



CLEAN PRODUCTION STRATEGIES:

HOW COMPANIES CAN ELIMINATE THEIR USE OF TOXIC CHEMICALS

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1. Companies usually do not realize the potential for toxic use reduction and elimination.

A series of studies published in the USA in the 1980s discovered that companies could be cutting their generation of hazardous chemical waste but were not doing so. The US Office of Technology Assessment in the USA found that at least 10 percent reduction of waste per year was possible for the following five years but that the major obstacles to increased waste reduction were institutional and behavioural rather than technical.¹

At the same time, a review of 29 chemical companies in the US by the research group INFORM showed that less than 1% of companies had any chemical waste reduction initiatives at all; that any efforts to reduce waste was caused by regulations; and that not one company had done a waste audit and not one company knew how much waste they produced in total. The researchers found that in some cases up to 80 percent of emissions could be avoided in many cases without sophisticated techniques. The researchers recommended:

- 1.the government needed to close cheap disposal options
- 2.companies needed to accept increased liability
- 3.the public needed more access to information about emissions from each company, and
- 4.Companies needed to set timelines and goals to reduce their waste generation.

A follow up study 2 years later found even more chemical waste reduction opportunities.²

This realization prompted the establishment of the 1986 Emergency Planning and Community Right-to-Know Act which included the Toxic Release Inventory (TRI), followed by the Pollution Prevention Act of 1990 which established state and federal based pollution prevention offices and the requirement for additional reporting on source reduction activities under the TRI. The federal US Environment Protection Agency (EPA) published a series of case studies demonstrating how companies could reduce or eliminate their generation of hazardous chemical waste.³ Reductions in the generation of hazardous chemicals emissions were tracked under the annual Toxic Release Inventory reports and each state had to produce reports showing how industries were develop cleaner processes. However the state of Massachusetts established timelines and goals to reduce the actual **use** of toxic chemicals and in 1989 the Toxic Use Reduction Act was passed with the goal of reducing the use of a prescribed list of toxic chemicals in the state by 50% over the following ten years.

The experience of national Cleaner Production programmes in Europe, Canada, USA, Australia – in fact, everywhere – shows that, in many cases, once manufacturers have been forced to make process changes in order to reduce pollution, they often have a more efficient and lower cost production line. Why does industry wait for government to prompt cost reduction measures? – UNEP Cleaner Production Programme. 1996⁴

2. The Potential of Toxics Use Reduction Planning

An assessment of the Toxic Use Reduction Act found that from 1990 to 2001 actions taken by the more than 600 companies who submitted plans resulted in:

- 45% reduction in chemical use
- 69% reduction in toxic chemical byproducts and
- 92% reduction in releases of toxics.⁵ (see figures 3 and 4 below).

These reductions can be broken down into types of toxic chemicals eliminated. In 2004 it was revealed that TURA resulted in 18% reduction in the use of 41 listed carcinogens and 65% reduction in their release.

Figure 3. Toxic Use reductions 1990-2005

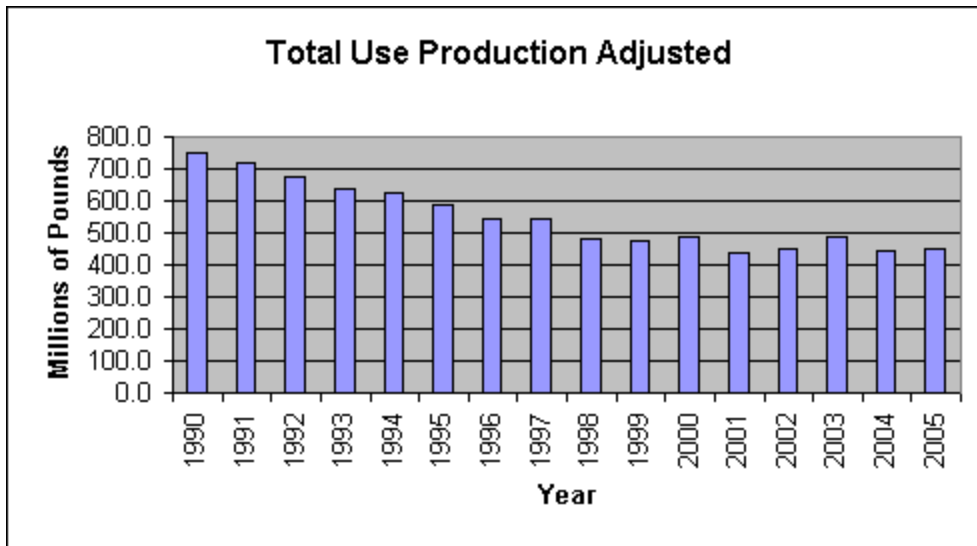
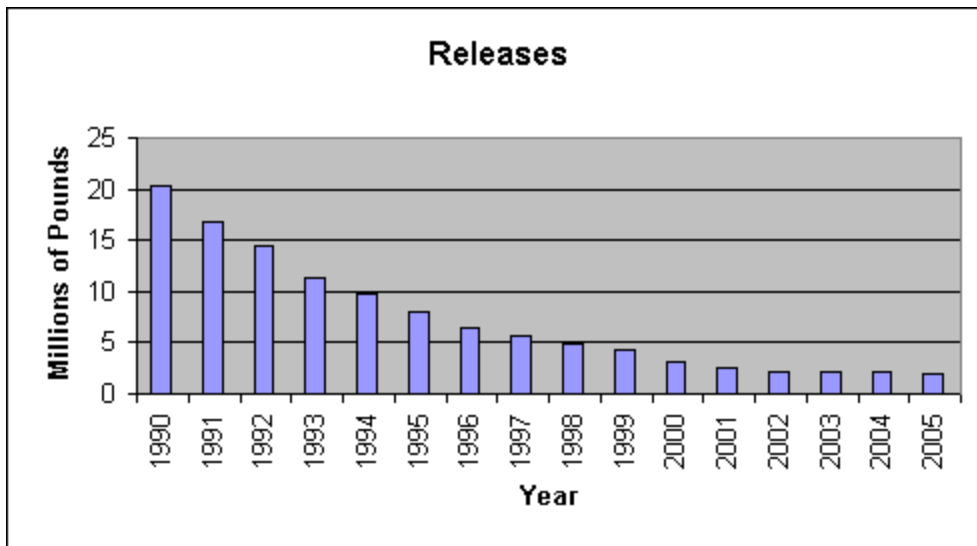


Figure 4: Toxic Release reductions 1990-2005



During this time, core companies reported an overall 17% increase in production. Furthermore, eighty-six percent of respondents said they would continue to conduct TUR planning even if the legal requirement to conduct it was removed.

In addition, economic benefits exceeded costs. From 1990 – 1998 reported costs were \$77 million compared to monetized benefits of \$91 million. These benefits do not include wider human health and ecological benefits.⁶

More recently, over the period of 2000 to 2007 541 Large Quantity Toxic Users reported under the TURA program. Between 2000 and 2007 despite these companies reporting an overall 19% decrease in production they still decreased their overall toxic chemical use in real terms (figures adjusted for the production drop) by 14% compared to the 2000 base year, and they have reduced releases of TRI reported on-site chemicals by 44%. The quantities of chemicals shipped in product have also reduced by 14% since 2000. In other words significant decreases are still being achieved⁷ (see glossary for definitions of terms used here).

Campaign Action Points:

3. Your governments should clearly define the goals and methods to achieve pollution prevention and clean production.

Clear definitions help a company to differentiate between what is end of pipe pollution control and what is clean production. For example:

The European PREPARE network of cleaner production projects defines the prevention of waste and emissions as: the prevention or reduction of the generation of waste and emissions by reduction at source or onsite reuse and/or reduction of the total pollution load.⁸

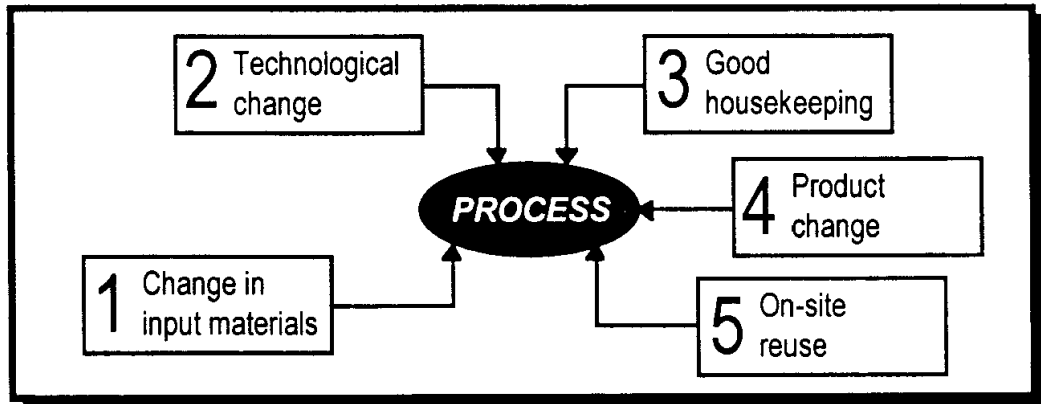
The US Pollution Prevention Act of 1990⁹ established a clear definition of pollution prevention:

*Pollution prevention or **source reduction** is any practice which reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal...**Source reduction includes** equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials and hazardous chemicals, and improvements in housekeeping, maintenance, training, or inventory*

However, probably one of the clearest definitions is the Massachusetts (US) Toxic Use Reduction Act (TURA) which declared Toxic Use Reduction as: "...in-plant changes in production processes or raw materials that reduce, avoid, or eliminate the use of toxic or hazardous substances or generation of hazardous byproducts per unit of product, so as to reduce risk to the health of worker, consumers or the environment, without shifting risks between workers, consumers or parts of the environment." Only five types of toxic use reduction are allowed under the Act:

- Input substitution
- Production process modification or modernization
- Finished product reformulation
- Good Housekeeping or improvements in operations and maintenance
- In-process recycling of production materials in a closed pipe or on-site reuse. External recycling of materials or waste is not considered toxic use reduction.

Figure 1. Some different ways to achieve toxic use reduction.



Source: UNEP IE

Reducing pollutants at source, before they become hazardous waste emissions can also save the company money and thousands of case studies since the 1980s have compiled evidence of this (see Table 1).

Preventing pollution at the source should take over as the best technical approach of the 1980s. The reason is that it is more environmentally efficient and less costly than the end-of-pipe treatment approach of the 1970s. - Dr Bringer, Executive Director of Pollution Control, 3M Company. 1985¹⁰

For example, 3M's Pollution Prevention Pays Program (3P) worked to achieve source reduction by reformulating products; modifying the manufacturing process; redesigning equipment and recovering and recycling waste products. By 1985 the combined total of over 1,500 projects had resulted in the company eliminating annually the discharge of 100,000 tons of air pollutants; 11,000 tons of water pollutants and over 150,000 tons of sludge of which 18,000 tons were hazardous, along with the prevention of 1.4 billion gallons of wastewater.

Table 1. Some examples of reductions through chemical related process changes and their payback periods

<i>Industry</i>	<i>Method</i>	<i>Waste reduction</i>	<i>Payback period</i>
Pharmaceutic production	Water-based solvent replaced organic solvent	100%	< 1 year
Equipment manufacture	Ultrafiltration	100% of solvent	2 years
Farm equipment manufacture	Proprietary process	80% of sludge	2.5 years
Automotive manufacture	Pneumatic cleaning process replaced caustic process	100% of sludge	2 years
Microelectronics	Vibratory cleaning replaced caustic process	100% of sludge	3 years
Organic chemicals production	Absorption, scrap condenser, conservation vent, floating roof	95% of cumene	1 month
Photographic film processing	Electrolytic recovery ion exchange	85% of developer; 95% of fixer, silver and solvent	< 1 year

Source: D. Huisingsh 'Cleaner technologies through process modifications, materials substitutions and ecologically based ethical values' in *Industry and Environment* 12:1 [1989]

Many of the case studies collected in the 1980s are still applicable because most SMEs have still not adopted pollution prevention practices. See the Clean Production contact list (available on Greenpeace Toxics Water campaign intranet – section 7707) for a list of resources and groups who are working with companies to implement clean production.

4. Companies should officially recognize the need for Prevention and clean production

Successful projects by industry are the result of top management involvement, setting up a project team, and conducting a pre-assessment. Many barriers arise from personal attitudes and the wish to maintain the present situation and avoid the unknowns or the fear that new waste and emission prevention options will not work as expected or will not prove profitable. It is the responsibility of the management to convince all those involved that change is beneficial and therefore will be made.

5. Your governments should make toxic use reduction plans a mandatory and enforceable requirement for all companies using hazardous substances.

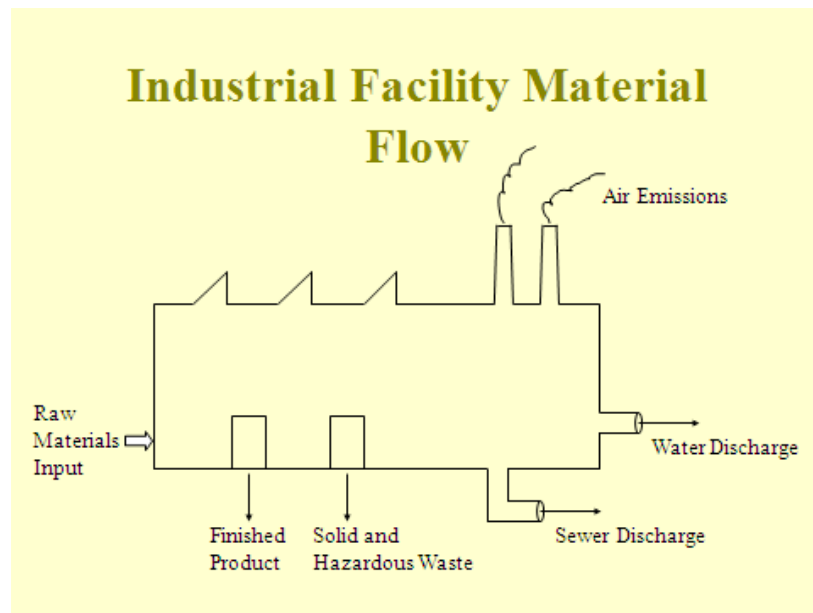
“You cannot reduce what you do not measure.” A company must know what types and quantities of materials enter the factory, how they are processed and how they leave the factory. The practice of doing a full chemicals accounting, or a **mass balance audit**, has proven to be an essential element in clean production implementation. Yet few companies do so. That is why the state of Massachusetts in the US passed the Toxic Use Reduction Act (TURA) of 1989 to make toxic use reduction plans mandatory for firms who use more than a certain amount of the 1200 toxic chemicals listed in the State.

The Act requires these firms to prepare a Toxics Use Reduction Plan, in which they

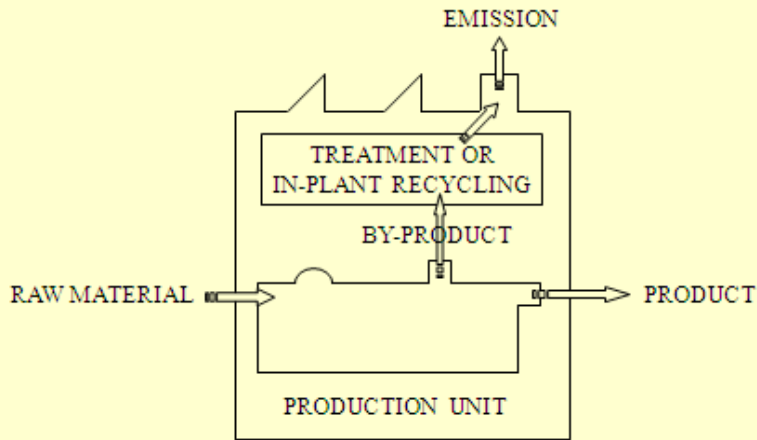
- examine how, where and why toxic chemicals are used at their facility,
- assess the costs associated with using each of the chemicals they must report on
- evaluate what their options are, and
- report the quantities of toxic chemicals used, generated as byproducts (waste) and shipped in or as product.

The list of hazardous chemicals adopted by the state of Massachusetts was based on the federal Public Right to Know Toxic Release Inventory (TRI) List, with the ability to add or delist chemicals through consultation with a Science Advisory Board and public input.¹¹ Companies who had to report were in designated industrial classes, had ten or more employees and used a minimum of the thresholds on the chemical list.

Figure 2. Key elements of a full chemicals accounting or a mass balance audit.



TUR Data Collection Points



A very important result of the audit is the cost accounting that identifies how much money companies can save through reducing the use or formation of hazardous chemicals. There are many manuals and checklists that help a company to do full cost accounting of all the materials, chemicals, energy and water that pass through the company's gates. UNIDO has a comprehensive toolkit which is used by the National Cleaner Production Centres.¹² The Toxic Use Reduction Institute in the state of Massachusetts (established by the TURA) trains employees how to do a comprehensive plan and provides ongoing technical assistance and support. Each company plan must be certified by the State government.¹³

6. Toxic use reduction legislation should establish clear timelines and goals, including interim targets, and monitor progress against these goals. Summary plans and progress reports must be publicly available

Goal setting is important. In 1989 the Massachusetts Toxic Use Reduction Act (TURA) established a statewide goal to reduce toxic waste generated by fifty percent (50%) by the year 1997 (against the base year of 1987) using toxics use reduction as the means of meeting this goal. This was a statewide goal and individual firms could set their own TUR targets.

It is important to note that the plan summaries and progress reports are publicly available (see for example the data in pt.1 above¹⁴). See for example the total releases, byproducts and shipped of chemicals used by Wang Laboratories producing Printed circuit boards from 2001 to 2007¹⁵. The detailed and certified toxic use reduction plans are held by the company and regulators can obtain these on demand. In this way confidential business information is protected.

7. Your government should ensure there is well funded technical expertise and ongoing help for companies, particularly small and medium scale enterprises.

Technical support is essential to the success of pollution prevention by companies. The support must be professional and well funded. In Massachusetts, the Toxic Use Reduction Institute was funded by a series of fees paid by companies depending on the number of people the company employs and the number of listed chemicals it manufacturers, processes or otherwise uses in excess of applicable thresholds. A company calculates its fee using a worksheet that the firm submits along with its annual toxics use report.¹⁶ The fees range in size from \$500 up to \$8,500 per facility/year. .

A wide range of international cleaner production networks supply training, advice and case studies on the financial success of clean production implementation. See the [Clean Production contact List](#) for more information and web resources.

8. Glossary

Toxic Use Reduction is in-plant changes in production processes or raw materials that reduce, avoid, or eliminate the use of toxic or hazardous substances or generation of hazardous byproducts per unit of product, so as to reduce risks to the health of workers, consumers, or the environment, without shifting risks between workers, consumers, or parts of the environment.

Toxics use reduction shall not include or in any way be inferred to promote or require incineration, transfer from one medium of release or discharge to other media, off-site or out-of-production unit waste recycling, or other end-of-pipe treatment for toxic wastes.

Toxics use reduction can be achieved through any of the following techniques:

- Input substitution: changing the raw materials of a product to use nontoxic or less toxic raw materials.
- Product reformulation: reformulating or redesigning end products to be nontoxic or less toxic upon manufacture, use, release, or disposal.
- Production unit redesign or modification: using production units of a different design than those used previously;
- Production unit modernization: upgrading or replacing production unit equipment or methods.
- Improved operation and maintenance: modifying existing equipment or methods by such steps as improved housekeeping, system adjustments, or process/product inspections.
- Recycling, reuse, or extended use of toxics: only by using equipment or methods that are integral to the production unit.

Terms That Describe What Happens to a Toxic chemical. Once a toxic chemical is used, something happens to it. It either becomes a byproduct or it is shipped either as a product or as part of a product. These two results are called `generated as byproduct´ and `shipped in product´.

Byproduct (including generated byproduct) is further broken down into transfers and releases. These terms reflect the fact that some of the toxic material may leave the facilities, for example as a solid or liquid waste that is transported away from the site (a transfer), or as an air or water emission (a release). Quantities for transfers are not shown in the reports.

Generated Byproduct means all non-product outputs of toxic or hazardous substances generated by a production unit, prior to handling, transfer, treatment or release.

Shipped in Product means any toxic or hazardous substances that leave the facility as product or as part of an article containing the toxic or hazardous substance.

A *Release* is a discharge of a toxic chemical to the environment. This includes releases to the air, either as a stack or fugitive emission, discharges to bodies of water such as streams or lakes, or discharges to the ground or underground.

This fact sheet was commission by Greenpeace International and written by Beverley Thorpe.

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9. Endnotes

- 1 US Congress. Serious Reduction of Hazardous Waste. 1986 (available on line?)
- 2 Mark Dorfman and Warren Muir. Cutting Chemical Waste. INFORM. 1986
http://www.informinc.org/fact_tracking.php
- 3 The EPA's Pollution Prevention Clearing House can be accessed at:
<http://www.epa.gov/opptintr/ppic/pubs/ppicarchive.htm>
- 4 UNEP Cleaner Production Training Resource Package. First Edition March 1996
- 5 See <http://turadata.turi.org/Success/ResultsToDate.html>
- 6 For more information on the progress of the Toxic Use Reduction Act visit TURA DATA section of the TURI website: <http://turadata.turi.org/Success/ResultsToDate.html>
- 7 For an updated look at reductions visit: <http://turadata.turi.org/Success/ResultsToDate.html>
- 8 Sybren de Hoo, Brezet Han, Crul Marcel, Dieleman Hans. PREPARE Manual for the Prevention of Waste and Emissions. Netherlands Ministry of Economic Affairs within the framework of PREPARE. For more information visit: <http://www.prepare-net.com/cms/index.php?id=10>
- 9 For more information about US Pollution Prevention Act 1990 visit
<http://www.epa.gov/p2/pubs/basic.htm>
- 10 Dr Robert Bringer. 'Waste Minimization – 10 years of experience at 3M. Presentation of the Conference on Low and Non Waste Technology. Zel Am See, Austria. October 9, 1985.
- 11 See legal text at: <http://www.mass.gov/legis/laws/mgl/21i-9.htm>
- 12 UNIDO CP Toolkit is available at <http://www.unido.org/index.php?id=o86205>
- 13 More information about The Toxic Use Reduction training materials is available at
http://www.turi.org/training/recent_training_events/toxics_use_reduction_planning
- 14 See <http://turadata.turi.org/Success/ResultsToDate.html>
- 15 See
http://turadata.turi.org/report.php?action=report_company_quantity_summary_all_years&facility_id=118797.
- 16 For more information about TURA reporting and fees visit:
<http://www.mass.gov/dep/toxics/tura/reportsum.htm#fees>