

2006 Guide to Pollution Prevention Tools

Prepared by

**Ashok Kumar
Nagaveena Raman
Abhilash Vijayan**

Department of Civil Engineering

University of Toledo

Sept. 2006

Abstract

Growing awareness to the problem of pollution and associated regulatory policies by governmental environmental agencies has created a lot of interest in the area of pollution prevention (P2).

Various aids are available on the Internet for helping the general public, not just to understand the concept of pollution prevention, but also to help in carrying out P2 measures. This guide is intended to serve as a reference document for most of the pollution prevention aids available on the internet for their use by small and medium size companies.

The report consists of a summary of websites and a brief description of the type of information available on the websites. The report also presents a brief description and the web addresses of 97 tools which are found online. Apart from tools available online the report incorporates nine different tools that were developed by the University of Toledo as a part of the Pollution Prevention Incentives for States Grant from the US EPA. The tools are the GAP Assessment tool, MSDS Manager, Emission Reduction tool, Lean Assessment Screening tool, HVAC Checklist, Energy Assessment Spreadsheet, Hybrid HVAC System Design Tool, Building Sustainability Tool and Hospital Assessment Tool.

TABLE OF CONTENTS

Section	Contents	Page
i	Abstract	i
ii	Table of contents	ii
1	Introduction	1
2	General Pollution Prevention Information on Internet	4
<i>2.1</i>	<i>General pollution prevention information on Internet</i>	5
<i>2.2</i>	<i>Material substitution</i>	9
<i>2.3</i>	<i>Recycling information</i>	10
<i>2.4</i>	<i>Green design for the environment</i>	10
<i>2.5</i>	<i>State Internet programs</i>	11
<i>2.6</i>	<i>Academic resource centers</i>	12
<i>2.7</i>	<i>Environment, health and safety</i>	13
<i>2.8</i>	<i>Energy conservation</i>	14
<i>2.9</i>	<i>Total quality management</i>	15
<i>2.10</i>	<i>Water Quality</i>	17
<i>2.11</i>	<i>Affirmative procurement</i>	18
<i>2.12</i>	<i>Life cycle analysis/Life cycle assessment</i>	19
3	Tools Available on the Internet	20
4	Tools Developed at the University of Toledo	25
5	Conclusion	26
6	Literature Cited	27

CHAPTER 1

INTRODUCTION

The United States of America's Pollution Prevention Act of 1990 states that the pollution should be prevented or reduced at the source whenever feasible. The US Environmental Protection Agency further defines pollution prevention as the use of other practices that reduce or eliminate the creation of pollutants through increased efficiency in the use of raw materials, energy, water, or other resources, or protection of natural resources, or protection of natural resources by conservation [1, 2, 3]. Berger [4] points out that the need for pollution prevention is stronger than ever because of environmental challenges, cost competition, and consumer and shareholder demands.

The definition of pollution prevention from various references is given below:

1. ASTM definition[9]: The act of reducing or eliminating the use, release or generation of a pollutant or potential pollutant through source reduction, recycling, reuse, reclamation or modification of existing practices.
2. USEPA's definition[10]: Pollution prevention means "source reduction," as defined under the Pollution Prevention Act, and other practices that reduce or eliminate the creation of pollutants through:
 - increased efficiency in the use of raw materials, energy, water, or other resources, or
 - protection of natural resources by conservation.
3. Ohio EPA's definition[11]: The use of source reduction techniques in order to reduce risk to public health, safety, welfare and the environment and, as a second preference, the use of environmentally sound recycling to achieve these same goals. Pollution prevention avoids cross-media transfers of wastes and/or pollutants and is multimedia in scope. It addresses all types of waste and environmental releases to the air, water and land.
4. IDEM (Indiana Department of Environmental Management) definition[12]:

- Any practice that (these practices are known as “source reduction”):
 - 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, and
 - Reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.

- Other practices that reduce or eliminate the creation of pollutants through:
 - Increased efficiency in the use of raw materials, energy, water, or other resources, or
 - Protection of natural resources by conservation.

- Equipment or technology modifications; process or procedure modifications; product reformulation or redesign; substitution of raw materials; or improvements in housekeeping, maintenance, training or inventory control.

5. Oklahoma Environmental Quality Act Definition [13]: "Pollution prevention" means any practice which reduces the use of any hazardous substance or amount of any pollutant or contaminant prior to recycling, treatment or disposal, and reduces the hazards to public health and the environment associated with the use or release or both of such substances, pollutants or contaminants. The term "pollution prevention" shall not include or in any way be construed to promote or require substitution of one hazardous waste for another, treatment, increased pollution control, off-site recycling, or incineration.

Pollution Prevention Act Definition: The Pollution Prevention Act defines pollution prevention as "source reduction," and it defines "source reduction" as 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; and
- Reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.

More specifically, pollution prevention in an industrial environment means in-plant practices, including, but not limited to:

- Process modifications,
- Feedstock substitutions,
- Product reformulation,
- Management practices or housekeeping alterations,
- Recycling within industrial processes, and
- Equipment replacement or modifications.

The changes in management practices or housekeeping alterations would include maintenance and preventive maintenance, training, inventory control, and improvements in housekeeping.

Pollution prevention and source reduction are used interchangeably throughout the US and mean the same thing. Methods for achieving waste reduction divide conveniently into two basic types: pollution prevention or source reduction and recycling.

In this report an attempt has been made to provide information about the online resources, existing tools and new tools developed by the Air Pollution Research Group (APRG) at the University of Toledo that are available for pollution prevention. Small to medium size businesses will be able to download these tools and will be able to use for pollution prevention work.

CHAPTER 2

GENERAL POLLUTION PREVENTION INFORMATION ON THE INTERNET

The growth of information available on the internet is amazing. It has become very difficult and time consuming to search for particular information in a short time due to the vast amount of information available on the internet. Although more than 500 sites were reviewed for this report, only a limited number of sites are included in this review because it is not possible to cover all the available sites.

The information collected from the internet has been presented under following categories:

- General pollution prevention information on Internet
- Material substitution
- Recycling information
- Green design for the environment
- State Internet programs
- Academic resource centers
- Environment, health and safety
- Energy conservation
- Total quality management
- Water Quality
- Affirmative procurement
- Life cycle analysis/Life cycle assessment

2.1 GENERAL POLLUTION PREVENTION INFORMATION ON INTERNET

- Agriculture Compliance Assistance Center (AgCenter) – <http://es.epa.gov/oeca/ag/>

The AgCenter provides "one-stop shopping" for the agriculture community. The Center offers comprehensive, easy-to-understand information about compliance -- commonsense, flexible approaches that are both environmentally protective and agriculturally sound. The Center also provides information on reducing pollution and making good use of the latest pollution prevention technologies.

- Automotive Service and Repair: Greenlink – <http://www.ccar-greenlink.org/>

This site offers access to environmental compliance information and pollution prevention information to those working in the automotive service, repair, and auto body industry.

- EnviroSense: <http://es.epa.gov/links/vicyoung.html>

This site is a source of Internet bookmarks related to P2 and environmental information.

- Canadian Center For Pollution Prevention (C2P2) - <http://c2p2.sarnia.com/expertise/index.html>

The Canadian Center for Pollution Prevention (C2P2) was founded to stimulate the adoption of pollution prevention approaches — to influence changes in behavior. Serving as a catalyst for change, the C2P2 disseminates information so that others include pollution prevention in their decision-making and helps businesses, governments and the public find solutions that result in pollution prevention action.

- Center for Neighborhood Technology - <http://www.cnt.org/>

This site is designed to promote public policies, new resources and accountability, which supports sustainable, just, and vital urban communities.

- Central European Environmental Data Request Facility (CEDAR) - <http://www.cedar.univie.ac.at/>

This site features environmental information about Central Europe. The site serves as a transition point to many other destinations and useful environmental information.

- Defense Environmental Network & Information Exchange (DENIX) - <http://denix.cecer.army.mil/denix/Public/public.html>

DENIX provides the general public with timely access to environmental legislative, compliance, restoration, cleanup, safety & occupational health, security, and DoD guidance information.

- Department of Energy (DOE) EPIC Home Page - <http://epic.er.doe.gov/epic/>

The DOE EPIC home page provides a database search of DOE documents, P2 Regulations, internet search engines, a P2 Calendar, P2 software, environmental information sources, material exchange, material substitution and recycling information.

- Earth Systems, Inc. – <http://earthsystems.org/Environment.html>

This site provides links to over 650 virtual library environmental sites. Industry associations, recycling projects, P2 project reports and other environmental documents are also listed.

- EnviroLink – <http://envirolink.netforchange.com/>

EnviroLink is a grassroots non-profit organization that unites hundreds of organizations and volunteers around the world and serves over 1.5 million people in 130 countries. This web site offers links to environmental web sites and EnviroNews, a sustainable business network, and other environmental information related to ecology.

- Environmental Law Institute (ELI) – <http://www.eli.org/>

This site incorporates ELI publications, programs, law and policy documents related to environmental law.

- Enviro\$en\$e Home Page - <http://es.epa.gov/>

This site is one of the most comprehensive environmental web site. Enviro\$en\$e provides search services, industry sector notebooks, links to DOE, EPA, DOD, Federal, Regional and State Agencies, Academia, public interest groups, industry and trade associations, international resources, vendor information, material exchange and substitution libraries, P2 information exchange programs and other valuable P2 resources. Information is constantly updated.

- EPA Home Page – <http://www.epa.gov>

This web site provides access to a large amount of information. Users may search for environmentally related information, public information centers, grants and financing, press releases, software, databases and newsletters regarding EPA's policies, regulations and assistance programs.

- EPA Atmospheric Pollution Prevention Division - <http://www.epa.gov/cpd.html>

This site provides information on the activities of EPA's Atmospheric P2 Division. Information on the Energy Star Program, Green Lights Program, Methane Outreach

Program, publications, and software tools are also located at this web site.

- P2GEMS – <http://www.p2gems.org/>

P2 Gems is an Internet search tool for facility planners, engineers, and managers who are looking for technical, process, and materials management information on the web. The Toxics Use Reduction Institute manages this site.

- Pacific NW Pollution Prevention Resource Center – <http://www.pprc.org/pprc/>

This website includes an on-line database of P2 research projects, an on-line P2 request of proposals clearinghouse, P2 technology reviews, a newsletter, and other information for businesses in the Northwest.

- Pollution Prevention Roundtable – <http://www.p2.org/>

The site provides information on the activities of the Natural P2 Roundtable. The P2 Roundtable provides a national forum for promoting the development, implementation, and evaluation of efforts to avoid, eliminate or reduce pollution at the source. The site provides information on legislative briefings, upcoming conferences, publications, and access to P2 Roundtable yellow pages, links to other state and local web sites and information regarding international activities.

- Toxics Action Center: <http://www.cqs.com/tac.htm>

The Toxics Action Center (TAC) of New England is one of the best regional grassroots support organizations in the US. The staff of TAC is committed to both helping people with environmental problems and also launching independent initiatives for pollution reduction and prevention.

- Waste Minimization National Plan - <http://www.epa.gov/wastemin/>

The Waste Minimization National Plan (WMNP) web site provides access to the WMNP and presents descriptions of available tools, programs, and plans; available to assist in reducing the presence of persistent, bio-accumulative, and toxic chemicals in hazardous waste. Access to the Waste Minimization Prioritization Tool is also available at this site.

2.2 MATERIAL SUBSTITUTION

- SAGE – Solvents Alternative Guide – <http://clean.rti.org>

SAGE is a comprehensive guide designed to provide pollution prevention information on solvent and process alternatives for parts cleaning and degreasing.

- Coating Applications Research Laboratory (CARL) - <http://www.ecn.purdue.edu/CMTI/CARL/>

CARL allows Midwest manufacturers to test state-of-the-art pollution prevention technologies under the guidance of personnel expert in their application. Supervised use of this facility will give you a "level playing field" opportunity to determine which of the available products or processes meets your manufacturing and market requirements

- Environmental Stewardship - Pollution Prevention - Los Alamos National Laboratory (P3O) Material Substitution Resource List – <https://nicext.lanl.gov/>

This web site provides information on material substitution alternatives and links to over 26 material substitution related sites on the Internet.

- ILSR – <http://www.ilsr.org/>

Information on substitutes for synthetic chemicals is available on this site.

2.3 RECYCLING INFORMATION

- Global Recycling Network – <http://grn.com/grn/>

This site provides recycling-related information to buyers and sellers of recyclable commodities.

- King County Recycled Procurement Program – <http://www.metrokc.gov/procure/green/index.htm>

The King County Recycled Procurement Program lists resources for buyers, information on construction and landscaping materials, office products, automotive products, product performance summaries, and other environmental links.

- Recycler's World – <http://www.recycle.net/>

The Recycler's World was established as a world-trading site for information related to secondary and recyclable commodities, by-products, and used and/or surplus items and materials.

2.4 GREEN DESIGN FOR THE ENVIRONMENT

- Carnegie Mellon University Green Design Initiative Home Page – <http://www.ce.cmu.edu/GreenDesign/>

This site provides access to research, publication lists, and education programs in green design. The site also provides information on its partnerships.

- Pacific Northwest Laboratory's Design for Environment Page – <http://pprc.pnl.gov/>

The PPRC is a nonprofit organization that works to protect public health, safety and the environment by supporting projects that result in pollution prevention and the elimination or reduction in toxic use. The database includes over 300 P2 projects. The request for Proposals (RFP) Clearinghouse provides information about P2 projects. The site offers search engines, up-to-date newsletters, P2 conference schedules and abstracts on P2 research projects.

- UC Berkeley Center for Green Design and Manufacturing–
<http://greenmfg.me.berkeley.edu/green/Home/Index.html>

Research, publications, contacts and green design software is available at site.

2.5 STATE INTERNET PROGRAMS

- Alabama DEM - <http://www.adem.state.al.us/>
- Colorado Department of Public Health & Environment - <http://www.coloradop2.org/>
- Delaware DNREC - <http://www.coloradop2.org/>
- Florida DEP - <http://www.dep.state.fl.us>
- Georgia Department of Natural Resources, P2 Assistance Division -
<http://www.georgianet.org/dnr/p2ad/>
- Indiana Department of Environmental Management - <http://www.state.in.us/idem/>
- Office of P2 & Technical Assistance Illinois HWRIC - <http://www.wmrc.uiuc.edu/>
- Kansas State University Pollution Prevention Institute -
http://www.oznet.ksu.edu/dp_nrgy/
- Kentucky P2 Center (KPPC) - <http://www.kppc.org/>
- Louisiana DEQ - <http://www.deq.state.la.us/>
- Maine DEP, Pollution Prevention Program - <http://www.state.me.us/>
- Massachusetts Department of Environmental Protection -
<http://www.magnet.state.ma.us/dep/dephome.htm>
- Massachusetts Office of Technical Assistance - <http://128.11.42.63/ota/>
- Michigan DEQ, Environmental Assistance Division - <http://www.deq.state.mi.us/ead/>

- Minnesota Technical Assistance Program - <http://www1.umn.edu/mntap/>
- NH Department of Environmental Services - <http://www.des.state.nh.us/>
- New Jersey Technical Assistance Program for Industrial Pollution Prevention - <http://www.njit.edu/njtap/>
- New York Department of Environmental Conservation - <http://www.dec.state.ny.us/website/pollution/prevent.html>
- North Carolina Waste Reduction Resource Center - <http://wrrc.p2pays.org/>
- Oregon Department of Environmental Quality, P2 Division - <http://www.deq.state.or.us>
- South Carolina Department of Health & Environmental Control - <http://www.state.sc.us>
- Tennessee Department of Environment & Conservation - <http://www.state.tn.us/environment/>
- Texas Natural Resources Conservation Commission (TNRCC) - <http://www.tnrcc.state.tx.us/>
- Vermont Agency of Natural Resources - <http://www.anr.state.vt.us/>
- Virginia DEQ, Office of Pollution Prevention - <http://www.deq.state.va.us/p2/homepage.html>
- Washington Department of Ecology, Hazardous Waste & Toxics Reduction Program - <http://www.ecy.wa.gov/>

2.6 ACADEMIC RESOURCE CENTERS

- The National Pollution Prevention Center (NPPC) for Higher Education - <http://www.umich.edu/~nppcpub/index.html>

The site provides educational material to universities, professionals and the public. The NPPC actively collects, develops and disseminates pollution prevention educational materials.

2.7 ENVIRONMENT, HEALTH, AND SAFETY[5]

- Office of Federal Environmental Executive (OFEE) - <http://www.ofee.gov/recycled/cal-index.htm>

This site provides information on sustainable environment, Waste prevention and recycling, Green purchasing and Environmental management Systems.

- DOE's Safety & Health Technical Information Services – <http://tis.eh.doe.gov/portal/home.htm>

The web site provides accurate and current information regarding MSDS sheets, EPA Chemical Fact Sheets, and other topics related to materials, health, and safety.

- Environmental Indicators Web site - <http://www.epa.gov//indicators/index.html>

This site provides information on a variety of data that provide a picture of the environmental status of a state, county or region within the United States using EPA data. Indicators include air quality, water quality, hazardous waste management, use of toxic chemicals and pesticides. Information on frequently asked questions, environmental progress and indicator reports and links to EPA National Program offices, and other data sources are available through this site.

- Vermont SIRI (Safety Information Resources on the Internet) – <http://hazard.com/>

This website provides access to material safety data sheets, and a wide variety of occupational and environmental safety and health information.

- Occupational Safety and Health Administration: <http://www.osha.gov/>

This web site provides information on OSHA standards, programs and services, compliance assistance programs, and technical information. This site also contains links to other health and safety sites on the Internet.

- Right To Know Network (RTKNET) - <http://www.rtk.net/>

RTK NET was established to empower citizen involvement in community and government decision-making. This site provides free access to databases, text files, and other information on the environment, housing and sustainable development. In addition to information on upcoming conferences, newsletters, training sessions and job opportunities, the site provides links to other related web sites.

Kumar et al. [5] provides more information on other available sites.

2.8 ENERGY CONSERVATION

- Building Energy Software Tools Directory - http://eeredev.nrel.gov/buildings/tools_directory/

This site provides information on 293 building software tools for evaluation energy efficiency, renewable energy, and sustainability in buildings.

- Sustainable Buildings Industry Council - <http://www.sbicouncil.org/store/e10.php>
The information given in the website helps in advancing the design, affordability, energy performance, and environmental soundness of America's buildings.
- Alternative Fuels Data Center (AFDC), National Renewable Energy Laboratory, US Department of Energy. – <http://www.afdc.nrel.gov/>

The AFDC collects operating information from vehicles (in programs sponsored by the Alternative Motor Fuels Act) running on alternative fuels, analyzes those data, and makes

them available to the public. Data is also available for the Bio-fuels Information Center and the Clean Cities program.

- Ames Laboratory Environmental Technology Development (ETD) – <http://www.etd.ameslab.gov/>

As part of the US Department of Energy, Ames Laboratory ETD is developing technological solutions to the problems of contamination resulting from nuclear weapons production. Features of this site include a library and Internet "Green" Pages.

- Climate Wise – <http://www.epa.gov/oppeinet/oppe/climwise/cweb/index.htm>

This site provides information on EPA's Climate Wise program; a government-industry partnership that helps businesses improve energy efficiency and reduce greenhouse gas emissions.

- The Electric Power Research Institute (EPRI) – <http://www.epri.com/>

EPRI conducts research and development activities and P2 initiatives for the electric utility industry.

- Energy Efficiency and Renewable Energy Network (DOE) – <http://www.eren.doe.gov/>

Offers hundreds of pages of information from the Office of Energy Efficiency and Renewable Energy. This online library of resources offers news and archives about conservation techniques and developments in the world of energy.

- Energy Information Administration (DOE) – <http://www.eia.doe.gov/>

This site provides information on energy prices, consumption information, and

forecasting for a variety of fuel groups.

- EPIC (Energy Pollution Prevention Information Clearinghouse) – <http://epic.er.doe.gov.epic.htm>

The purpose of EPIC is to facilitate the exchange of US DOE pollution prevention information between DOE sites, state and local governments, and private industries. It includes a file listing of DOE-specific P2 information and a calendar of upcoming DOE-sponsored conferences, meetings, and training events related to pollution prevention.

- Office of Environmental Management (EM) – <http://www.em.doe.gov/index4.html>

This DOE site features information and links to environmental management and pollution prevention at DOE.

- Office of Industrial Technologies (OIT) Home Page (DOE) – <http://www.oit.doe.gov/>

OIT is part of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy. It creates partnerships among industry, trade groups, government agencies, and other organizations to research develop, and deliver advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial customers.

- Office of Industrial Technologies (OIT) Chemicals - Industry of the Future - <http://www.oit.doe.gov>

As part of OIT's Industries of the Future strategy, the Chemicals Industry Team was established as a partnership between OIT and the US chemical industry to maximize economic, energy, and environmental benefits through research and development of innovative technologies.

2.9 TOTAL QUALITY MANAGEMENT / ISO 14000[6]

- DOE's Environmental Management Home Page –

<http://www.em.doe.gov/index4.html>

The site provides waste management, environmental restoration, nuclear material, cross cutting, and other environmental management information.

- EPA Standards Network (ISO 14000) – <http://es.epa.gov/partners/iso/iso.html>

The web site provides information on ISO Environmental Management Standards and their potential impact in the United States.

- NIST's Global Standards Program (GSP) –

<http://ts.nist.gov/ts/htdocs/210/216/216.htm>

NIST promotes the economic growth of U.S. industry by helping develop and apply technology. General ISO 14000 information is provided.

- Exploring ISO 14000 – <http://www.mgmt14k.com/>

A primer to the ISO 14000, this site includes features such as frequently asked questions and full text articles. The site covers ISO 1400 in-depth and touches on ISO 9000 as well.

Additional sites on ISO 14000 are available in a paper by Kumar and Kumar [6].

2.10 WATER QUALITY

- The Water Environment Federation (WEF) – <http://www.wef.org/>

The WEF provides information on information searches, links, catalogs, events, missions and other activities as they relate to water issues.

- Water Online – <http://www.wateronline.com/>

This site supplies information on water-related manufacturing markets, discussion forums, engineering technology, resource libraries, and associations.

- Waterwiser – <http://www.waterwiser.org/>

This site provides information on water efficiency and conservation, books, conferences, and links to other water-related web sites.

2.11 AFFIRMATIVE PROCUREMENT

- Affirmative Procurement – <http://www.epa.gov/epaoswer/non-hw/procure/index.htm>

This web site provides a list of guidelines and resources to assist federal, state, and local agencies and others purchase and use products containing recovered materials.

- Army Acquisition Pollution Prevention Support Office – <http://www.aappso.com/>

The Army Acquisition Pollution Prevention Support Office, commonly referred to as AAPPSO, is located at Headquarters, US Army Materiel Command, in Alexandria, Virginia. AAPPSO has staff responsible for pollution prevention as it applies to the materiel acquisition process and the entire equipment life cycle.

2.12 LIFE CYCLE ANALYSIS/LIFE CYCLE ASSESSMENT (LCA)

- ECOSITE – <http://www.ecosite.co.uk/>

The web site provides information on recent events in LCA, case studies, and downloadable copies of software.

- European Network for Strategic Life Cycle Assessment Research and Development (LCANET) -<http://www.leidenuniv.nl/interfac/cml/lcanet/hp22.htm>

LCANET is a concerted action in the Environment and Climate Program for establishing a European Network for Strategic Life-Cycle Assessment (LCA) Research and Development: LCANET. The task of this network is to describe the state-of-the-art of LCA methodology and to provide input to the EU Environment and Climate Research and Development Program.

- EcoDS (Environmentally Conscious Decision Support System) –
<http://shogun.vuse.vanderbilt.edu/usjapan/ecods.htm>

EcoDS is a decision support tool for a cost-risk evaluation of environmentally conscious alternatives using streamlined LCA.

CHAPTER 3

TOOLS AVAILABLE ON THE INTERNET

In the face of the various technological advancements, it is only natural that software and information technology is being put to use in environmental fields. Today, tools are being developed that can be applied to different areas of an industrial process to aid P2 experts, planners, mitigators, and even house owners. P2 tools find their use in compliance assessments, in measurement of pollution and/or its prevention or offer solutions to P2 problems being faced by the users.

A myriad of tools are available on the Internet. The EPA website has a huge database of tools that serve various uses in real life situations. Other tools are also mentioned in this section.

S No.	Tool Name	Purpose	Website
1	MFFP2T	This tool calculates the quantity of waste generated by a particular process flow sheet and also estimates various options for waste reduction.	http://www.colan.org/CO%20Update/COUpdate08_EPA_Technical_Article.html
2	BV2	This software calculates the total annual use of heating, cooling and electricity.	http://eeredev.nrel.gov/buildings/tools_directory/
3	Coatings Guide	This is a pollution prevention tool for paints and coatings users	http://cage.rti.org/
4	Environmental Sustainability Kit	Is a set of tools-ideas, procedures and resources to help local leaders, residents, and business work toward making their own communities more sustainable.	http://www.environmentaldefense.org/documents/1247_ESK.pdf
5	ProcureSmart	To reduce the amount of pollution causing products.	http://www.ga.com/atg/pollution.php
6	Expert Choice	It's a terrific tool for choosing between pollution prevention options, and selecting pollution prevention priorities in large facilities.	http://www.expertchoice.com/
7	Evolver	It permits the user to apply genetic algorithms to a wide variety of process and product optimization problems.	http://www.axcelis.com/
8	Green Cleaning P2 Calculator	This quantifies the projected environmental benefits of purchasing and using "green" janitorial services and products	file:///U:/P2%20Tools/What's%20New%20Item.htm
9	BASINS 3.1	A multi-purpose analysis system that integrates a geographical information system(GIS), national watershed data, and state-of-the-art environmental assessment and modeling tools into one convenient package	http://www.epa.gov/waterscience/basins/
10	Paper Calculator	This tool calculates the U.S. average energy and wood consumption and environmental releases summed across the full "life cycle" of each of five major grades of paper and paperboard	http://www.ofee.gov/recycled/cal-index.htm
11	ReCon Tool	It helps the companies and individuals estimate the life-cycle greenhouse gas(GHG) emissions and energy impacts from purchasing and/or manufacturing materials with varying degrees of post-consumer recycled content.	http://www.ofee.gov/gp/recon.htm
12	EMAPPT	Check that your operation complies with your legal responsibilities through good environmental management and recognize opportunities for increasing efficiency and saving money through	file:///U:/P2%20Tools/em.htm

		pollution prevention.	
13	EDGE (3.1)	Designed to help engineers and designers incorporate sustainable measures into the design of facilities to reduce life-cycle costs and increase materials and energy efficiency.	http://www.pnl.gov/doesustainable/design/
14	TRILOGY	This program offers a complete one-stop introduction to a wide range of environmental issues and decisions that affect small to medium-sized communities.	http://www.epa.gov/seahome/trilogy.html
15	ReVA	This program is designed to produce the methods needed to understand a region's environmental quality and its spatial pattern.	http://amethyst.epa.gov/revatoolkit/Welcome.jsp
16	ABEL	Evaluates a corporation's or partnership's ability to afford compliance costs, cleanup costs or civil penalties	http://www.epa.gov/compliance/civil/econmodels/index.html
17	BEN	Calculates a violator's economic savings from delaying or avoiding pollution control expenditures	http://www.epa.gov/compliance/civil/econmodels/index.html
18	PROJECT	Calculates the real cost to a defendant of a proposed supplemental environmental project	http://www.epa.gov/compliance/civil/econmodels/index.html
19	INDIPAY	Evaluates an individuals ability to afford compliance costs, cleanup costs or civil penalties	http://www.epa.gov/compliance/civil/econmodels/index.html
20	MUNIPAY	Evaluates a municipality's or regional utility's ability to afford compliance costs, cleanup costs or civil penalties.	http://www.epa.gov/compliance/civil/econmodels/index.html
21	ECHO	A web based tool that provides public access to compliance and enforcement information for approximately 800,000 EPA regulated facilities.	http://www.epa.gov/echo/
22	BEES	It's a powerful technique for selecting cost-effective, environmentally preferable building products	http://www.epa.gov/opptintr/epp/tools/bees.htm
23	EPEAT	This tool helps the purchasers rank computer desktops, laptops and monitors based on their environmental attributes	http://www.epeat.net/
24	Environmental Benefits Calculator	This is used to compute environmental benefits from recycling carpets, personal computers, clay brick, aggregate and fly ash.	
25	EPP Database	This database will help you buy greener products and services.	http://yosemite1.epa.gov/oppt/epps/tand2.nsf

26	AIRMaster+	Provides comprehensive information on assessing compressed air systems, evaluating savings and effectiveness of energy efficiency measures.	
27	CVAT	This helps to compare the emissions and financial impacts for a range of energy-efficient and renewable energy products	http://www.climate-northeast.org/Business_tools.php
28	CWSAT	This tool is used to determine energy requirements of your system, and to evaluate opportunities for energy and costs savings by applying improvement measures	
29	CHP	This helps industrial users evaluate the feasibility of CHP for heating systems.	
30	ENERGY STAR	Compares buildings for track energy use and benchmark improvement over time, both for individual buildings and total portfolio.	http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfolio/manager
31	Energy Cost Calculator	This calculates the payback period for your retrofit project	http://www.eere.energy.gov/femp/procurement/eep_fluorescent_lamps_calc.cfm
32	ENERGY-10	This software integrates day lighting, passive solar heating, and low energy cooling strategies with energy efficient shell design and mechanical equipment.	http://www.sbicouncil.org/store/e10.php
33	EnergyPlus	A free building energy simulation program for modeling building heating, cooling, lighting, ventilating, and other energy flows.	http://www.eere.energy.gov/buildings/energyplus/
34	FSAT	Is used to help quantify the potential benefits of optimizing fan system configurations that serve industrial processes.	
35	Green Power Locator	Gives the information about green power options available.	http://www.epa.gov/greenpower/locator/index.htm
36	Home Energy Saver	It's an energy audit tool	http://hes.lbl.gov/
37	NxEAT	Helps plants in petroleum refining and chemical industries to assess and analyze NOx emissions and application of energy efficiency improvements	http://www1.eere.energy.gov/industry/bestpractices/software.html#nox
38	ChemPEP Tool	Provides chemical plant managers with the information they need to identify savings and efficiency opportunities	http://www1.eere.energy.gov/industry/bestpractices/software.html#nox
39	Power Profiler	It generates a report about your own electricity use.	http://www.epa.gov/cleanenergy/powerprofiler.htm

40	PHAST	Provides introduction to process heating methods and tools to improve thermal efficiency of heating equipment.	http://www1.eere.energy.gov/industry/bestpractices/software.html#nox
41	PSAT	Helps industrial users assess the efficiency of pumping system operations.	http://www1.eere.energy.gov/industry/bestpractices/software.html#nox
42	Roof Energy Cost Savings Calculator	It is designed to showcase the benefits of ENERGY STAR labeled roof products	http://roofcalc.cadmusdev.com/
43	Steam System Tool Suite	It highlights the potential steam system improvements of the plant.	http://www1.eere.energy.gov/industry/bestpractices/software.html#nox
44	WUFI-ORNL/IBP	This is a menu driven PC program which allows realistic calculation of the transient coupled 1D heat and moisture transport in multi-layer building components exposed to natural weather.	http://web.ornl.gov/sci/btc/apps/moisture/
45	ARIP	It's a collection of information on accidental releases of hazardous chemicals at fixed facilities	http://yosemite.epa.gov/oswer/ceppo/web.nsf/content/evalandstudy.htm#program
46	CAMEO	A system of software applications used widely to plan for and respond to chemical emergencies	http://www.epa.gov/ceppo/cameo/index.htm
47	IRIS Database for Risk Assessment	A database of human health effects that may result from exposure to various substances found in the environment	http://www.epa.gov/iris/
48	RMP Comp	This is an electronic tool used to perform the off-site consequence analysis	http://yosemite.epa.gov/oswer/ceppo/web.nsf/content/rmp-comp.htm
49	RMP Review	A free software program designed for reviewing and analyzing risk management plans	http://yosemite.epa.gov/oswer/ceppo/web.nsf/content/rmp_review.htm
50	RMP Submit 2004	It's a free official EPA personal computer software for facilities to use in submitting Risk Management Plans	http://yosemite.epa.gov/oswer/ceppo/web.nsf/content/ap-rmsb.htm
51	Tier2 Submit	It helps facilities prepare an electronic chemical inventory report	http://yosemite.epa.gov/oswer/ceppo/web.nsf/content/tier2.htm
52	TRI-ME	A tool to help facilities determine and complete their emergency planning	http://www.epa.gov/tri/index.htm
53	HPVIS	This system provides complete and easy access to technical health and environmental effect information on chemicals that are manufactured in exceptionally large amounts	http://www.epa.gov/hpvis/

54	REACH-IT	This system gives information about innovative remediation and characterization technologies	http://www.frtr.gov/matrix2/appd_a/appd_a.html
55	PARIS II	Computer program for solvent substitution or design	http://www.tds-tds.com/parfact.htm
56	TRACI	Quantification of human health and ecological impacts of chemicals	
57	P2P(MARK II)	Computer program for characterization of chemical pollutants and energy use	
58	LCA	Methodology of identifying and quantifying all impacts associated with a product, process, or activity life-cycle	
59	PAM	Statistical methodology for selecting the correct unit of product to measure pollution prevention	
60	PPOA	Methodology for doing materials balance to identify wastes and P2 options	
61	P2 Factors	Indicator of the general degree of environmental improvement resulting from implementing a P2 activity	
62	P2 Tools	Prototype computer program that integrates several tools(PPOA, P2P, ISP2 and Total Cost Assessment)	
63	ISP2	Computer program that estimates the quantity and cost of waste generation	
64	Air CHIEF	Provides access to air emission information pertaining to estimating the types and quantities of pollutants originating from various sources	http://www.epa.gov/ttn/chief/index.html
65	ChemSTEER	Uses EPA's Office of Pollution Prevention and Toxics latest workplace exposure and release methods to estimate environmental releases and worker exposures to chemicals used and/or manufactured	http://www.epa.gov/oppt/exposure/docs/chemsteer.htm
66	ECOSAR	Used for prediction of toxicity (long term and short term) of chemicals discharged into water bodies on aquatic organisms by implementing Structure Activity Relationships	http://www.epa.gov/oppt/newchems/21ecosar.htm
67	E-FAST	Used to provide estimates in terms of possible inhalation, ingestion and dermal dosage rates of chemical concentrations released to air, water, surface and landfills and also due to consumer products.	http://www.epa.gov/oppt/exposure/docs/efast.htm

68	EFRAT	Used to calculate environmental and health impact estimations of chemical process design options	http://es.epa.gov/ncercqa_abstracts/centers/cencitt/year3/process/shonn2.html
		<i>EPI Suite</i>	
69	BCFWIN	Used to calculate the BioConcentration factor and its logarithm from the log Kow	http://www.epa.gov/oppt/exposure/docs/episuite.htm
70	HENRYWIN	Used to calculate Henry's Law constant by use of group contribution and bond contribution methods	http://www.epa.gov/oppt/exposure/docs/episuite.htm
71	KOWWIN	Used to estimate log Kow	http://www.epa.gov/oppt/exposure/docs/episuite.htm
72	MPBPWIN	Used to estimate melting point, boiling point and vapor pressure of organic chemicals	http://www.epa.gov/oppt/exposure/docs/episuite.htm
73	PCKOCWIN	Used to estimate soil adsorption coefficient (Koc) of a chemical	http://www.epa.gov/oppt/exposure/docs/episuite.htm
74	WSKOWIN	Used to estimate octanol-water partition coefficient using algorithms in the KOWWIN software	http://www.epa.gov/oppt/exposure/docs/episuite.htm
75	AOPWIN	Used to estimate the gas-phase reaction rate of a chemical with the dominant atmospheric oxidant and hydroxyl radicals	http://www.epa.gov/oppt/exposure/docs/episuite.htm
76	BIOWIN	Used to estimate aerobic biodegradability of organic chemicals	http://www.epa.gov/oppt/exposure/docs/episuite.htm
77	HYDROWIN	For estimating Acid- and Base-catalysed hydrolysis constants of certain organic classes	http://www.epa.gov/oppt/exposure/docs/episuite.htm
78	LEV3EPI	Used to predict partitioning of chemicals between air, soil, sediment and water steady state for environment model defaults which can be changed by the user	http://www.epa.gov/oppt/exposure/docs/episuite.htm
79	STPWIN	Used to predict removal of chemicals in a sewage treatment plant by using EPIWIN outputs	http://www.epa.gov/oppt/exposure/docs/episuite.htm
80	WVOLMIN	Used to estimate rates of chemical volatilization of a chemical from rivers and lakes	http://www.epa.gov/oppt/exposure/docs/episuite.htm
81	FIRE	Is a DBMS that provides EPA's recommended emission estimation factors for criteria and hazardous air pollutants as well as industry emissions and emission factors	http://www.epa.gov/ttn/chief/software/index.html
82	GCES	Used to assess existing processes, build a green chemical process, design a new green chemical for	http://www.epa.gov/greenchemistry/tools.htm

		a new or existing chemicals	
83	Mackay Level III v 2.20	Used to map the life cycle of a chemical in the face of degradation and advection	http://www.trentu.ca/academic/aminss/envmodel/VBL3.html
84	OncoLogic	Used to predict carcinogenic capacity of chemicals	http://www.logicchem.com/index.html#onco
85	PARIS II	Provides solvent design capabilities which can suppress undesirable characteristics such as carcinogenicity, toxicity, etc. to choose a suitable chemical from an extensive	http://www.tds-tds.com/
86	TANKS	Used to estimate emissions due to working and standing losses for four major types of storage tank	http://www.epa.gov/ttn/chief/software/tanks/index.html
87	UCSS	Used to identify and screen chemical clusters for performing specific tasks and also to identify clusters in terms of hazards	http://www.epa.gov/oppt/exposure/docs/ucss.htm
88	WAR	This is a method used to provide a measure of the impact of generated wastes, which is then compared to indexes from other possible designs of the same process to obtain a more environmentally friendly design of the process in question	http://www.epa.gov/oppt/greenengineering/software.html
89	ERATE	Used to calculate emission rates for accidental and toxic releases under different conditions	http://www.epa.gov/ORD/NRMRL/std/sab/sim_war.htm
90	CAGE	This is a coatings alternative guide developed as comprehensive material substitution tool for coatings	http://cage.rti.org
91	CHETAH	Used to predict thermochemical properties and potential reactive chemical hazards of chemicals, chemical reactions and chemical mixtures	http://www.astm.org
92	P2 Library	It is a comprehensive resource for information on equipment, technologies, and management practices pollution prevention efforts at joint service installations.	http://p2library.nfesc.navy.mil/
93	ISSDS	It was developed to access solvent alternative information through a single, easy to use command structure.	http://es.epa.gov/issds/
94	GREENBIZ LEADRES	It shows hundreds of examples of how companies of all sizes and sectors align environmental responsibility with business success	http://www.greenbiz.com/toolbox/
95	P2 OASYS	This tool helps companies determine whether the TUR options being considered may have unforeseen negative environmental impacts.	http://www.turi.org/content/content/view/full/1125/

96	CLEANTOOL	This is a wide database for metal cleaning	http://www.cleantool.org
97	GLRPPR	This tool quantifies the projected environmental benefits of purchasing and using “green” janitorial services and products.	http://www.ofee.gov/janitor/index.asp

CHAPTER 4

TOOLS DEVELOPED AT THE UNIVERSITY OF TOLEDO

These tools have been developed to assist small and medium sized industries in their pollution prevention efforts [7]. The theoretical basis of the tools is given in Appendix A. The software are available free of charge on the website www.p2tools.utoledo.edu. Detailed instructions are provided on the site and users also have access to user's manuals (see Appendix B) and PowerPoint slides (see Appendix C) to learn the use of these tools.

Tool	What it Does	Website
GAP Assessment Tool	This tool performs a GAP analysis, based on ISO 14001, to gauge the implementation of an Environment Management System in a facility	www.p2tools.utoledo.edu
MSDS Manager	This is a software tool that enables the user to maintain an electronic database of MSDS sheets	www.p2tools.utoledo.edu
Emissions Reduction Calculator	The tool calculates the reduction in emission of three criteria pollutants (CO ₂ , NO _x and SO ₂) that can be achieved by reducing energy consumption	www.p2tools.utoledo.edu
Lean Assessment Tool	The software can be used for a screening assessment of the amount lean and green engineering implemented in a facility	www.p2tools.utoledo.edu
HVAC Checklist	The checklist provides a list of measures to improve an existing HVAC system to make it more energy efficient	www.p2tools.utoledo.edu
Energy Assessment Spreadsheet	This provides complete break-up summaries of the total annual energy consumption and cost	www.p2tools.utoledo.edu
Hybrid HVAC System Design Tool	This is used to design HVAC systems for a manufacturing facility and associated office building	www.p2tools.utoledo.edu
Building Sustainability Tool	It helps in evaluating the sustainability of building elements, indoor environment and the occupant behavior, which affects the indoor living quality	www.p2tools.utoledo.edu
Hospital Assessment Tool	It's a technique that provides technical support to the healthcare industry for selecting products and work practices to eliminate or reduce occupational and environmental hazards, and to maintain quality patient care	www.p2tools.utoledo.edu

CHAPTER 5

CONCLUSION

This guide presents more than 50 web sites based on a review of over 500 sites. Information on these web sites related to pollution prevention methodologies, tools, software, databases etc. is included to assist in your initial selection. The web site addresses included in this guide represent the most current information available. However, the contact address is subject to change as web sites change, publications change ownership or as staff leave existing positions.

A list of 97 tools presented in this publication is also subject to change. There may be more tools available on the internet.

Nine new tools, the GAP Assessment tool, MSDS Manager, Emission Reduction Calculator, Lean Assessment Screening tool, HVAC Checklist, Energy Assessment Spreadsheet, Hybrid HVAC System Design Tool, Building Sustainability Tool and Hospital Assessment Tool are available for download from the website: <http://www.p2tools.utoledo.edu>. The tools are being further tested and upgraded.

LITERATURE CITED:

1. Theodore, L. and C. M. Young, "Pollution Prevention", Van Nostrand Reinhold, New York (1992).
2. U. S. Environmental Protection Agency, "Pollution Prevention 1997: A National Progress Report", Office of Pollution Prevention and Toxics, U.S. EPA, Washington, DC (1997).
3. Mulholland, K. L. and J. A. Dyer, "Pollution Prevention: Methodology, Technologies, and Practices", AIChE, 214pp (1998).
4. Berger, S. A., "Pollution Prevention: The need is Stronger Than Ever", Environmental Progress, 19 (1), S3 (2000).
5. R. Kumar, A. Kumar and N. Shah, "A Guide to Workplace Environmental Health and Safety: Internet Sites and Databases on CDs", Environmental Progress, 18(4), W7-W12 (1999).
6. Kumar R. and A. Kumar, "Introduction to WWW.ISO14001.COM", Environmental Progress, 16 (3), F13-F15 (1997).
7. Kumar A., S. Thomas and S. Ojha, Pollution Prevention Tools for Small and Medium Sized Industries, 2002 AWMA Annual Conference, 2002.
8. A. Kumar, S. J Thomas and S. Ojha, "Pollution Prevention Tools For Small And Medium Sized Industries", CD for Proceedings of the 2002 Conference, AWMA
9. Environmental Protection and Waste Services Division,
<http://www.ornl.gov/adm/ornlp2/p2define.htm>, Accessed July 2006.
10. United States Environmental Protection Agency,
<http://www.epa.state.oh.us/opp/planning/fact1.html>, Accessed July 2006.
11. Indiana Department of Environmental Management,
<http://www.in.gov/idem/prevention/awards/govawards/p2definition.html>, Accessed July 2006.
12. The Oklahoma State Courts network,
<http://www.oscn.net/applications/oscn/DeliverDocument.asp?CiteID=78959>, Accessed July 2006.
13. Florida Department of Environmental Protection,
<http://www.floridadep.org/air/programs/p2.htm>, Accessed July 2006.