chemicals to the land, the greater is the state land are, *ceteris paribus*, the more places there may be to dispose of the chemical safely. Toxic chemicals may travel great distances through water however, prompting greater concern over the polluting activities of firms, and leading to more pressure to engage in voluntary reduction efforts. Vot88 is a measure of the percentage of the eligible state population that voted in the 1988 presidential election. The expected sign of the coefficient of this variable is not clear. On the one hand, it may be argued that this variable is a proxy for political activism in the state and therefore acts as a pressure variable towards emissions reductions. However since we control also for the degree on conservation membership within each state, one might argue that this variable is capturing the degree of activism not accounted for by those individuals likely to push for environmental legislation. In this regard this variable might contribute negatively towards voluntary reduction efforts. Finally, as mentioned we control for cross-state differences in conservation membership by including the state rank of per capita membership in environmental groups as measure by Hall and Kerr (1991). Again, the impact of this variable may be argued from both sides. State with a greater number of environmentally concerned individuals may be more likely to pressure firms to reduce their emissions in the future, or may represent a greater market for green products.

[18] This may be because consumers are likely to pressure for new legislation if voluntary efforts fail, or because consumers are likely to purchase greener products. Given the mobility of goods produced in the US, however, the latter explanation is less likely.

[19] The assumption here, of course, is that it is cheaper for firms to engage in voluntary emissions reductions efforts and avoid legislation than to comply with future regulations.

However, if such pressure has already resulted in greener production processes further reduction efforts are likely to be more costly.

Our primary goal here is not to predict the signs of the various pressure variables included in this study. It is instead to determine whether controlling for other factors influencing firm decisions to reduce toxic emissions, participation in the 33/50 program remains as an important factor contributing to emissions reductions. To this end, we ran several regressions of percentage emissions reductions on the explanatory variables just discussed. Using various combinations of percentage reductions in emissions to air and land of 33/50 and non-33/50 chemicals over the two sample period we ran a total of 8 regressions. Regressions indicated some heteroskedasticty and White-corrected standard errors we used. Multicollinearity was not a problem in any regression, with correlations between independent variables being generally below .3 and with the highest being .67 between state land and water areas. While the regressions are of course quantitatively different the qualitative results are similar. We include various regression results in the appendix and provide an overview of the results here.

While most regressors enter with the predicted sign (where clear predictions have been indicated) they are frequently statistically insignificant. We found that income and education consistently serve to pressure firms to engage in voluntary reduction efforts, however the education variable is only statistically significant for non-33/50 chemical reductions. Unionization acts to limit emissions reduction efforts, however it too is only found to be significant in affecting non-33/50 chemical reductions. States with a higher conservation membership rank generally exhibit less emission reduction whether the reductions are measured over the entire sample period or between only 1991 and 1994. The land and water area variables often enter with the predicted sign and land area is a significant factor in explaining land releases of non-33/50 chemicals. It is interesting to point out that the variable with most consistency in explaining reduction of 33/50 chemicals is Envprog. That is it appears that states with existing environmental programs were the ones that reduced their emissions of 33/50 chemicals the most. This is not the case for non-33/50 chemicals. Two explanations for this phenomenon are possible. The first is that existing regulations are a strong signal of future regulations. The second is simply that existing state regulations were either directly or indirectly influencing the reduction of the 33/50 chemicals. In either case the result call into question the value of 33/50 participation.

The variable of principle interest in this study, 33/50 participation, is found to cause reductions in air releases over the period 1991 to 1994 for both 33/50 and non-33/50 chemicals. However the variable performs inconsistently in the other tests. In fact in the regressions which best fit the data, namely releases of non-33/50 chemicals to the land, program participants are found to lag

non-participants in reductions. For the sample period 1991 to 1994, program participation was found to have an insignificant impact on land releases on non-33/50 chemicals. Program participation is also found to have an insignificant impact on releases of 33/50 chemicals to the land, once other pressure variables are taken into account.

Conclusions

The EEA's 1997 report on Environmental Agreements suggests that for such agreements to be effective, minimum criteria of credible reporting of participant performance and well defined goals are necessary. The present paper illustrates the difficulties in defining program success in voluntary agreements even when such criteria are met. As the present paper discusses there are many factors pressuring firms to engage in toxic emissions reductions.

This paper represents a preliminary step in the formal evaluation of the impact of participation in a voluntary program, namely the EPA's 33/50 program. Results suggest that once other pressure factors have been taken into account, participation in the 33/50 program generally fails to be a significant factor contributing to TRI emissions reductions. Furthermore, there is some evidence that the 33/50 program may have refocused the efforts of participating firms towards the elimination of air releases of the designated chemicals to the detriment of other releases. Alternatively, the results may simply show that those firms which were best suited to reducing 33/50 chemicals joined the program, while those best suited to making other reductions did not join the program.

A more thorough study of the effectiveness of the 33/50 program should consider more firm and industry-level factors that would influence firm decisions to reduce their toxic emissions. However, given the fact that participation in the program is voluntary, inclusion of these variables is likely to diminish, rather than enhance the significance of program participation in emissions reductions.

Putting the statistical evidence aside, we have seen that there is abundant evidence that the claimed successes of the 33/50 program have likely been overstated. It seems clear that the setting of targets and the monitoring of performance is a worthy goal, but care must be taken in ensuring that the targets do represent a significant improvement over the "business as usual scenario". The facts that emissions were dramatically different over the two sample periods (with a significant drop off over the latter period) and that non-participants came close to meeting program goals suggests that the program did not require participants to stretch beyond the business as usual case.

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Appendix

Regression Results

Dept.Var.	88-94 33/50 Air Rel. % Reduc.	91-94 33/50 Air Rel. % Reduc.	88-94 33/50 Land Rel. % Reduc.	91-94 33/50 Land Rel. % Reduc.	88-94 non-33/50 Air Rel. % Reduc.	91-94 non-33/50 Air Rel. % Reduc.	88-94 non-33/50 Land Rel. % Reduc.	91-94 non-33/50 Land Rel. % Reduc.
Indep. Vari.								
Dmy 33/50	-.06094 (0.669)	.27754 (0.069)*	1.555 (0.452)	-.2347 (0.908)	-.1603 (0.098)*	.24086 (0.002)†	-.21220 (0.620)	-.34221 (0.424)
Income	.000027 (0.128)	.00003 (0.081)*	.0005 (0.043)ŧ	.00034 (0.158)	.00001 (0.381)	3.9e-06 (0.672)	.00006 (0.227)	.00015 (0.006)†
Educat.	.074512 (0.194)	.02836 (0.640)	-1.001 (0.186)	.31905 (0.665)	.0237 (0.053)*	.03045 (0.305)	.13039 (0.426)	.27896 (0.091)*
Union	-.00419 (0.594)	-.0089 (0.285)	-.0428 (0.661)	-.0436 (0.650)	-.0038 (0.074)*	-.00597 (0.145)	-.02993 (0.170)	-.05842 (0.009)†
Envprog	.056906 (0.008)†	.06848 (0.003)†	-1.759 (0.563)	.6747 (0.028)ŧ	.01764 (0.225)	-.01763 (0.116)	.06730 (0.277)	.07030 (0.256)
Rtkaid	-.12934 (0.526)	-.3379 (0.121)	-1.792 (0.516)	-.8558 (0.752)	.1078 (0.445)	.02647 (0.807)	-.28378 (0.631)	.26597 (0.652)
Pop	-.16510 (0.253)	-.1583 (0.301)	4.086 (0.029)ŧ	-2.944 (0.106)	-.0727 (0.495)	-.01908 (0.800)	.81322 (0.048)ŧ	1.1472 (0.006)†
Land	1.2e-06 (0.558)	3.2e-06 (0.157)	-.0001 (0.069)*	.00005 (0.064)*	-2.3e-06 (0.114)	-1.5e-06 (0.174)	-9.1e-06 (0.107)	-.00003 (0.000)†
Wat	.000023 (0.691)	9.9e-06 (0.875)	-.0002 (0.828)	-.0006 (0.390)	.00006 (0.136)	.00002 (0.412)	.00078 (0.000)†	-.0010 (0.010)†
Vot88	-.01827 (0.283)	-.00717 (0.691)	.1325 (0.557)	-.2676 (0.032)ŧ	-.00621 (0.577)	.00344 (0.687)	.03870 (0.438)	.13141 (0.049)ŧ
Cmemr.	-.01827 (0.026)ŧ	.02706 (0.030)ŧ	-.2568 (0.112)	.34363 (0.032)ŧ	-.01093 (0.177)	-.01524 (0.015)ŧ	.01682 (0.615)	.06693 (0.002)†
Cons	-1.2085 (0.286)	-1.7662 (0.143)	15.084 (0.348)	-12.13 (0.442)	1.138 (0.145)	1.085 (0.071)*	-3.686 (0.262)	-10.794 (0.200)
R-sq.	.31	.36	.35	.25	.28	.34	.40	.45

Note: P values are given in parentheses, not standard errors or t-statistics.

* denotes significance at "=.10

ŧdenotes significance at "=.05

† denotes significance at "=.01

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