Pathways to Efficiency

Massachusetts Toxics Use Reduction Program

Annual Report FY13

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

OTA
OFFICE OF TECHNICAL ASSISTANCE & TECHNOLOGY

TURI
TOXICS USE REDUCTION INSTITUTE
UMASS LOWELL

Submitted to:
The Governor of the Commonwealth of Massachusetts
The Commonwealth of Massachusetts House of Representatives
The Commonwealth of Massachusetts Senate

Prepared by the Office of Technical Assistance and Technology
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"Polartec has been engaged in TUR planning since 1994 and TURA has not only supported our expansion into international markets, it has given us a competitive edge globally. Our European customers require vendors to achieve bluesign® certification, which mandates complex audits and requires full disclosure of all ingredients, recipes, processes, resource consumption and discharges. Polartec was the 1st company in the United States to achieve bluesign® certification and, in large part thanks to TURA, we were able to meet their standards without having to make any disruptive process changes."

- *Jihad Hajjar, EH&S Director at Polartec, LLC*

Executive Summary

The Toxics Use Reduction Act (TURA) is a successful environmental protection program that exemplifies the philosophy that a healthy environment goes hand in hand with a healthy economy. TURA combines regulatory incentives with technical assistance, education and research programs, and has led companies to voluntarily reduce tens of millions of pounds of toxic chemicals while improving their bottom line. The Act, administered jointly by the Office of Technical Assistance and Massachusetts Department of Environmental Protection in the Executive Office of Energy and Environmental Affairs and the Toxics Use Reduction Institute at UMass Lowell, has led businesses to improve their manufacturing efficiency.

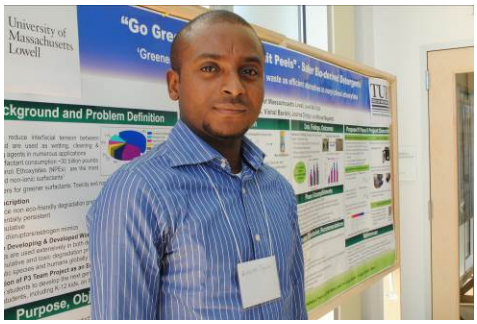
Between 2000 and 2012, companies subject to TURA reduced their total use of toxic chemicals by 23 percent and direct release of toxics to the environment by 73 percent. These reductions are in addition to those achieved during the first decade of the program (40 percent reduction in toxic chemical use and 90 percent reduction in releases to the environment).

During FY13, the TURA program continued to support sustainable economic growth in the Commonwealth by helping businesses reduce their reliance on toxic chemicals and achieve greater operational efficiencies. The TURA program agencies provided assistance to companies and communities through technical assistance, grants, workshops, publications, supply chain work and targeted research. FY13 accomplishments include:

- **site visits** to more than 100 small and large businesses;
- **demonstrations** at a DNA/RNA manufacturing facility showing a 70 percent reduction in toxics use and at professional dry cleaner businesses to showcase wet cleaning technology;
- collaborative research with aerospace and defense supply chain on **alternatives** to hexavalent chromium sealants;
- a greener materials **research symposium** with UMass Lowell researchers and Massachusetts industries;
- **fact sheets** on formaldehyde and perchloroethylene (perc);

- a **guidance document** and training on preventive hazard evaluation for process safety;
- **training programs** for TUR planners on a wide variety of TUR topics as well as Environmental Management Systems;
- **workshops** on topics that include process safety and environmental purchasing; and
- **case studies** demonstrating how companies have made substantial progress in toxics use reduction and resource conservation.

In addition, academic grants supported research on safer alternative chemistries for manufacturing polyester resins, testing of safer disinfection formulations, developing a safer alternative for professional nail polishes and developing safer processes for manufacturing conducting polymers.



Community grants helped a group of public health departments working with hair and nail salons to implement safer practices, supported the elimination of toxic chemical use in Head Start child-care facilities in Boston neighborhoods and contributed to a model for organic food production in a school community setting.

The TURA program continued to work with dry cleaners to help them save money while eliminating a highly toxic chemical. **Perchloroethylene (perc)** is a powerful neurotoxin and suspected carcinogen. In FY13, the TURA program updated MassDEP's Environmental Results Program (ERP) guidance for dry cleaners and provided a grant for KMK Cleaners in Walpole to convert to 100 percent wet cleaning. Data collected from multiple facilities show that eliminating perc by switching to professional wet cleaning can reduce energy and water usage by as much as 50 percent; KMK Cleaners has also seen significant reductions in rework and employee

sick time. The changes to the ERP will be closely monitored for four years to determine effectiveness. If the percentage of newly installed perc machines over that time period is greater than expected, MassDEP will impose a permitting requirement for future installations.

The success of the TURA program with regards to reducing the use of perc in dry cleaning is an example of all TURA agencies working together and with the business community to implement programs and policies that best fit the situation. As a result, Massachusetts benefits from more efficient regulation, safer garment cleaning, lower energy and water use and healthier workplaces.

The designation of **methylene chloride** as a Higher Hazard Substance (HHS) encourages businesses to find less harmful alternatives. Methylene chloride is found in paint strippers and adhesives. It is also used as a metal degreaser and as an extraction solvent. The adverse health effects of methylene chloride include skin, eye and respiratory irritation and liver, kidney and central nervous system damage. Exposure has been responsible for a number of deaths nationwide, including one in Massachusetts in 2004. Designation as a Higher Hazard Substance lowers the reporting threshold to 1,000 pounds. Designation will also help to discourage the use of methylene chloride as a substitute for other toxic chemicals. OTA's targeted outreach to companies around Higher Hazard Substances has helped dozens of companies consider alternatives while explaining the meaning of the HHS designation.

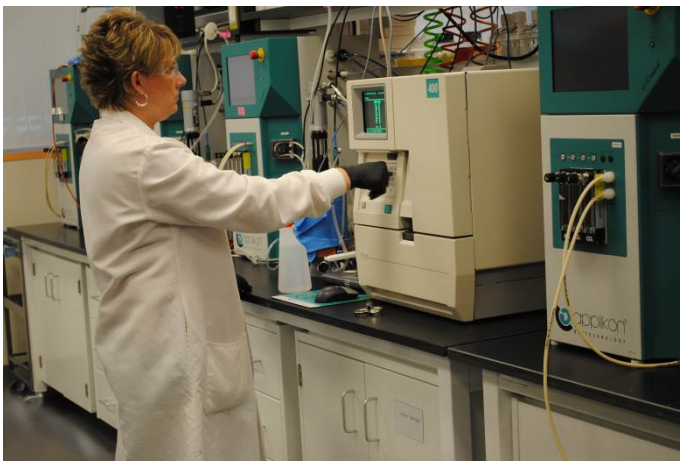
TURI produced the report ***Opportunities for Cancer Prevention: Trends in the Use and Release of Carcinogens in Massachusetts.*** It finds that there are 200 known or suspected carcinogens that are reportable under TURA. Of those, 74 have been reported as used by facilities. There has been a significant decrease in the use of these chemicals over the past 20 years, and a dramatic decrease in releases. The report suggests that toxics use reduction can continue to be an important component of a broader strategy to prevent cancer in the Commonwealth.

A Report on Barriers to Reducing the Use of Asthma-Related Chemicals, produced by OTA, revealed a number of opportunities for increasing community awareness of the benefits of reducing chlorine, formaldehyde and isocyanates. For example, TURA agencies continue to look for alternative cleaning

methods in order to reduce the use of chlorinated substances. The Toxics Reduction Task Force, an interagency collaborative effort supported by TURA program agencies, offered training sessions to state agencies on less toxic methods for disinfecting surfaces.

The Toxics Use Reduction (TUR) Approach

The Commonwealth established itself as a leader in chemical policy by adopting the Toxics Use Reduction Act (TURA) in 1989. At that time, the principal approach to addressing toxic chemicals was "command and control" by setting limits on the amount of a chemical pollutant that could be legally released into the environment. Massachusetts was the first in the nation to harness market forces through a mandatory reporting and planning process that systematically leads to a decline in chemical use over time. Facilities subject to TURA requirements must report annually on chemical use and conduct a planning process every two years during which they decide whether to implement specific toxics use reduction options based on their individual needs.



The program has seen great success. From 2000 to 2011, TURA businesses reduced total toxic chemical use by 22 percent, toxic byproduct by 33 percent and on-site release of toxics into the environment by 65 percent.

The TURA program also helps companies stay competitive in national and international markets. As the European Union continues to update its chemical reporting requirements and restrictions through the Registration, Evaluation, and Authorization of Chemicals (REACH) regulation, the TURA program works to keep Massachusetts businesses informed of these changes. For example, n-propyl bromide (nPB) was recently added as a candidate to the

REACH list of substances of very high concern. In FY13, the TURA program began an investigation that has lead to a recommendation for nPB to be added to the TURA Higher Hazard Substance list. If the recommendation is adopted, education and outreach from the TURA agencies will target Massachusetts businesses that currently use or may consider using nPB. By proactively addressing chemical substances that are more stringently restricted abroad, local industry can keep a competitive edge.

FY 2013 Selected TURA Accomplishments

ChemGenes, a DNA/RNA manufacturing facility in Wilmington has a long history with Toxics Use Reduction. Working with the Office of Technical Assistance and Technology since 2005, the company has reduced its use of chloroform by 55 percent and hexane by 35 percent, resulting in a net savings of $215,000. The Toxics Use Reduction Institute (TURI) at UMass Lowell awarded ChemGenes an incentive grant in 2012 to help offset capital costs for a new solvent recovery and recycling system. In the long-term, ChemGenes expects to reduce the use of hexane and ethyl acetate by 27,000 pounds or 70 percent annually. Factoring in the TURI grant, ChemGenes estimates a return on investment in less than two years.

TURA program outreach has helped many companies discover options for saving money by reducing resource consumption. For example, Dalton-based Crane & Company, Inc., founded in 1801, is the oldest continuously run paper manufacturer in North America. With the help of OTA, Crane was able to identify opportunities for reducing energy costs. The company installed a hydroelectric power generator at an existing dam located on their property. The generator was brought online in August 2013. Crane had previously

installed a combined heat and power back-pressure steam turbine generator. Together, the projects save the company nearly $273,000 annually in reduced energy costs. The new installations have the added benefit of significantly reducing carbon dioxide, sulfur dioxide and nitrous oxide emissions.

TURA program activities are focused, in part, by the review of the Toxic and Hazardous Substances list to identify specific chemicals that merit targeted outreach and specific education programs. Once identified, the chemical is considered for designation as a Higher Hazard Substance. The program's continued investigation into the categorization of chemicals has resulted in:

- changes in the reporting requirements for dry cleaners using perc;
- a recommendation for methylene chloride to be added to the list of Higher Hazard Substances;
- a report on trends in the use of carcinogens by TURA companies; and
- a study on the barriers to reducing the use of asthma-related chemicals in the Commonwealth.

Reduced Toxic Chemical Use by Dry Cleaners

The TURA agencies worked together to develop an approach for reducing the amount of perc used by dry cleaners throughout Massachusetts. Dry cleaners are encouraged to adopt safer alternatives through changes that were made to the existing dry cleaner Environmental Results Program (ERP). The ERP requires dry cleaners using perc to provide an annual self certification to MassDEP to demonstrate that they are in compliance with relevant environmental regulations.

At least seven businesses have already switched from perc-based machines to less toxic wet cleaning technologies with the help of TURI grants. Their results

are proving that toxics use reduction can boost the bottom line. KMK Cleaners in Walpole is showing a 40 percent reduction in electricity costs and more than a 50 percent drop in water consumption. Silver Hanger cleaners in Bellingham reduced electricity use by 20% and saved more than $2,700 in the first year.

Higher Hazard Substance Designation

Under the 2006 Amendments to the Massachusetts Toxics Use Reduction Act, the TURA Administrative Council has the authority to designate up to 10 Higher Hazard Substances and up to 10 Lower Hazard Substances per year. The goal of this provision is to help Massachusetts companies and communities focus their toxics use reduction efforts on those chemicals that pose the most serious threats to health and the environment.

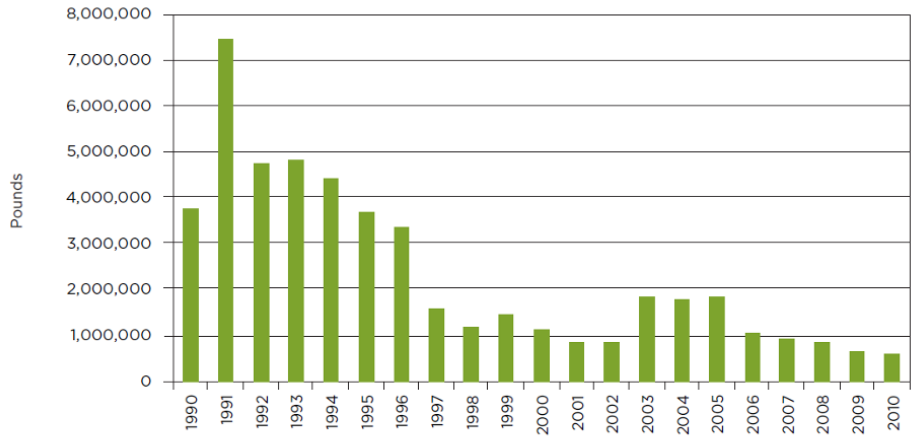
In June of 2013, the TURA Administrative Council voted to add methylene chloride to the Higher Hazard Substance list. Methylene chloride, or dichloromethane (DCM), is a chlorinated solvent commonly used as a metal degreaser, a chemical intermediate, a reaction or extraction solvent, a paint stripper and a component in adhesives. Adverse health effects include damage to the liver, kidney, cardiovascular system and central nervous system. High, short-term exposures can be lethal. Methylene chloride exposure has been responsible for a number of deaths nationwide, including one in Massachusetts.

Traditionally, manufacturing companies with more than 10 employees that incorporate 25,000 pounds or more of the chemical in their products, or use 10,000 pounds of methylene chloride for production and operations, are required to report to the MassDEP and conduct toxics use reduction planning. The Higher Hazard Substance designation lowers the reporting threshold to 1,000 pounds per year. The TURA program has prioritized methylene chloride in allocating resources to ensure that facilities will receive targeted assistance in reducing or eliminating this chemical.

Trends in Carcinogens Use

The report *Opportunities for Cancer Prevention: Trends in the Use and Release of Carcinogens in Massachusetts* was published by TURI in June 2013. It shows that reported use of carcinogens among Massachusetts companies declined 32 percent from 1990 to 2010, and reported releases of carcinogens declined 93 percent from 1991 to 2010. The report notes that toxics use reduction, which prevents carcinogenic exposures at their source, is a powerful tool for cancer prevention and that continued work to minimize the use of carcinogens in manufacturing and services can help to reduce the burden of cancer in Massachusetts. In addition to evaluating progress in reducing use of all carcinogens combined, the report analyzes progress for groups of chemicals associated with 11 specific types of cancer.

FIGURE B
Total Environmental Releases of Known and Suspected Carcinogens
TURA Program, 1990–2010



Based on publicly available data. Data claimed trade secret are not included in these figures.

The report concludes with a number of opportunities that the TURA program agencies can spearhead in order to assist in reducing the risk of cancer in the Commonwealth. The program is evaluating other carcinogens for addition to the TURA list, designation of additional Higher Hazard Substances, and working with other state agencies to incorporate toxics use reduction information into cancer education programs.

Asthma-Related Chemicals

An OTA report, *Barriers to Reducing the Use of Asthma-Related Chemicals,* was presented to the Advisory Committee in the fall of 2012. OTA found that TURA filers have achieved impressive reductions in use of chemicals associated with asthma, but there continue to be important opportunities for further reductions. The report also highlighted uses of asthma-related chemicals that are not covered under TURA.

The report provides detailed information on isocyanates, formaldehyde and chlorine. Recommendations include supporting strategies that promote reduction of use and encouraging the TURA agencies to increase awareness of these chemicals by incorporating information into education materials and programs. Examples of work undertaken by the program includes workshops sponsored by OTA on the proper installation methods for isocyanate-based spray foam products and specific outreach to companies that now file under TURA due to the Higher Hazard Substance designation of formaldehyde. The TURA agencies, working through the interagency Toxics Reduction Task Force, are also helping to educate state agencies about safer alternatives to chlorine-based products in janitorial cleaning applications.

Administrative Council

The Administrative Council is composed of representatives of the Executive Office of Energy and Environmental Affairs, the Department of Environmental Protection, the Executive Office of Housing and Economic Development, the Department of Public Health, the Department of Labor Standards and the Executive Office of Public Safety. The Council serves as a forum for interagency coordination on toxics and makes policy decisions on individual chemical initiatives. For example, in FY13 the Council unanimously resolved to integrate incentives for reduction in perc use into the MassDEP Environmental Results Program (ERP) for drycleaners. As a result of the resolution, a voluntary perc reduction program will be offered during a trial period of four years. See “FY 2013 Selected TURA Accomplishments” for more information.

Key activities in FY13 included further action on the classification of Higher Hazard Substances. At the June 14th meeting, the Administrative Council voted 4 to 0, with one abstention, to designate methylene chloride as a Higher Hazard Substance, making it the 7th substance to be added to the list. See “FY 2013 Selected TURA Accomplishments” for more information.

Advisory Committee

The Advisory Committee is made up of representatives from business, environmental, health and labor organizations, advocacy groups and the general public and provides input from their various perspectives to the program offices and the Council. The Committee reviewed a sector analysis for the janitorial industry to determine needs, identify opportunities, barriers and chemicals used and to identify available alternatives in order to develop a work plan. The Advisory Committee also provided feedback and recommendations for changes to the 2013 ERP Dry Cleaner Compliance Certification Form. In addition, the Committee reviewed preliminary results of outreach efforts to formaldehyde and hex-chromium users, a policy analysis for the Higher Hazard Substance designation of methylene chloride, a draft policy analysis for n-propyl bromide (nPB), a report on Trends in the Use and Release of Carcinogens in Massachusetts and implications of these trends for future policy actions. The Committee also made comments and recommendations on outreach to formaldehyde users and on raising awareness of asthmagen use.

Science Advisory Board

The Science Advisory Board (SAB) provides science-based recommendations on the questions considered by the Advisory Committee and Administrative Council, as well as providing expert scientific review to inform other agency decisions.

Among other topics, the SAB reviewed the latest scientific evidence on methylene chloride and n-propyl bromide, recommending Higher Hazard Substance designation under TURA; conducted a detailed review of the hazard profiles in the phthalate esters category to inform decision-making by MassDEP; reviewed the science on the volatile methyl siloxanes; added methylene-bis-2-chloroaniline (MOCA) and 1,3-butadiene to the informational More Hazardous Chemicals list; and reviewed the science on hydrofluoroethers (HFEs), chemicals that could be adopted as substitutes for some chlorinated solvents.

Toxics Use Reduction Act (TURA) Agencies

Three program agencies work together to implement the Act. The Department of Environmental Protection (MassDEP) certifies TUR Planners and ensures that Massachusetts companies are in compliance with TURA. The Office of Technical Assistance and Technology (OTA) provides confidential, on-site technical assistance to Massachusetts businesses and others to help them reduce their use of toxic chemicals and improve operations. The Toxics Use Reduction Institute (TURI) at UMass Lowell sponsors and conducts technical and policy research, provides education and training, and provides technical support and grants to Massachusetts businesses, municipalities, community organizations and researchers.

Department of Environmental Protection

MassDEP is responsible for implementing the regulatory aspects of the Toxics Use Reduction Act. The Act applies to facilities in certain industrial codes that employ 10 or more full-time equivalents and annually use more than a specified quantity of listed toxic chemicals. These toxics users are required to submit annual reports on the quantities of chemicals they use, waste and release to the environment from their production processes. They are also required to pay toxics use reduction fees based on the number of employees and the number of listed chemicals they use. In addition, every other year, toxics users are required to undertake a planning process in which they quantify the total cost of using a chemical, including the cost of waste disposal and fees. They are asked to identify if there are any changes they can make to their production processes that would both save them money and reduce toxic chemical use and waste.

Facilities that have prepared a toxics use reduction plan and performed two plan updates, may use an Environmental Management System (EMS) to fulfill the planning requirement or substitute a similar Resource Conservation (RC) planning process for water or energy use, solid waste, or for chemicals not regulated under the Toxics Use Reduction Act. These plans are not submitted to MassDEP for approval. Instead, they are approved by a MassDEP certified Toxics Use Reduction Planner (TURP) and a summary of the results is sent to

the agency. MassDEP is responsible for establishing and enforcing the annual reporting and biennial planning requirements, collecting the reports and fees, conducting data quality assurance and analysis, preparing the data for publication and certifying toxics use reduction planners.

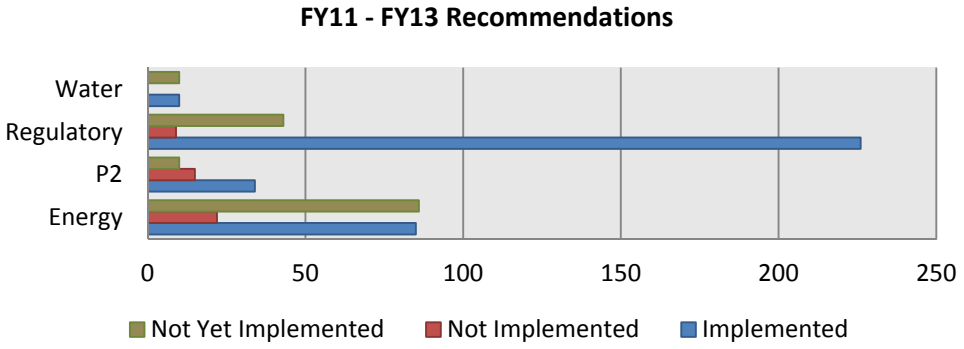
During Fiscal Year 2013, MassDEP:

- Collected and analyzed 1,694 individual chemical reports from 482 facilities covering toxics use in calendar year 2011 and collected $2.6 million in fees;
- Issued 10 Notices of Non-compliance (NON) for failure to submit a required toxics use report by the reporting deadline, and three Administrative Consent Orders with Penalties (ACOPs) to facilities that had repeatedly failed to submit the required reports;
- Conducted 65 inspections of TURA filers and issued one NON and three ACOPs for violations of the TURA statute found through the inspections;
- Conducted 271 screening inspections at facilities to determine if they were subject to the Act;
- Drafted the annual data release report with the assistance of OTA and TURI;
- Reviewed and approved applications demonstrating qualifications from 16 new TUR Planners and reviewed and approved applications demonstrating that they had completed the required continuing education requirements from 44 TUR Planners seeking recertification (of these, 10 were also certified to approve RC plans and four were also certified to approve EMS plans and three of these RC and EMS planners were certified to approve both types of plan);
- Approved over 30 continuing education courses;
- Administered one Toxics Use Reduction Planner Exam, required for TUR Planners seeking certification to approve TUR Plans at companies other than their current employer;
- Conducted four Reporting and Planning training sessions with the assistance of OTA and the Environmental Protection Agency;
- Conducted four training programs on TURA inspection procedures for MassDEP regional compliance assurance staff; and

- Worked with OTA and TURI to integrate the information and incentives for reductions in perc use into the "Dry Cleaner Environmental Results Program" reporting forms, workbook and data management system.

Office of Technical Assistance and Technology

The Office of Technical Assistance and Technology (OTA) provides industrial pollution prevention assistance focused on toxics use reduction. Office services include resource conservation consultation and environmental regulatory compliance guidance. The recommendations help companies understand their options for reducing the use of toxics, water and energy, while at the same time often saving money and avoiding potential liabilities. Working in collaboration with the MassDEP and TURI, OTA brings in-the-field experience to chemical policy developed by the Administrative Council.



Site visits, primarily to manufacturing facilities, are at the core of the Office activity. Demand for on-site assistance services has increased by over 20% during the past year, and of the more than 480 recommendations given during the past two years more than half have been implemented. Since 2006, recommendations made to companies during OTA's site visits have increasingly expanded beyond toxics use reduction and compliance issues. While more than 45 percent of the recommendations given in FY11-FY13 were regulatory, 43 percent were energy and water related. Energy recommendations included changes to HVAC, compressors, operations and participation in utilities programs.

According to the Department of Energy, electricity demand in the industrial sector is expected to increase steadily over the next 10 years. Energy use reduction in industry is lagging behind reductions in other sectors and OTA is working to close that gap. Manufacturing process energy loads are often greater than standard building energy loads. The Office has been examining industrial processes to determine opportunities for efficiency for more than two decades. Staff members target energy efficiency as a specific strategy for saving businesses money while creating a more efficient manufacturing process overall.

OTA is also designated as the Commonwealth's small business compliance assistance office under the Clean Air Act. During fiscal year 2013, more than half of OTA's site visits were to businesses with less than 100 employees. Many small businesses have relied on OTA to help them understand and comply with environmental regulations.

Site visit data breakdown FY13

SBAP Companies	Large Companies	Total
55	14	69

OTA will provide assistance for an expanded audience by organizing workshops for contractors, building inspectors, architects and others on isocyanates contained in spray polyurethane foam insulation materials. When applied correctly, spray polyurethane foam can improve the energy efficiency of a building and save owners and occupants money. When sprayed improperly, the foam can present a health threat to the installer, the surrounding workers and the building inhabitants. In some cases, it can create issues relating to fire, maintenance and indoor air quality. The workshops on isocyanates spray foam insulation are in collaboration with the Executive Office of Energy and Environmental Affairs, the Massachusetts Departments of Labor Standards, Public Safety and Public Health, as well as the U.S. Environmental Protection Agency, the Occupational Safety and Health Administration, the Spray Polyurethane Foam Alliance, ACC Center for the Polyurethanes Industry and the MA Coalition for Occupational Safety and Health.

In FY 2013, OTA sent updated information to TURA filers and constituents regarding the new Global Harmonization System for worker hazard communication, new Clean Air Act regulations pertaining to boilers and mobile generators, new Higher Hazard Substance designations and new Massachusetts Fire Marshal's regulations on Hazardous Materials Processing. The Office worked with others to offer trainings for fire departments and for companies in Fall River, Cambridge, and the Merrimack Valley as well as other parts of the state. The new rules require safety planning by companies processing hazardous materials in large vessels. OTA was able to use its experience in TUR planning to help develop guidance on how to conduct this effort.

The Office has built long-lasting relationships with businesses in Massachusetts. For example, the Lightolier Company has been working with OTA on toxics use reduction since the early 1990s. The company has since been purchased by Philips and OTA has been involved in numerous discussions with the company in recent years regarding resource conservation efforts and implementation. Two new case studies for the company were published as a result; the first focuses on water efficiency and the second on energy reductions. Since 2007, Philips Lightolier reduced water consumption by 64 percent, which saves nearly $242,000 annually. In addition, the company expects to save more than $700,000 annually in energy cost due to energy efficiency measures, new equipment and an installed wind turbine.

In 2013, OTA continued chairing the Toxics Reduction Task Force on Environmentally Preferable Purchasing (EPP), working with the state's purchasing office and other Task Force members to help state agencies switch to using green products and services. As in previous years, the team focused on green cleaners and developed training and guidance on selecting and using these products. The Task Force identified green disinfectants with help from TURI's Cleaning Laboratory. In collaboration with the Department of Public Health, the Task Force undertook an effort to educate users about toxic disinfectants and encourage reducing or eliminating the amounts used while achieving public health standards.

In addition to the individual assistance and the special projects noted above, OTA also worked with MassDEP to train inspectors on the Toxics Use Reduction Act, on regulations pertaining to toxics used in cosmetology and on

alternatives to Higher Hazard Substances. OTA also monitors toxics policy in order to keep companies and others informed of new developments. In FY 2013, OTA provided comments on the bills before Congress pertaining to the Toxic Substances Control Act, helping others to understand provisions concerning preemption of state law, judicial review, and standards of review. OTA coordinates its work with the other program offices, chairs the Advisory Committee meetings and manages communications between the Council and interested members of the public.

Toxics Use Reduction Institute

In FY13, TURI provided a wide range of services to Massachusetts businesses and communities, including training, research, alternatives assessment, work with industry supply chains and grant programs.

- TURI offered **training** programs to Massachusetts industry, including the 48-hour TUR Planner course, two full-day Continuing Education conferences, and training in Environmental Management Systems.

- TURI performed **technical and policy research** aimed at reducing the use of chemicals listed under TURA, with a particular focus on the TURA Higher Hazard Substances.

- The **TURI laboratory** continued to serve Massachusetts companies while expanding its expertise into new areas, such as disinfection and janitorial cleaning products.

- TURI provided **grants to University researchers, small businesses and community organizations** to advance toxics use reduction goals in a wide variety of sectors.

- TURI continued to play a leading role in national and international efforts to refine methodologies for **alternatives assessment**, a key component of policy development related to toxic chemicals. These methodologies are also providing new tools for TUR Planning.

- The **TURI Library** worked actively to expand its user base and to ensure broad awareness of its resources. A new course has been developed, "Beyond the MSDS," which trains researchers, students, and others in key skills necessary for assessing chemical hazards and identifying safer alternatives. The TURI library also produces a weekly bulletin on chemical information in the news, providing up-to-date information on safer alternatives.

- TURI published a number of reports and articles, including *Opportunities for Cancer Prevention: Trends in the Use and Release of Carcinogens in Massachusetts*. The report draws on 20 years of data collected from industries reporting to the Massachusetts TURA program to assess trends in the use and release of chemicals associated with cancer. The analysis shows that reported use and release of carcinogens among Massachusetts companies have decreased dramatically over time. Reported use declined 32 percent from 1990 to 2010 and reported releases declined 93 percent from 1991 to 2010.

- TURI provided science and policy research to support the work of the Science Advisory Board, and to inform the Institute's recommendations to the TURA Advisory Council.

Grants: TURI provided grants to academic researchers, businesses and community organizations.

- By funding University of Massachusetts Lowell researchers, TURI helps to keep Massachusetts companies on the leading edge of technologies that are ahead of compliance trends, and environmentally, occupationally and economically sound. Four projects were supported in FY13:

- *Assistant Professor Chris Hansen, Mechanical Engineering:* Safer alternative chemistries to replace styrene monomer used to manufacture unsaturated polyester resins.

- *Assistant Professor Nancy Goodyear, Clinical Laboratories and Nutritional Sciences:* Conduct performance testing of safer disinfection formulations and test meters that detect residual organisms. Work was performed in conjunction with the Montachusett Opportunity Council; see below under Community Partners.

- *Assistant Professor Emmanuelle Reynaud, Mechanical Engineering, and Associate Professor Daniel Schmidt, Plastics Engineering:* Develop a nail polish made from safer thiol-ene chemistry and compare the performance to polishes that contain toxics such as toluene, formaldehyde and phthalates.

- *Assistant Professor Margaret Sobkowicz-Kline, Plastics Engineering:* Develop safer processes for manufacturing conducting polymers that are used in many applications including organic photovoltaics and thin film transistors.

TURI provided three business incentive grants:

- *Dry Cleaners:* TURI provided a $15,000 grant to KMK Cleaners of Walpole to completely eliminate their use of perc and become a dedicated professional wet cleaner. The facility made the transition in November of 2012. The facility hosted a demonstration event in May of 2013 to showcase to other cleaners and interested stakeholders how they can process 100 percent of the items they receive using wet cleaning with both great results and significant savings.

- *Plating sector:* Independent Plating (Worcester). In FY12, Independent Plating received a TURI Demonstration Grant to assist them in converting from hexavalent to trivalent chromium for nickel-chrome plating operations. In FY13, they held two demonstration events. Attendees learned about the history of the manufacturing site, saw the new

trivalent chromium plating line in action, learned about the process Independent Plating went through to identify the right technology for their needs, got details on the chemistry and process characteristics of the new plating line, and were challenged to distinguish between parts processed with hexavalent or trivalent chromium materials. The resulting case study is available at: http://www.turi.org/TURI_Publications/Case_Studies/Metal_Finishing_and_Plating/Independent_Plating_-_Trivalent_Chromium_Plating_Conversion._2012

- *Biotechnology sector:* Wilmington-based ChemGenes was selected as the FY13 Industry Incentive Grant recipient. The company installed a new solvent recovery system designed to reduce the use of ethyl acetate and hexane by 70 – 90 percent. The first demonstration event was held on June 6, 2013.

TURI assists municipalities, small businesses and community organizations in reducing the use of toxics at the source. Five projects were supported in FY13:

- *Norfolk County 7 Public Health Coalition (towns of Canton, Dedham, Milton, Needham, Norwood and Westwood): "Helping Salons Achieve Green and Clean Project."* Building on a project that began last year, the Norfolk County 7 Public Health Coalition worked with hair and nail salons in the Norfolk 7 area to implement safer practices. The project team created a "Green and Clean" certificate standard to encourage salons to make their work environments safer for employees and customers. The certificate will be awarded to businesses that replace toxics and improve air quality.

- *Clean Water Fund, Boston: "Educating Dry Cleaning Consumers about Healthier Alternatives."* In partnership with collaborating organizations, Clean Water Fund (CWF) educated consumers across the state on the health and safety of different types of dry cleaning options – including the most widely-used toxic chemical perchlorethylene and safer alternatives such as professional wet cleaning, hydrocarbons and GreenEarth. By understanding the health effects of each option, consumers will be able to accurately evaluate their local dry cleaning

shops and avoid being swayed by "green-washing." The team conducted a survey to identify cleaners who are using professional wet cleaning and created a map available at: http://batchgeo.com/map/8b456d0b0e8aa7790f44fd2e4e9ec19a

- *Massachusetts Coalition for Occupational Safety and Health (MassCOSH), Boston: "Cleaning for a Healthy Head Start."* The project team's goal was to eliminate toxic chemical use in Head Start child-care facilities in underserved Boston neighborhoods, contributing to improved environmental health and environmental awareness for low-income children and adults. With their partners, MassCOSH promoted safer cleaning agents and the implementation of toxics use reduction practices. They established an environmental committee of staff and parents to develop education and outreach strategies. This will lead to the development of new, safer cleaning policies at 25 Head Start facilities that will serve as a model that can be easily replicable across the Commonwealth.

- *Mill City Grows, Lowell: "School Garden Pilot Project."* Mill City Grows educated the community about the risks of using herbicides, pesticides and synthetic fertilizers in gardening and landscaping. In partnership with the Lowell School Department, the project team planted four garden beds at the Dr. An Wang and Pawtucketville Memorial Schools in Lowell. Students, teachers and parents are growing vegetables, flowers, herbs and fruits that will, in turn, function as a training and resource center on how to reduce the use of toxic chemicals in the garden. Mill City Grows' School Garden Pilot is a model for organic food production in the school community setting. Through the documentation of the creation process, as well as training and workshops, the team created a

model that can be replicated at other schools in the City of Lowell and in the region.

- *Montachusett Opportunity Council, Fitchburg (serving North Central Massachusetts): "Green and Clean in North Central Mass."* The project team educated residents in North Central Massachusetts – including the Hmong population, Spanish speakers and low-income individuals as well as professionals working with vulnerable populations – about toxins in cleaning supplies and safer, less expensive alternatives. They conducted workshops with community groups, translate materials into Hmong and Spanish and distributed free samples of safer cleaning products for trial.

Aerospace and Defense Sector: TURI has continued a project working with companies and government agencies in the aerospace and defense sector to research safer alternatives to the use of hexavalent chromium in selected applications. Core participants include Raytheon, Lockheed Martin, Northrop Grumman, NASA, U.S. Navy, U.S. Army, and U.S. Air Force. Phase I research on sealants was completed in FY13 providing positive results for some alternative materials. Phase II research is currently being planned and will be undertaken during FY14. The objective of the Phase II research is to provide sufficient technical results to enable the participating companies and government agencies to specify the best performing alternative materials for new product designs.

Policy Research: TURI conducted policy research as background for a variety of questions considered by the Advisory Committee and Administrative Council. Among other topics, TURI developed a policy analysis for methylene chloride, and implementation plans for formaldehyde and hexavalent chromium.

Laboratory Services: By providing free testing services to Massachusetts companies looking for safer cleaning alternatives, TURI helps companies reduce the amount of hazardous chemicals used in surface cleaning. The TURI Laboratory tested the performance of safer cleaning solutions for Massachusetts companies and suppliers representing the metal working, biomedical, coating and cleaning chemicals sectors. The Lab worked with 17

companies in FY13 and made test results available for other companies in an online database, CleanerSolutions: http://www.cleanersolutions.org.

Publications and Presentations: TURI continued to make its work accessible to state, national and international audiences through its publications and presentations. TURI publications are listed in Appendix C.

Looking Ahead: Selected Program Activities in FY14

Since TURA's inception, Massachusetts companies have reduced toxics use by hundreds of millions of pounds. In FY14, the TURA program will continue to promote reductions in toxics use though program activities that include: evaluating opportunities for industry sectors; categorizing substances based on hazard; working with the regulated community to increase understanding of its emerging needs; promoting opportunities to enhance workplace health and safety; working to overcome barriers to sustainable practices through toxics use reduction; increasing awareness and use of program services through effective outreach and networking. In FY14, TURA agencies will be undertaking activities including the following:

- providing grants to large and small businesses, community organizations, and university researchers;
- continuing to work with the Aerospace and Defense sector on targeted research to identify viable alternatives to hexavalent chromium and other toxic chemicals;
- conducting outreach to educate methylene chloride users about TURA program services and safer alternatives;
- finalizing a policy analysis on n propyl bromide and continue to develop a policy on a chemical category of halogenated hydrocarbons;
- using the Federal Tier 2 data and other data sources to expand efforts to ensure that facilities subject to TURA comply with the reporting and planning requirements;

- using the information included on the Dry Cleaner ERP certifications to do targeted outreach to facilities to encourage the adoption of environmentally preferable alternatives to perc; determine the percent of new perc dry cleaner installations that would trigger the imposition of a new permitting requirement for perc based dry cleaning;
- updating guidance for auto body and auto repair shops and survey current operations at auto shops; and
- Continuing interagency work through the EPP Toxics Task Force program and through an Administrative Council ad-hoc Building Envelope and Indoor Air Quality Committee.

Appendix A: TURA Program Revenue and Fees

FY12 Revenues:

Chemical Fees:	$2,900,000
Late Fees:	$30,000
TOTAL:	$2,930,000

FY13 Expenditures:

OTA	$663,132
MassDEP	$735,984
TURI	$1,313,218
TOTAL:	$2,712,332

Appendix B: TURA Events

Demonstration Sites:

- Garment cleaning: AB Cleaners, Westwood, December 2012
- Garment cleaning: KMK Cleaners, Walpole, May 2013
- Metal plating: Independent Plating, Worcester, August and September 2012

TUR Planner Training:
Continuing Education Conferences:

- Featured Ken Geiser as keynote speaker and six breakout sessions on a variety of toxics use reduction topics, November 2012
- Featured Art Fong, Toxicology and Chemical Management, IBM, as keynote speaker, April 2013
- Environmental Management Systems for Toxics Use Reduction, January 2013

"Beyond the MSDS": Workshop on accessing chemicals information at the TURI Library:

- TURI grantees and researchers – September 2012
- Industry, UML Faculty and Students, May 2013

Webinar: Brazilian Women's Group - Green Cleaning (in Portuguese), January 2013

Appendix C: TURI Publications

Goldstein, B., Banda, S., Cairncross, E., Jiang, G., Massey, R., Miglioranza, K., Samseth, J., and Scheringer, M. 2013. "Reaching for the 2020 Goal: The Need for Better Information and Sound Management to Minimize Chemical Risks." In *UNEP Yearbook 2013: Emerging Issues in our Global Environment*. Nairobi and Geneva: UNEP.

Jacobs, M. M., Massey, R. I., and Clapp, R. W. 2013. "The Burden of Cancer from Organic Chemicals." In Carpenter, David O., *Effects of Persistent and Bioactive Organic Pollutants on Human Health*. Hoboken, New Jersey: John Wiley & Sons.

Jacobs, M., Tenney, H., Massey, R., and Harriman, E. 2013. *Opportunities for Cancer Prevention: Trends in the Use and Release of Carcinogens in Massachusetts*. Toxics Use Reduction Institute Methods and Policy Report No. 29. Lowell, Massachusetts: Toxics Use Reduction Institute, University of Massachusetts Lowell.

Massey, R. and Jacobs, M. 2013. "Global Chemicals Outlook: Trends and Indicators." In *United Nations Environment Programme (UNEP), Global Chemicals Outlook: Toward Sound Management of Chemicals*. Nairobi and Geneva: UNEP.

Morose, G. and Becker, M. "Chemical Alternatives Assessment, Chapter 5: A Collaborative Industry and University Alternative Assessment of Plasticizers for Wire and Cable." *Issues in Environmental Science and Technology*, Volume No. 36: Royal Society of Chemistry Publishing, 2013.

National Institute for Occupational Safety and Health. 2012. *General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories*. DHHS (NIOSH) Publication No. 2012-47. (Tsai and Ellenbecker were co-authors.)

Schulte, P.E., Kuempel, E.D., Zumwalde, R., Geraci, C.L., Schubauer-Berigan, M., Castranova, V., Hodson, L., Murashov, V., Dahm, M., and Ellenbecker, M., "Focused Actions to Protect Carbon Nanotube Workers," published online, *American Journal of Industrial Medicine*, DOI: 10.1002/ajim.22028 (2012).

Toxics Use Reduction Institute. 2013. *Massachusetts Chemical Fact Sheet: Formaldehyde*. Lowell, MA: Toxics Use Reduction Institute.

Toxics Use Reduction Institute. 2012. *Assessment of Alternatives to Perchloroethylene for the Dry Cleaning Industry*. Lowell, MA: Toxics Use

Reduction Institute, Methods and Policy Report Number 27.

Tsai, S., Echevarría-Vega, M.E., Sotiriou, G.A., Santeufemio, C., Huang, C., Schmidt, D., Demokritou, P., and Ellenbecker, M., "Evaluation of Environmental Filtration Control of Engineered Nanoparticles using the Harvard Versatile Engineered Nanomaterial Generation System (VENGES)," *Journal of Nanoparticle Research*, 14:812, (2012), DOI: 10.1007/s11051-012-0812-x.

Tsai, S., White, D., Rodriguez, H., Munoz, C., Huang, C-Y., Tsai, C-J., Barry, C., and Ellenbecker, M., "Exposure Assessment and Engineering Control Strategies for Airborne Nanoparticles: An Application to Emissions from Nanocomposite Compounding," *Journal of Nanoparticle Research*, 14 (7):989, (2012), DOI: 10.1007/s11051-012-0989-z.

Appendix D: TURI - Professional Conference Presentations, Workshops, Training Presentations & Demonstrations

Dunn, K., Tsai, S., Woskie, S., Bennet, J., and Ellenbecker, M., "Evaluation of Nanoparticle Dispersion and Containment of a New Nanomaterial Fume Hood using Computational Fluid Dynamics," American Industrial Hygiene Conference & Expo (AIHCE), Indianapolis, IN, June 2012.

Eliason, P., "Alternatives 101," two-day training sponsored by Department of Toxic Substances Control, Chatsworth, CA, June 2012.

Eliason, P., "Alternatives to Perc: Massachusetts Assessment of Alternatives for the Professional Garment Care Industry," Massachusetts Toxics Action Coalition, Boston, Massachusetts, June 2012.

Eliason, P., "Government, Industry and Academia Collaborations Spur Innovation: The Massachusetts Example," Forum on Innovating for Safer, Greener Products, Infocast, California, September 2012.

Eliason, P., "Technical Feasibility of Safer Alternatives," European Chemicals Agency (EChA), Workshop, Helsinki, Finland, October 2012.

Eliason, P., "Alternatives Assessment: More than a Simple Chemical Comparison," Great Lakes Green Chemistry Network, workshop on safer products, Columbus, Ohio, May 2013.

Ellenbecker, M., Tsai, S., and Dunn, K., "Methods to Evaluate the Effectiveness of Nanoparticle Control Strategies," Conference on Nanotechnology and Sustainability, Washington DC, November 2012.

Ellenbecker, M., and Tsai, S., "Research into the Evaluation and Control of Airborne ENP Exposures," NSF NSEC Grantees Conference, Washington, DC, December 2012.

Goodyear, N., Brouillette, N., Tenaglia, K., Marshall, J., and Quinn, M. "Effectiveness of a Do-It-Yourself Recipe for Cleaning and Disinfection," poster, American Society for Microbiology General Meeting, Denver, CO, May 2013.

Harriman, E. "Chemical Restrictions Coming from All Directions," Wire Association, Boxborough, MA, Oct 2012.

Harriman, E. "Alternatives Assessment for Flame Retardants," UL Environment, Atlanta, GA, April 2013.

Jacobs, M., Massey, R., Tenney, H., and Harriman, E. “Trends in the Use and Release of Carcinogens in Massachusetts,” poster, Environmental Health: Science and Policy to Protect Future Generations Conference, Boston, MA, March 3-6, 2013.

Massey, R. “Toxics Use Reduction and Vector Control,” Cape Ann Boards of Health Forum, March 2013.

Massey, R. “Global Chemicals Outlook: Toward Sound Management of Chemicals,” Paths to Global Chemical Safety: The 2020 Goal and Beyond Conference organized by the Center forInternational Environmental Law and the Swedish Society for Nature Conservation, Washington, DC, March 2013.

Massey, R., Tenney, H., and Harriman, E. “Designation of Higher Hazard Substances under the Toxics Use Reduction Act: Results from the First Six Years,” poster, Environmental Health: Science and Policy to Protect Future Generations Conference, Boston, MA, March 3-6, 2013.

Massey, R., Jacobs, M. “United Nations Environment Programme Global Chemicals Outlook,” poster, Environmental Health: Science and Policy to Protect Future Generations Conference, Boston, MA, March 3-6, 2013.

Morose, G. “Alternatives Assessments for Hexavalent Chromium for the Aerospace/Defense Industry,” TURA Program Retreat, Leominster, MA, October 23, 2012.

Morose, G. “Hexavalent Chromium Sealant Alternatives Evaluation,” SAE Aerospace G8/G9 Technical Conference, St. Louis, Missouri, May 1, 2013.

Morose, G. “Research of Alternatives to the Use of Hexavalent Chromium in Aerospace and Defense Applications,” Eastec Conference, West Springfield, Massachusetts, May 15, 2013.

Myles, M. “Pollution Prevention and Green Chemistry,” Sustainable Communities Conference, Worcester, MA, April 2013.

Onasch, J. “Sustainable Practices in the Dry Cleaning Sector - Making the Case for Professional Wet Cleaning,” Sustainable Communities Conference, Worcester, MA, April 2013.

Wilcox, H., “Training on Steam Vapor Cleaning as an Alternative to Bleach in WIC Facilities,” Montachusett Opportunity Council, July 2012.

Wilcox, H., “The TURI Lab Process and How it Accomplishes Toxic Use Reduction,” PCx Parts Cleaning Conference, Columbus, OH, April 2013.

Janitorial Demonstrations

Wilcox, H. IEHA, Alternatives to Traditional Janitorial Cleaning, Chicago, IL, November 2012.

Wilcox, H., Alternative Metal Finishing Solvents, New England Surface Finishing, Sturbridge, MA, May 2013.

Wilcox, H., Alternatives to Traditional Janitorial Cleaning, MIA Green Conference, Miami, FL, January 2013.

Wilcox, H., Alternatives to Traditional Janitorial Cleaning, Mass Buys, Worcester, MA, May 2013.

Wilcox, H., Alternatives to Traditional Janitorial Cleaning, MAFMA, Worcester, MA, June 2013.

Wilcox, H., Alternatives to Traditional Janitorial Cleaning, DCR Supervisor's Academy, Devens, MA, April 2013.

Appendix E: TURI Media Coverage (Selected)

Anon., "Dramatic decline in Massachusetts carcinogen releases." Chemical Watch: Global Risk & Regulation News, June 13, 2013

White, Monica. "Cancer-Causing Chemicals Used by Mass. Companies on the Decline." GoLocal Worcester, Saturday, June 8, 2013. Available at http://www.golocalworcester.com/news/use-of-cancer-causing-carcinogens-on-the-decline-umass-report/

WWLP-TV, "Dry Cleaning Alternative Saves $, Environment", May 1, 2013, available at http://www.wwlp.com/dpp/news/politics/state_politics/wry-cleaning-alternative-saves-environment-cl

Coverage of UNEP Report (see Publications section, above)
Media coverage of the UNEP Global Chemicals Outlook appeared in nearly a thousand news outlets, with coverage in English, Spanish, French, Arabic and Chinese. Examples are given below. UNEP's compilation of press coverage is available at: http://www.unep.org/docs/Global-Chemicals-Outlook-Media-Coverage.doc

Lederer, Edith M. "U.N.: Chemicals Damaging Health and Environment." USA Today September 6, 2012. Available at: http://www.usatoday.com/news/health/story/2012-09-06/un-chemicals-health/57634948/1

Reuters, "Rising chemicals output a hazard, clean-up needed by 2020." Chicago Tribune September 7, 2012.

Associated Press, "Pesticides could cost Sub-Saharan Africa $90bn in illness bill, UN warns." The Guardian September 6, 2012. Available at http://www.guardian.co.uk/environment/2012/sep/06/pesticides-hazardous-chemicals-un?newsfeed=true

Voice of America. "Health, Environmental Hazard from Chemicals are Rising." September 5, 2012. Available at http://www.voanews.com/content/health_and_environmental_hazards_from_chemicals_are_rising/1502433.html

Appendix F: TURI Grants

Grants: University Research

- Safer alternative chemistries to replace styrene monomer used to manufacture unsaturated polyester resins.
- Performance testing of safer disinfection formulations and test meters that detect residual organisms.
- Development of an alternative to nail polish made from safer thiol-ene chemistry.
- Development of safer processes for manufacturing conducting polymers used in organic photovoltaics and thin film transistors.

Grants: Businesses

- Plating sector: Independent Plating (Worcester)
- Biotechnology sector: ChemGenes (Wilmington)
- Dry cleaners: KMK Cleaners (Walpole)

Grants: Municipal and Community Organizations

- Norfolk County 7 Public Health Coalition towns of Canton, Dedham, Milton, Needham, Norwood and Westwood: "Helping Salons Achieve Green and Clean Project."
- Clean Water Fund, Boston, "Educating Dry Cleaning Consumers about Healthier Alternatives."
- Massachusetts Coalition for Occupational Safety and Health (MassCOSH), Boston, "Cleaning for a Healthy Head Start."
- Mill City Grows, Lowell, "School Garden Pilot Project."
- Montachusett Opportunity Council, Fitchburg (serving North Central Massachusetts): "Green and Clean in North Central Mass."