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Note from the Field

The experiences of four corporate officials managing compliance with the Massachusetts Toxics Use Reduction Act

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ABSTRACT

The Massachusetts Toxics Use Reduction Act (TURA), one of the original pollution prevention laws, has faced repeated repeal attempts and budget cuts. Yet the Massachusetts toxics use data and other analyses have provided firm indications that the law has actually worked. Though the program has survived it is notable that an approach that both saves money and reduces pollution has been reduced and not expanded. This paper does not attempt to answer the question of why the strategies of TURA have not seen wider application, but offers four stories to illustrate what happens when they are properly applied. The experience of corporate officials who had to comply with TURA, related at a symposium on the occasion of the law's 20th anniversary, shed light on how a strong pollution prevention law can benefit regulated companies as well as the environment and worker and public health, and provide suggestions, in addition to data and surveys, that TURA-like sets of governance tools should receive wider consideration.

1. Can an environmental law be good for manufacturing?

After the Massachusetts legislature passed the Toxics Use Reduction Act (TURA) unanimously in 1989, many worried that it would have a negative impact on manufacturing in the state. Although the bill had been crafted by a diverse group of stakeholders including prominent business representatives, in 1992 a new trade association, (the Massachusetts Chemistry and Technology Alliance (MCTA)), was created to represent companies using chemicals in the state, and began a long-term campaign to repeal or substantially modify the law. The primary lobby for manufacturing in the state, the Associated Industries of Massachusetts, had already formed and held regular meetings of a "Toxics Use Management" committee, (note: *use management* as opposed to *use reduction*). Although both organizations consistently promoted environmental responsibility, both criticized the specific requirements of TURA, with MCTA sponsoring several legislative attempts to repeal or radically alter the state's program. None of these bills succeeded and when in 2006 the Act was amended, none of the features causing complaints – its focus on input substitution, documentation of biennial TUR planning, the requirement that certified Toxics Use Reduction Planners (TURPs) certify the TUR plans, the public reporting of chemical input, and the fees for chemical use – were removed.[1]

Rather, flexibility was provided to companies covered under the act to do Resource Conservation planning instead of TUR planning if they had already done several TUR plans, and to incorporate TUR planning into Environmental Management Systems if they had them in place. None of the basic principles or aims or mechanisms of the law were changed. Its basic approach was *expanded.* It is possible that this is because critics of TURA as it has been implemented did not make a sufficiently forceful case for a basic change in the fundamental strategy of the law. But it is also possible that whatever the merits of their arguments, the TURA experience has by and large been positive for companies covered by the law. Indeed, the Massachusetts TUR data and some surveys have provided quantitative indications that the law has been successful in reducing pollution, and that many covered by it have ended up saving money and sometimes jobs, and that the act has prompted upgrading, operational improvements, and information sharing between

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[1] TURA requires large chemical users to do "TUR plans" – which means that they document an examination of their chemical use and opportunities for using less, including "input substitution", (which means using another chemical), or using chemicals more efficiently. These plans must be certified as adequate by a trained "TUR Planner". The act also provides for significant assistance and educational activities, and requires that companies covered by the act pay a fee for using toxics and submit reports on their use, waste and releases.

companies and between companies and government.[2] Companies testified at hearings on bills to repeal TURA that its program services had been useful. When the program faced budgetary reductions in 2008 and 2009, dozens of companies wrote to the governor and the state's environmental secretary to ask that the program be fully funded.[3] Many anecdotes from case studies, awards and recognition programs, the on-site visit and laboratory analysis services, and the many educational events of the TUR program provide indications that it has created good solutions to vexing compliance and risk issues.[4] Nevertheless, the policy response to these indications has not been widespread adoption and scaling up of what appear to be effective tools of environmental governance.[5]

This article reviews some of the indications that the TURA example is worth consideration for more widespread application, and introduces four examples of how it works in practice. There is already a robust anecdotal literature on pollution prevention[6] and much has been shown to merit closer consideration of preventive governance tools such as chemical-input reporting, planning, and concerted assistance and education.[7] It is possible to speculate on why the apparent success of TURA and programs like it, even if illusory, has not prompted more frequent attention to its methods as options for agency mandates. The widespread assumptions that corporations already act in self-interest to be as efficient as they can be, and government should not intervene in the market, may dampen impetus to further explore how well TURA-like approaches could work. Doubt about the credibility of the program's claims of success, raised by the Chemical Manufacturer's Association and others, may have also played a role.[8] It is also possible that it is hard to picture just how something like TURA really works. This might make it harder to see its value and importance, and prevent incorporation into an accepted canon of essential elements of environmental governance. This article is another attempt to supply some illustration. The four professionals managing corporate responses to TURA were some of the first who ever had to perform the task, and they shared their stories at a symposium reviewing TURA's 20th year, held in Massachusetts in November, 2009. Their stories encompass an historical perspective from the beginning of the problem up to the present, and thus are not "snapshots" in time. Three had very positive stories to tell (for example, savings of more than a million dollars per year for one company), and one had a more mixed by generally positive story. Their stories do not answer the question of whether something like TURA will work every time, for every similar problem, but they help show how the idea can work.

TURA does not require any specific toxics use reduction. It focuses on thinking about the issue of toxics use and the opportunities to reduce, providing drivers and assistance – arguably a more gentle push and pull than more conventional command and control regulation.[9] What it requires has been described as using "mandatory self-monitoring to induce firms and citizens to acquire information that reveals problems and possibilities for their solution."[10] Perhaps we are too habituated to thinking of environmental governance as being about defining clear and universal standards and policing compliance. These stories show another version of standards, more flexible, stimulating beyond compliance performance; and another hand of government (assistance and education), more user-friendly, complementing enforcement. If the four officials whose stories are related here were the only ones to have had good experiences with the law and the program, it would still be important to understand this strategy and learn how to make it work, for unless you believe that companies are already as efficient as they can be, there is a logical basis to it. If a company has not become efficient in its use of toxic materials, the Act's intrusion should not be regarded as untoward, for what it causes them to examine will be worth the attention. If a company has already

[2] See General Indications of Massachusetts Success, below.

[3] Letters available upon request to OTA.

[4] For example, OTA case studies Acushnet Rubber Company, Brittany Dyeing and Printing, etc. at www.mass.gov/eea/ota, (click to Education and Outreach, then Publications). See also the resources at www.turi.org, the website of the Toxics Use Reduction Institute. Of especial interest is the recent *Toxics Use Reduction Act Program Assessment, 2009:* www.turi.org/policy/ma_tura_program/tura_program_assessment. For an independent description of how the TURA program holds lessons for better environmental governance, see O'Rourke, Dara, and Lee, Eungkyoon; *Mandatory Planning for Environmental Innovation: Evaluating Regulatory Mechanisms for Toxics Use Reduction*, http://nature.berkeley.edu/orourke/PDF/TURA.pdf. "By analyzing the underlying mechanisms of TURA, a start can be made to generate hypotheses, admittedly preliminary at this time, on how regulation can motivate firms to innovate, how regulation can support learning within firms and among regulators and how regulation can support implementation of innovative environmental practices."

[5] Indications of not scaling up: 1. EPA not going forward with national chemical use reporting: see EPA's Toxics Release archives, http://www.epa.gov/tri/archive/1990s.html, under 1997. The TRI Phase 3 fact sheet notes: "EPA believes that chemical use information could expand the public's ability to evaluate a range of important environmental issues." EPA issued an Advance Notice of Proposed Rulemaking (ANPR) at 61 Federal Register 51321–51330 but did not issue a proposed rule. 2. EPA's 2010 P2 Grant program Request for Proposals offered only $4.1 million nationwide, in contrast to the 1990 Pollution Prevention Act authorization of $8 million from 1991 to 1993 for P2 grants to the states (42 USC 13109). These grants have been competitive and require match, in contrast to base grants for activities considered essential.

[6] See, for example, http://www.p2rx.org/new_home/case_studies.cfm; http://www.p2.org/wp-content/road-to-sustainability-2004-20062.pdf; http://www.newmoa.org/prevention/pubs.cfm; http://www.pprc.org/pubs/pubslist.cfm.

[7] The 1997 TURA program evaluation by Abt Associates, overseen by TURI, for example, showing benefit to companies covered by the Act (http://www.turi.org/policy/ma_tura_program/1997_program_evaluation), and the 2006 evaluation by OTA of TURA data, showing that companies visited by MA OTA's assistance program reduced significantly more toxics use and waste than those not visited by the program. *The Effect of Providing On-site Technical Assistance for Toxics Use Reduction*, 2006: http://www.mass.gov/Eoeea/docs/eea/ota/programs/ota_effectiveness_study_final_2006.pdf. (Reibstein, principal author).

[8] CMA claimed that TURA success in fact represented economic slow-down and not true reductions in toxics use. Concerning slow-down, the Massachusetts Department of Environmental Protection uses company-reported data to adjust for production. The data shows substantially less toxics being used *after accounting for changes in the amount of work performed*. The impact of company shutdowns, which involves companies leaving the system, is not so easy to assess from the TURA data. Using information from follow-up to companies dropping out of the program and web-searches, OTA established in 2006 that for most years of the program the impact on reductions from company shutdowns has been minimal. "In 1999, the maximum percentage of reduced pounds of toxics use that could possibly have been due to business shutdowns was less than one percent. In 1997 it was less than five, and in 1995 it was less than three. Only in 1998, when the maximum possible amount was 19.3%, and in 1996, when it was 27%, could the shutdown factor have possibly contributed anything meaningful to the measured changes in performance." *The Effect of Providing Onsite Technical Assistance,* p. 3.

[9] It is critical to note that TURA does not replace but supplements existing regulations such as Clean Air Act, Clean Water Act, etc.

[10] Karkkainen, Fung, and Sobel, After Backyard Environmentalism: Toward a Performance-Based Regime of Environmental Regulation, *American Behavioral Scientist*, Vol. 44, No. 4, December, 2000, p. 696. "Taken together, plans, planners, TURI, and OTA create an inspection regime in which current conditions in individual firms or industrial segments can be compared with each other and with expert understanding of best practices, even as that understanding improves through exposure to innovative firms. Finally, applying the pragmatist principles of adjustment of means and ends to these novel institutions themselves, TURA provides a high-level governance structure that periodically suggests modifications in services and reporting requirements in light of its evaluation of progress toward the act's overall reduction target." http://www.archonfung.net/papers/FungAmBevSci00.pdf.

become as efficient as it can be, then the TURA requirements should not be very burdensome. Except for the fees, the burden will consist of documenting what it has already done.

That the stories told in this paper are representative of many more who have passed through the TURA process, received assistance from TURA services, and ended up moving from resentment at being regulated to appreciation for the results, is shown in the extensive documentation created over the years, and the fact that there has been extraordinary participation in the voluntary aspects of the program.[11] These stories are clues to how we might more effectively address the risks of toxics in our society.

2. The general acceptance of pollution prevention concepts

In 1990 all fifty states in the United States had some form of a pollution prevention program, predominantly focused on providing assistance or education.[12] These voluntary programs were inspired by the concept that businesses would find cost-saving opportunities, and some would even find marketing advantages or benefit from the innovation prompted by a search for solutions to environmental problems in process and/or input changes (in contrast with leaving the process or input materials unexamined, and simply installing control equipment to mitigate pollutant releases).[13] Congress reinforced earlier work by EPA to instill a preventive strategy in state environmental programs,[14] stating in the 1990 Pollution Prevention Act that "Pollution Prevention is fundamentally different and more desirable than waste management and pollution control."[15] In 1992 the United Nations convened its conference on Environment and Development, at which participating countries adopted Agenda 21 and related conventions, a declaration by the world community of policies needed for sustainable development. Chapter 30 explicitly recognizes that cleaner production is a route toward improved manufacturing, and not just necessary for public health and environmental protection.[16]

Many companies had joined, and some led, this evolution in policy thinking, and in the mid-1990s pollution prevention concepts started to become arguably mainstream in the corporate world. This was well illustrated by the 1997 publication of *EcoEfficiency*, by the World Business Council for Sustainable Development. The book begins by noting that McKinsey consultants Noah Walley and Bradley Whitehead had written in a 1994 issue of the Harvard Business Review that win–win thinking, (in which environmental and economic aims are met at the same time), is "unrealistic",[17] but then proceeds to detail story after story of win–win examples and to elucidate the concept of "hidden costs", which helps explain why managers don't automatically find the most environmentally efficient solutions to production problems.[18] By 1999 the *Harvard Business Review* had published "A Road Map for Natural Capitalism", by Paul Hawken and Amory and Hunter Lovins, showing how preventive and whole-system design would result in the very win–win that had been doubted in the *Review*'s pages just five years earlier. These articles paralleled discussions that had been taking place in state and federal environmental agencies, at meetings of the State Roundtable on Pollution Prevention, conferences on "source reduction" and "waste minimization", and in the pages of *Pollution Prevention Review*, for several years.[19]

3. The limited spread of strong pollution prevention mandates

Despite widespread institutional acceptance of pollution prevention concepts, the spread of pollution prevention requirements in the United States has effectively been halted since the early 1990s. By the end of that decade, only 38 states had a statute concerning pollution prevention, only 18 of which had mandatory elements,[20] and the Clinton Administration's attempt to expand the Toxics Release Inventory (TRI) to require chemical-input reporting as performed in Massachusetts and New Jersey ("TRI Phase III") had been abandoned. Instead, purely voluntary partnerships had proliferated (for example, the EPA's 33/50 program, Climate Wise, Energy Star, the Environmental Leadership Program, and WasteWi$e).[21] In light of the tendency to implement voluntary approaches without

[11] Though no company has ever been required to have OTA on-site, and OTA has no inspection authority, its staff have made more than 3600 visits to about 1700 facilities, all by invitation.

[12] There appears to have been at least a twenty percent decline in states with P2 technical assistance programs: less than 40 states now list programs providing P2 assistance in the national directory of p2 programs at P2 Resource Exchange, (P2Rx™), a "consortium of eight regional pollution prevention information centers, funded in part through grants from EPA. These centers all provide pollution prevention information, networking opportunities and other services to States, local governments and technical assistance providers in their region." http://www.p2rx.org/programs/.

[13] For an example of strong skepticism applied to the notion that regulation can spur innovation, see: Shaw, Stroup, "Do Environmental Regulations Increase Economic Efficiency?", in *Regulation*, Vol. 23, No. 1, Spring, 2000. One of the companies mentioned as an example is one of OTA's case studies, the Robbins Company. The article notes that Robbins saved a few hundred thousand dollars a year moving to a closed-loop system, but fails to note that treating water for reuse also improved the quality of water input, reducing product reject rate. Robbins president Robert Chatel told OTA that the greatest benefit of ceasing water discharge was in productivity, a value far outweighing the reduction in water management costs.

[14] For example, in 1989 EPA gave Massachusetts $821,000 to expand an existing technical assistance source reduction program, provide technical assistance coordinated with a multimedia regulatory inspection program, and provide for outreach to generators and other states. EPA gave Rhode Island $763,000 to perform in-plant audits, document case studies, establish a library of waste reduction technologies and procedures, and develop training programs and seminars. And EPA gave the New England Waste Management Officials Association (NEWMOA) $630,000 to establish a regional information clearinghouse, provide state training and industry workshops, and develop options for source reduction for waste streams destined for resource recovery systems: http://epa.gov/oppt/p2home/pubs/archive/1989.html.

[15] 42 U.S.C.A. 13101(a) "Findings" (4).

[16] At 30.5, *Basis for Action*: "There is increasing recognition that production, technology and management that use resources inefficiently form residues that are not reused, discharge wastes that have adverse impacts on human health and the environment and manufacture products that when used have further impacts and are difficult to recycle, need to be replaced with technologies, good engineering and management practices and know-how that would minimize waste throughout the product life cycle. The concept of cleaner production implies striving for optimal efficiencies at every stage of the product life cycle. *A result would be the improvement of the overall competitiveness of the enterprise*. The need for a transition towards cleaner production policies was recognized at the UNIDO-organized Ministerial-level Conference on Ecologically Sustainable Industrial Development, held at Copenhagen in October 1991." (Italics added).

[17] Noah Walley and Bradley Whitehead, "It's Not Easy Being Green," Harvard Business Review, May–June 1994, pp. 46–52.

[18] O'Rourke and Lee state in *Mandatory Planning for Environmental Innovation* (noted above) that "it appears to us that industry consistently fails to implement even the 'low hanging fruit' of economically efficient pollution prevention options."

[19] For example, Massachusett's former Department of Environmental Management's Office of Safe Waste Management hosted four national conferences on Source Reduction of Hazardous Waste, 1984–7. No history of pollution prevention is complete without mention of the publication of *Serious Reduction of Hazardous Waste* by the former Office of Technology Assessment, 1986. http://www.fas.org/ota/otareports/topic/ghtopics/.

[20] *A Comparison of Voluntary and Mandatory State Pollution Prevention Program Achievements*, Heather Tenney, (Masters Thesis), Civil and Environmental Engineering, Tufts University, May 2000.

[21] Partnerships in Preventing Pollution, U.S. EPA 100-B-96-001, Spring 1996.

hard requirements it is important to note that production-adjusted reductions of waste averaged 51 percent in states with mandatory programs, as opposed to only 25 percent in those with purely voluntary programs.[22] A 2003 paper by a Harvard Kennedy School of Government researcher described the obstacle that seemed to stand in the way of acceptance of strong legal requirements for pollution prevention efforts: "The concept of the government requiring plants to evaluate their production process with an eye toward opportunities to reduce risk, but allowing plants the discretion to adopt only those activities that the plant finds profitable, appears at odds with the commonly held concept that plants act as profit-maximizers. If the plant is profit-maximizing it should always be reviewing its production processes and actively seeking and implementing cost-saving changes. If the regulation does not require plants to do anything that is not in their own best interest, how could government-mandated planning requirements change the outcome?"[23] The paper answered this question by noting that plants may not be optimizing, and then concludes through an analysis of TRI data that pollution prevention planning requirements have "had a measurable positive effect on the environmental performance of manufacturing plants", including "larger decreases in total pounds of toxic chemicals released" and a greater likeliness of engaging in source reduction activities.

There has been general acceptance of the concepts of pollution prevention, and there are other, related trends, such as increased attention to sustainability, energy efficiency, green chemistry, green buildings, and product stewardship. There is a recent trend toward bans or limitations on individual chemicals in Washington, Maine and other states (such as Bis-Phenol A or brominated flame retardants). There have been new requirements that state and federal agencies implement environmental purchasing programs. And enforcement agencies have widely adopted assistance modes, which can increase effectiveness if the deterrence message is not diluted, but is unlikely to produce the same results as a dedicated assistance provider.[24] EPA and state environmental agencies have also adopted explicit pollution prevention policies. But there has not been widespread adoption of strong pollution prevention legislation in the United States, at the state or national level, or expansion of on-site technical assistance programs. (For the purposes of this paper, "strong" pollution prevention programs are those that have mandatory planning of some kind to ensure P2 options are considered, chemical use reporting to ensure public scrutiny of performance and cognizance of risk, and robust assistance and educational programs to combat the tendency to do the minimum to comply). There is an opportunity cost of not having such programs. It is impossible to estimate that cost with any precision. However, the data shows that Massachusetts companies covered by TURA reduced at least half a billion pounds during the first decade of the program.[25] Such reduced use must have also led to reduced releases, spills, exposures and costs across the entire life cycle of the chemical, from extraction and refinement to shipping, storage, processing, use, and post-use disposition. Because of this, and many other indications that most companies were not hurt, but benefited from coverage, the Massachusetts example merits further scrutiny.

4. General indications of success in Massachusetts

In 1997 the state contracted for a study of companies regulated by TURA, and the results were widely touted in the pollution prevention field: total aggregated benefits to companies exceeded total aggregated costs.[26] Monetized costs to regulated companies were $76.6 million, while benefits were $90.5. It is important to note that capital investments of $27.1 million were included in the cost category, although no company is required to make such investments under TURA – only to evaluate their options. If these capital investments are removed from the cost category, because they were voluntarily made and are presumed to be good for business, it becomes apparent that *coverage under the act brought benefits to the companies about twice as large as costs.* It is also important to note that the benefits and costs were self-reported by the companies, and did not include quantification of benefits that have recurred over the years since implementation, or benefits that are not easily identified (such as reduced accident or liability risks) or quantified (such as improved relations with regulatory authorities, the public, staff, investors or business partners). A full assessment of the value of the act would focus as well on the many expected benefits to the community and the environment from reduced toxics use, and would consider the value of obtaining such benefits through comparatively efficient means.

A companion study looked closely at what happened to companies required to report and plan under TURA: "As a result of implementing their TUR projects, 67% (235 of 351) of respondent companies claimed they actually saw direct cost savings, for example, on materials use or waste disposal. Improved worker health and safety was the other major benefit of TUR implementation, a total of 66% (230 of 351) of respondents realized some improvements in this area."[27] The report notes that worker health and safety improvements lead to decreased worker sick days or accidents, which improve facility productivity and decrease other potential costs, such as insurance premiums. Nearly half of respondents (158) had reduced regulatory compliance requirements, more than a third (133) indicated that they "improved their environmental image", and more than a quarter (95) of respondents "realized marketing advantage, such as environmentally friendly products, from TUR project implementation."

One major point raised by critics[28] has been that although the process of carefully tracking chemicals and examining options for reducing use and/or byproduct often leads to design or operational improvements, such benefits decline over time as the available options are implemented, and some have claimed that the planning process (repeated every two years unless an alternative path is allowed) can become a valueless paperwork exercise. Although the program has noted that updating plans need not be as significant a labor as initial planning, some companies have cited the cost of

[22] Tenney, page 93.

[23] "Are Management-Based Regulations Effective? Evidence from State Pollution Prevention Programs", Lori D. Snyder, Regulatory Policy Program, Center for Business and Government, JFK School of government, Harvard University, RPP-2003-21, p. 5.

[24] Many companies will be unwilling to ask for assistance from the enforcer, or share information that might put them at risk. Besides being in a better position to establish a working relationship, dedicated technical assistance providers have concentrated expertise that inspectors, focusing on compliance and inspection time tables, may not have the time to develop.

[25] *The Effect of Providing Onsite Technical Assistance,* Abstract. "Data reported by companies covered by TURA shows that from 1993 to 2002, chemical input by all companies combined was approximately 500 million pounds less than what was expected. The study showed that for every company covered by TURA requirements that did not improve performance, there were nearly four companies that did improve."

[26] *Benefit–Cost Analysis of the Massachusetts TUR Act,* Methods and Policy Report #15, Abt Associates, Currier et al., 1997. See pp. ES-5.

[27] *Survey Evaluation of the Massachusetts TUR Program*, Methods and Policy Report #14, Abt Associates, Keenan, et al., 1997, p. 28, at http://www.turi.org/library/turi_publications/toxics_use_reduction_policy_analysis.

[28] The author here refers to personal experience receiving comments from regulated entities while providing training in the requirements of the Toxics Use Reduction Act.

TURP certification as a concern (all TURA plans must be certified by a Toxics Use Reduction Planner (TURP) who must be qualified to certify plans). Although there is an expected value in a continuing responsibility to plan toxics use reduction because it provides assurances that companies will examine new technologies and practices as they become available or affordable, the TURA program decided in 2008 to revisit the question of TURA's impact. The Massachusetts Toxics Use Reduction Institute (TURI) contracted for a new survey of companies covered by the Act, and found that of 196 companies, health and environmental benefits were reported by more than half, just over 40 percent reported financial savings as a result of implementing TUR, a third indicated benefits related to compliance, just under a third indicated they achieved improvements in production efficiency as a result of implementing TUR, and others cited improved product, extension of innovations to facilities outside of Massachusetts, improved worker-management relations, improved community relations, and other benefits.[29] Although the results were not as dramatic as the earlier study, TUR plans and the other features of TURA were clearly continuing to provide value to many companies, beyond assurances against an atavistic return to a manufacturing culture that does not sufficiently examine options for reducing environmental impacts and production costs caused by the use of toxic materials.

These surveys paint a picture of an environmental law that has helped many businesses. Environmental regulation has long been justified as a means of imposing costs that might otherwise be external to management decision-making. There is an argument that it is also justifiable because if designed well, it can be good for regulated companies (the Porter Hypothesis).[30] The story of TURA illustrates how an environmental regulation very much seems to have been good for business. It represents a new paradigm for regulation that directly stimulates and nurtures the innovation that is the root cause of economic benefit.

5. An environmental manager on the cutting edge

None of these hypotheses, surveys and data analyses, however, tell the story of how the law works on the ground, in real and personal terms. The only way to know that is to understand the actual experience of company officials who have had to deal with the requirements. At the twentieth anniversary symposium on TURA, held on November 18, 2009,[31] several people who have been in that position shared their experiences. Not everything that they had to say was positive. For example, Stephen Greene, formerly corporate environmental manager for Polaroid, noted that TURA was an "additional cost", because the company was already essentially doing what the law required when it was instituted (in fact, this reporter drew attention at the symposium to the example of Polaroid as one that helped shape the specific requirements of the act). He also noted that having to comply with a state requirement is far less business-friendly than if the requirement was national or international in scope. However, he told attendees that TURA "forced a thorough look at the production process", and stated that although Digital Equipment Company (DEC), where he worked before Polaroid, was "a good corporate citizen", that in his judgment what TURA required "was not something that DEC would have initiated" on its own, had the law not come about.

Others have noted Polaroid's role as an example that pollution prevention works: that although Polaroid's program began before TURA requirements, the closer scrutiny of chemical use that both promoted stimulated research that led to the elimination of hexavalent chromium, (planned for an oxidation step in the processing of a new dye), and the elimination of the use of mercury that "resulted in a more marketable battery pack as well as a more recyclable product."[32] John Warner and Paul Anastas, the co-authors of the influential book *Green Chemistry, Theory and Practice* and often identified as "the fathers" of Green Chemistry, began developing the famous 12 principles of their intelligent and responsible approach to the design of chemical-using products after Warner shared information about innovative work he had done at Polaroid.[33]

6. Getting the lead out and the value of planning

Gary Nedelman, Engineering Manager at AlphaGary Corporation in Leominster, MA, a developer and manufacturer of specialty thermoplastic materials, explained how complying with TURA caused AlphaGary to reduce lead in its products, from an average of 0.025 pounds per pound of product in 1999 to 0.001 pounds per pound of product in 2008, with more reductions planned, and its North Carolina facility now lead-free. The benefits to the company have included "satisfying multinational customer requirements", which have included a focus on lead-free items since the adoption of the Restrictions on Hazardous Substances by the European Parliament in 2003,[34] as well as "minimizing personal exposure" and the costs of managing toxic byproducts. The reductions were accomplished, he told attendees, by "injecting TUR techniques into the process", notably, the TUR activities of input substitution and process modernization. He described the process of adjusting to an initial imposition of what was experienced as a compliance and cost burden, to "understanding principles", a recognition of the "value of planning" and that "TUR was consistent with company objectives". In time, he said, the company learned to use TURA for the purpose of advancing materials and developing competitive advantage. The focus on carefully measuring materials and product has improved yields and reduced costs, and the company has applied the basic TUR strategies not just at the Massachusetts facility but generally throughout its operations, and not just to

[29] *Progress Report on Toxics Use Reduction in Massachusetts, a report to Governor Patrick*, November, 2008. http://www.turi.org/policy/ma_tura_program/tura_report_to_governor_patrick.

[30] Developed by Michael E. Porter and Claas van der Linde. See, http://www.sustainableprosperity.ca/event/porter-hypothesis-20-june-27-28-montreal-qc, a conference on "The Porter Hypothesis at 20". "On June 28 in Montreal, just prior to the World Congress of Environment and Resource Economists (WCERE), Sustainable Prosperity (SP) and Resources for the Future (RFF) are bringing together leading global scholars in this field for a high-level dialogue to compare research, share insights, and identify future policy research priorities on understanding how environmental regulation might enhance innovation and increase competitiveness." Michael Porter's powerpoint: http://www.sustainableprosperity.ca/files/PH@20%20Michael%20Porter%20Keynote%20slides.pdf.

[31] http://www.turi.org/tura_program_2010/what_s_new_at_tura__1/tura_20th_anniversary_symposium_and_conference/speakers_and_presentations.

[32] *Tracking Pollution Prevention in Massachusetts,* Ken Geiser, 1995, p. 7, http://www.p2pays.org/ref/23/22682.pdf.

[33] "The Right Chemistry", American Prospect, 3/19/2006, http://www.prospect.org/cs/articles?article=the_right_chemistry. "A key intellectual reaction occurred when John Warner, a chemist with Polaroid, met with EPA official Paul Anastas (who happened to be an old friend) to discuss a new innovation that, for once, had government regulators excited rather than worried. Warner had come up with a simpler and less toxic process, based on the use of tiny crystals, to help prevent Polaroid's instant film from deteriorating on the store shelf. Anastas recognized that Warner and Polaroid had accomplished all of the EPA's pollution prevention objectives through chemical design and scientific innovation, rather than through after-the-fact regulatory action."

[34] Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, Official Journal L 037, 13/02/2003 P. 0019–0023. At: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0095:EN:HTML.

covered toxics. It has improved blending operations, eliminated leakages of dust and byproduct, reduced lubrication wastes by reducing the need for lubrication at the source, and realized not just lower waste management costs but minimized worker exposures to fugitive dusts. TURA has enhanced the company's cultivation of a culture of continuous improvement, its relations with regulators, and its business reputation, "contributing to maintaining a competitive position" within the industry.

7. Reducing wastes and creating smarter employees

Raymond Lizotte shared his experience as Director of Environmental Stewardship at American Power Conversion (APC), which makes products for sensitive electronic, network, communications and industrial equipment; and as a TURP for Texas Instruments (TI) and other companies. At all companies with which he has worked, TURA's approach has contributed to competitive advantage, which he defined as "a condition which enables a company or entity to operate in a more efficient or otherwise higher-quality manner than those it competes with, and which results in benefits accruing to that company/entity." At TI's plating shop, where he first dealt with TURA's requirements, careful tracking of materials on a production unit basis, a key component of TURA, led to the identification of ways to reduce spills and "drag-out" (chemicals pulled out of the process by the movement through chemical baths of parts being plated). The company instituted "simple process changes" that saved $200,000 per year by avoiding the waste of raw materials – these losses had not been recognized before TURA. A consequence of this improvement was another $50,000 savings in reduced compliance costs, for what had previously been spilled and dragged out had required the addition of wastewater treatment chemicals to prevent their discharge. Wastes from using cyanide, silver, sodium hydroxide and acids were calculated per unit of product produced, and were each reduced by one-third to one-half per unit of product.[35] (TURA requires the tracking of product as well as chemical use and waste (byproduct), so that progress can be understood in relation to changes in production).

Lizotte noted that "TUR provides practitioners with skills that increase their value," which is a personal value for them, and that the value provided to the company includes the fact that these skills are integrated into company operations at lower cost than outsourcing to a third party with the requisite skills. He noted that the value for the state, besides reductions in toxics in the environment, also includes the fact that TURA has created "A generation of environmental practitioners who understand the relationship between environmental and business performance and have the tools to affect it."

8. Reducing costs and gaining marketing advantage

Don Alger, Senior Environmental Engineer of Allegro Microsystems of Worcester, MA, a maker of "high performance power and Hall-effect sensor integrated circuits", described how savings that exceeded $1 million per year were achieved as a result of the company's having to comply with TURA. One major step was converting to a water-based photographic development system, which eliminated a hazardous waste costly to dispose, and the need to use isopropyl alcohol for rinsing. Some wet etching processes were changed over to dry etch, eliminating the use of acids. Components that had been washed in baths were now washed with spray systems, reducing the volume of chemical use, and other cleaning operations were examined and converted to high efficiency. An ion-exchange system used for producing de-ionized water was discarded in favor of a more efficient reverse-osmosis system, spent process chemicals found secondary use in wastewater treatment neutralization, and temperature and other parameters for various operations were optimized.

Allegro took advantage of the option to do Resource Conservation planning after TURA was amended, and estimates that it has had annual savings of $1.5 million per year (some of them precede their inclusion in TURA planning). These include reducing water use, changing lighting, installing variable frequency drives on motors and occupancy sensors throughout the building, reclaiming production waste, turning off equipment when not needed, discontinuing an ultrafiltration system, and using a heat exchanger so that wastewater could be used to preheat incoming water.

A major result of Allegro's initiatives has been its ability to easily obtain registration to the ISO-14001 standard for environmental management, a certification that its customers strongly encouraged the company to obtain. Alger commented: "If we did not have an active TUR and resource conservation program, it would have been much more difficult to develop and achieve goals that are related to our significant aspects and environmental policy. If you do your homework, you can effectively identify projects that help the environment, have a reasonable payback, and help your company to be more competitive."

9. Concluding remarks

TURA seems to have met its statutory purpose of benefiting both the environment and the regulated community. The preamble of the law cites the legislature's intent to "sustain, safeguard and promote the competitive advantage of Massachusetts businesses, large and small, while advancing innovation in toxics use reduction and management". Four other cited purposes of the law are explicitly environmental, such as "to promote reductions in the production and use of toxic and hazardous substances within the Commonwealth."[36] In this respect TURA has certainly succeeded, and this significant value is not captured by analyses of benefits to companies. There are substantial benefits to many recipients, including nonhuman ones and future generations, from the fact that companies covered since 1990 have reduced toxic chemical use by 40 percent, toxic byproducts by 71 percent, toxics shipped in product by 41 percent, on-site releases of toxics to the environment by 91 percent, and transfers of toxics off-site for further waste management by 60 percent. (Because only 55 percent of chemicals reported are from companies covered since 1990, it is important to look at a more recent population as well: companies covered since 2000, representing 90 percent of reported chemicals, have reduced toxic chemical use by 14%, toxic byproducts by 34%, toxics shipped in product by 14%, on-site releases of toxics to the environment by 44%, and transfers of toxics off-site for further waste management by 39%).[37] Although progress in the second decade of TURA is not as marked as in the first, in both periods TURA has reduced toxics use significantly, leading to many benefits for those who are actually or potentially affected by toxic exposures and contamination.

Concerning the other purposes of the law, to promote economic efficiency, there is no question that the Toxics Use Reduction Act gave companies homework to do. It made them count up their

[35] For example, if a company made 100 widgets and had 50 pounds of cyanide waste before TURA, and a few years later made 100 widgets and had only 25 pounds of cyanide waste, it would have reduced its waste per unit of product by one-half.

[36] Chapter 265, Acts and Resolves of Massachusetts, 1989.

[37] 2007 Toxics Use Reduction Information Release, MassDEP, http://www.mass.gov/dep/toxics/priorities/07relfin.pdf.

chemicals before putting them into the process, and even count pounds of chemicals going into and coming out of production units, as well as on a facility-basis. It made them define a unit of product and then count how many units were produced in a year. It made them calculate how much of what they used became nonproduct output – waste, and if they weren't already reporting on releases under the federal Toxics Release Inventory, it made them do that as well. It made them solicit ideas from employees and come up with ideas about what might be changed to reduce chemical input and/or waste, and it made them assess the full cost of the chemical-using operations they were conducting, so that the options they identified would be accurately compared. And it made them report the pounds to the public, and hire or train a TURP to certify that they had done an adequate job of assessing their options. This is a lot of work to do, and if you think you're already doing everything you can do, it can seem like an enormous waste of time.

In 1993, Frances Laden and George Gray wrote that "We find that representatives of industry are, in general, opposed to TUR laws. There are several points of opposition. First and foremost, opponents say that the aspects of TUR that make sense are things that they have been doing all along."[38] The authors recommended that TURA "must be carefully examined if it is to deliver on its promise of decreased risk to workers, consumers and the environment," and that "Much greater experience with pollution prevention will be necessary" before we can know the true value of the approach. It is reasonable to question whether the stories related above are outliers, or illustrations of a general trend. The surveys cited earlier indicate that at the least, they are not unusual. Further pertinent information is contained in OTA's 2006 analysis of TURA data, which showed that the ratio of companies covered by TURA able to reduce input of toxic chemicals (proportionate to achieving the same level of production as before) was 3.75 to one.[39]

Not one pound of this use reduction was required. All that the law requires is that companies track their use, and consider their options for reduction. Perhaps the minority of companies that did not achieve toxics use reduction had already done everything they could do, or perhaps they did not apply its requirements effectively. For Polaroid, the act seems not to have had as much benefit as it did for the other companies that were not as environmentally advanced at that time. But Polaroid was an exemplar: the TURA program used its Environmental Accounting and Reporting ("EARS") system[40] for tracking materials use and releases as a model for teaching other companies and illustrating the link between good environmental practices and Quality Management. Stephen Greene noted that the other company where he worked, Digital Equipment Company, was also a "good corporate citizen". In 1992 DEC had gained fame in the pollution prevention field for developing a "microdroplet" process for cleaning, reducing the use of chlorofluorocarbons for cleaning circuit boards from almost one million pounds in 1988 to less than 85,000 pounds in 1992.[41] Yet Greene notes that even DEC would not, on its own, have initiated the "thorough look" at the production process that TURA requires.

Gary Nedelman's experience tells us that over time his company learned to use this activity for the purpose of modernizing and competitive advantage, after the principles were understood and value of the planning became clear. Careful measurement has improved yields and now the company applies the TURA approach at all of its facilities, including those outside of Massachusetts, and to materials not covered by the law. This goes against the idea that companies do not need this sort of instruction, and that the only reason to do it is to comply with a rule. Over the years, OTA has heard from several companies that they have instituted TURA-like practices to their non-Massachusetts facilities.

Ray Lizotte has much the same to say about TURA's impacts on two companies where he worked, one of which, (Texas Instruments), was also an environmental leader when TURA began, well-known for having built a state-of-the art water treatment system in Southeast Massachusetts. He clearly states that TURA's process of scrutinizing materials use led to awareness of substantial chemical losses that had not been recognized by this world-class firm. He notes also that the ancillary outcome of building skills is considerable, and that Massachusetts benefits from having a "generation" of staff who "understand the relationship between environmental and business performance". It is this relationship, this understanding, that TURA seeks.

For Don Alger's Allegro, the various projects that TURA prompted have had significant value, first in saving more than $1 million in toxics use reduction, and then in helping save a comparable amount through resource conservation. The value of the ISO-14001 registration is not quantified, but is related to the ability to do business internationally. Alger draws a direct connection to TURA planning.

None of these companies were laggards. They were all either industry leaders or well-respected. Yet when TURA came along, they accomplished the basic TUR goal of toxics input reduction by means other than reducing production levels. The planning and tracking and reporting led them to discover options that they then voluntarily implemented. Laden and Gray rightly stated long ago that it is important to subject TURA to close examination, so that we can understand whether or not the Toxics Use Reduction Act is forcing companies to go through motions, wasting time, or whether it really is a tool for reducing chemical risks to people and the environment, and saving companies money. The data from several studies, reviewed above, shows that the act has reduced chemicals use, releases, wastes, and costs. It also seems that this happened through greater efficiency and substitutions, not through plant shutdowns. The stories noted above are just a few examples, but they show us some very good companies had something to learn when they were required to undertake a careful accounting of their use of toxic materials, and their improvement options. The Act did not require that any of these companies invest a single dollar in any chemical substitutions or process changes, but after doing the plan, and sometimes after receiving assistance, these companies chose to do so. Not all companies will respond that way. But if some will, then surely wider application of the prevention strategies used by TURA deserves active consideration.

[38] "Toxics Use Reduction: Pro and Con", at http://www.piercelaw.edu/risk/vol4/summer/laden&gr.htm.

[39] *The Effect of Providing On-site Technical Assistance,* p. 30.

[40] For a description of EARS and its benefits, see Nash, Nutt, Maxwell & Ehrenfeld, "Polaroid's environmental accounting and reporting system: Benefits and limitations of a TQEM measurement tool", Environmental Quality Management, Volume 2, Issue 1, Pages 3–15, 1992.

[41] Ohio EPA Pollution Prevention Fact Sheet Number 7, October 1992, *Substitutes for Ozone Layer-Depleting Solvents in the Printed Circuit Board Industry* http://www.p2pays.org/ref/02/01758.pdf.