A Guide to Pollution Prevention Tools

Prepared by

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Abstract

Growing awareness to the problem of pollution and regulatory policies by government and environmental agencies have created a lot of interest in the area of pollution prevention.

Today, to feed this enormous interest in pollution prevention, various aids are available on the Internet in helping a layperson, 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 all pollution prevention aids available on the Internet.

This guide also showcases the P2 tools developed by the Air Pollution Research Group at the Department of Civil Engineering, University of Toledo as a part of the Pollution Prevention Incentives for States Grant from the US EPA.
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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]. In a recent editorial 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.

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 APRG at the University of Toledo that are available for pollution prevention.
CHAPTER 2

GENERAL POLLUTION PREVENTION INFORMATION ON INTERNET

The growth of information available on the Internet/World Wide Web 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 Net. 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 World Wide Web has been presented under following categories:

1. General pollution prevention information on Internet.
2. Material substitution.
3. Recycling information.
4. Green design for the environment.
5. State Internet programs.
6. Academic resource centers.
7. Environment, health and safety.
9. Total quality management.
10. Water Quality.
11. Affirmative procurement.
12. Life cycle analysis/Life cycle assessment.

- **Agriculture Compliance Assistance Center (AgCenter) –** [http://es.epa.gov/oeca/ag/](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.

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

- **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](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/](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.


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/](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](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](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.

  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/](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.

**MATERIAL SUBSTITUTION**

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


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.

RECYCLING INFORMATION


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.


  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.

**GREEN DESIGN FOR THE ENVIRONMENT**


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


  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](http://greenmfg.me.berkeley.edu/green/Home/Index.html)
Research, publications, contacts and green design software is available at site.

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/
- 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
- 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/

ACADEMIC RESOURCE CENTERS

- The National Pollution Prevention Center (NPPC) for Higher Education - 
  http://www.umich.edu/~nppc/pub/index.html
The site provides educational material to universities, professionals and the public. The NPPC actively collects, develops and disseminates pollution prevention educational materials.

ENVIRONMENT, HEALTH, AND SAFETY

- **DOE’s Safety & Health Technical Information Services** – [http://tis.eh.doe.gov/portal/home.htm](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.

  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.

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

- **[http://www.osha.gov/-](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/](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.

ENERGY CONSERVATION


  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.


  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/cwweb/index.htm](http://www.epa.gov/oppeinet/oppe/climwise/cwweb/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.

  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.


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.

TOTAL QUALITY MANAGEMENT / ISO 14000


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


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].

WATER QUALITY


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.
AFFIRMATIVE PROCUREMENT

  
  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/](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.

LIFE CYCLE ANALYSIS/LIFE CYCLE ASSESSMENT (LCA)

- **ECOSITE** – [http://www.ecosite.co.uk/](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](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](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.
In the face of the various technological advancements, it is only natural that software and information technology will be put to use in environmental fields. Today, tools that aid P2 experts, planners and mitigators and even house owners are being developed, which can be applied to different areas of an industrial process. 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.

<table>
<thead>
<tr>
<th>Software</th>
<th>Purpose</th>
<th>Website Address</th>
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<tbody>
<tr>
<td>Air CHIEF</td>
<td>Provides access to air emission information pertaining to estimating the types and quantities of pollutants originating from various sources</td>
<td><a href="http://www.epa.gov/ttn/chief/index.html">http://www.epa.gov/ttn/chief/index.html</a></td>
</tr>
<tr>
<td>ChemSTEER</td>
<td>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</td>
<td><a href="http://www.epa.gov/oppt/exposure/docs/chemsteer.htm">http://www.epa.gov/oppt/exposure/docs/chemsteer.htm</a></td>
</tr>
<tr>
<td>ECOSAR</td>
<td>Used for prediction of toxicity (long term and short term) of chemicals discharged into water bodies on aquatic organisms by implementing Structure Activity Relationships</td>
<td><a href="http://www.epa.gov/oppt/newchems/21ecosar.htm">http://www.epa.gov/oppt/newchems/21ecosar.htm</a></td>
</tr>
<tr>
<td>Tool</td>
<td>Description</td>
<td>Website</td>
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<td>-------------------------------------------------------------------------</td>
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<tr>
<td>E-FAST</td>
<td>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.</td>
<td><a href="http://www.epa.gov/oppt/exposure/docs/efast.htm">http://www.epa.gov/oppt/exposure/docs/efast.htm</a></td>
</tr>
<tr>
<td>EFRAT</td>
<td>Used to calculate environmental and health impact estimations of chemical process design options</td>
<td><a href="http://es.epa.gov/ncerqa_abstacts/centers/cencitt/year3/process/shonn2.html">http://es.epa.gov/ncerqa_abstacts/centers/cencitt/year3/process/shonn2.html</a></td>
</tr>
<tr>
<td><strong>EPI Suite™</strong></td>
<td></td>
<td><a href="http://www.epa.gov/oppt/exposure/docs/episuite.htm">http://www.epa.gov/oppt/exposure/docs/episuite.htm</a></td>
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<tr>
<td>BCFWIN</td>
<td>Used to calculate the BioConcentration factor and its logarithm from the log Kow</td>
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<tr>
<td>HENRYWIN</td>
<td>Used to calculate Henry’s Law constant by use of group contribution and bond contribution methods</td>
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<tr>
<td>KOWWIN</td>
<td>Used to estimate log Kow</td>
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<tr>
<td>MPBPWIN</td>
<td>Used to estimate melting point, boiling point and vapor pressure of organic chemicals</td>
<td></td>
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<tr>
<td>PCKOCWIN</td>
<td>Used to estimate soil adsorption coefficient (Koc) of a chemical</td>
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<tr>
<td>WSKOWIN</td>
<td>Used to estimate octanol-water partition coefficient using algorithms in the KOWWIN software</td>
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<tr>
<td>AOPWIN</td>
<td>Used to estimate the gas-phase reaction rate of a chemical with the dominant atmospheric oxidant and hydroxyl radicals</td>
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<tr>
<td>BIOWIN</td>
<td>Used to estimate aerobic biodegradability of organic chemicals</td>
<td></td>
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<tr>
<td>HYDROWIN</td>
<td>For estimating Acid- and Base-catalysed hydrolysis constants of certain organic classes</td>
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<tr>
<td>LEV3EPI</td>
<td>Used to predict partitioning of chemicals between air, soil, sediment and water under steady state for environment model defaults which can be changed by the user</td>
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<tr>
<td>STPWIN</td>
<td>Used to predict removal of chemicals in a sewage treatment plant by using EPIWIN outputs</td>
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<tr>
<td>WVOLMIN</td>
<td>Used to estimate rates of chemical volatilization</td>
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of a chemical from rivers and lakes

**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/tnn/chief/software/index.html](http://www.epa.gov/tnn/chief/software/index.html)

**GCES**
Used to assess existing processes, build a green chemical process, design a new green chemical for a new or existing chemicals
[http://www.epa.gov/greencemistry/tools.htm](http://www.epa.gov/greencemistry/tools.htm)

**Mackay Level III v 2.20**
Used to map the life cycle of a chemical in the face of degradation and advection losses
[http://www.trentu.ca/academic/aminss/envmodel/VBL3.html](http://www.trentu.ca/academic/aminss/envmodel/VBL3.html)

**OncoLogic**
Used to predict carcinogenic capacity of chemicals

**PARIS II**
Provides solvent design capabilities which can suppress undesirable characteristics such as carcinogenicity, toxicity, etc. to choose a suitable chemical from an extensive database

**TANKS**
Used to estimate emissions due to working and standing losses for four major types of storage tanks

**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](http://www.epa.gov/oppt/exposure/docs/ucss.htm)

**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/ORD/NRMRL/std/sab/sim_war.htm](http://www.epa.gov/ORD/NRMRL/std/sab/sim_war.htm)
ERATE  Used to calculate emission rates for accidental and toxic releases under different conditions

CAGE  This is a coatings alternative guide developed as comprehensive material substitution tool for coatings
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. 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 manuals and PowerPoint slides to give a better understanding of the tools.

<table>
<thead>
<tr>
<th>Tool</th>
<th>What it does</th>
<th>Website</th>
</tr>
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<tbody>
<tr>
<td>GAP Assessment Tool</td>
<td>This tool performs a GAP analysis, based on ISO 14001, to gauge the implementation of an Environment Management System in a facility</td>
<td><a href="http://www.p2tools.utoledo.edu">www.p2tools.utoledo.edu</a></td>
</tr>
<tr>
<td>MSDS Manager</td>
<td>This is a software tool that enables the user to maintain an electronic database of MSDS sheets</td>
<td><a href="http://www.p2tools.utoledo.edu">www.p2tools.utoledo.edu</a></td>
</tr>
<tr>
<td>Emissions Reduction Calculator</td>
<td>The tool calculates the reduction in emission of three criteria pollutants (CO₂, NOₓ and SO₂) that can be achieved by reducing energy consumption</td>
<td><a href="http://www.p2tools.utoledo.edu">www.p2tools.utoledo.edu</a></td>
</tr>
<tr>
<td>Lean Assessment Screening Tool</td>
<td>The software can be used for a screening assessment of the amount lean and green engineering implemented in a facility</td>
<td><a href="http://www.p2tools.utoledo.edu">www.p2tools.utoledo.edu</a></td>
</tr>
</tbody>
</table>
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 paper 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. The list of tools presented in this publication is also subject to change.
LITERATURE CITED:


APPENDIX A

THEORETICAL BASIS OF THE TOOLS

GAP Assessment Tool

The tool is in a question and answer format and has been prepared using MS Excel and Visual Basic. The tool is in a spreadsheet format and the results can be printed out in text or chart form. It is intended to serve as a self-assessment for industries, which want to assess the scope of implementation of ISO 14001 Environmental management systems in their establishment or facility. The checklist of questions answerable in Yes/No format has been prepared based on various sources ranging from the International Standards Organization (ISO) website and various industry manuals and documentation of ISO 14001 practices. It has been divided into multiple sections and the level of implementation in each area can be viewed in the chart in terms of percentages.

Significance of ISO 14001: An ISO 14000 based EMS is a management tool enabling an organization of any size or type to control the impact of its activities, products or services on the environment. An environmental management system makes possible a structured approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved.

ISO 14000 was developed with another aim: that of providing a framework for an overall, strategic approach to your organization’s environmental policy, plans and actions. ISO 14001 specifies the requirements for such an environmental management system. Fulfilling these requirements demands objective evidence, which can be audited to demonstrate that the environmental management system is operating effectively in conformance with the standard.
ISO 14001 is a tool that can be used for internal purposes: to provide assurance to management that you are in control of your processes and activities having an impact on the environment. Employees, in turn, may be happier if assured that they are working for an environmentally responsible organization.

ISO 14001 can also be used for external purposes: to provide assurance to interested parties – stakeholders – such as customers, the community and regulatory agencies.

**MSDS Manager**

**Theoretical Basis**

The MSDS Manager is a software tool that enables the user to maintain an electronic database of MSDS sheets. By using this tool an user can upload scanned MSDS sheets of a chemical in a database and print it if required. The individual MSDS sheets can be retrieved from the database as and when required.

**Importance of Material Safety Data Sheets (MSDS):** A Material Safety Data Sheet (MSDS) is a document that contains information on the potential health effects of exposure and how to work safely with the chemical product. The MSDS contains much more information about the material than the label and is prepared by the supplier. It is intended to tell what the hazards of the product are, how to use the product safely, what to expect if the recommendations are not followed, what to do if accidents occur, how to recognize symptoms of overexposure, and what to do if such incidents occur.
Emissions Reduction Calculator

Theoretical Basis

The Emission Reduction Calculator (ERC) tool has been designed to calculate the reduction in emissions of three criteria pollutants (SO$_2$, NO$_x$ and CO$_2$) that can be achieved by reducing consumption of solid, liquid and gaseous fuels. The ERC tool also calculates the reduction in emission for these criteria pollutants for any energy conservation project. The theoretical basis of the ERC tool stems from the fact that for every ton of solid, liquid or gaseous fuel saved there is a corresponding amount of reduction in emission of the criteria pollutants mentioned above. Similarly in the case of energy conservation project, the theoretical basis stems from the fact that for every kWh of electricity saved there is a corresponding reduction in emission of the pollutants. The analogy in this case is that for saving a kWh of electricity there is a corresponding reduction in consumption of fuel used. The US Environmental Protection Agency (EPA) has developed emission factors for different states of US for performing these calculations. These emission factors as finalized by EPA form the basis of calculations performed by the ERC tool. The tool uses the following formulae for calculating the reduction in the emissions:

For Utilities and Non Utilities

1. **Reduction in SO$_2$ emissions** (lbs/yr) = $W*S*E_f$

   where $W$ is the amount of fuel saved in tons/yr;
   
   $S$ is the amount of sulfur present in percentage; and
   
   $E_f$ is the emission factor (lbs/ton)

2. **Reduction in NO$_x$ emissions** (lbs/yr) = $W*E_f$

   where $W$ is the amount of fuel saved in tons/yr; and
E_f is the emission factor (lbs/ton)

3. **Reduction in CO₂ emissions = W*H*E_f**
   
   where W is the amount of fuel saved in tons/yr
   
   H is the calorific value (Btu/ton); and
   
   E_f is the emission factor (lbs/10^6 Btu)

**For Energy Conservation Project**

The respective emission factor for each of the three pollutants (SO₂, CO₂ and NOₓ) is multiplied by the reduction in amount of kWhs saved. The general formula used is:

**Reduction in emission = N*E_f**

where N is the no. of kWhs saved

E_f is the respective emission factor.

**Lean Manufacturing Screening Tool**

**Theoretical Basis**

The lean tool is intended to be a screening tool for establishments that want to assess the level of lean practices being implemented in their facilities. The software is designed in Visual Basic and it assesses the implementation of lean practices and also provides general directions for implementation of lean practices in their respective facilities. As lean manufacturing and lean engineering are vast topics and specific implementation varies for every factory, hence the effort has been directed toward building a screening tool so as to give an overall general idea. The entire assessment has been divided into 4 sections to enable greater understanding of the various
facets of lean industrial practices. Care has been taken to include green practices in the assessment to showcase how following environment friendly measures will help not just the organization save money and also contribute to pollution prevention.

**Significance of Lean practices:** Lean manufacturing principles represent a radical departure from traditional plant techniques. The employee’s roles, skill-sets, process-requirements, and rules have changed. Team members must operate like an independent business with total responsibility for the quality, manufacturing and delivery of the product to their customers. Team members need to be empowered with current information, dedicated resources, and established boundaries to accomplish their mission.

Lean Strategies are the application of quantitative methods and human resources to improve the material and services supplied to an organization, all the processes within an organization, and the degree to which the needs of the customer are met, now and in the future.

Lean Manufacturing integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach focused on Kaizen-Continuous Improvement. Lean manufacturing has turned motion reduction into a science and an art.
Chapter 1

How to Begin

1.1. System Requirements:

To run GAP Tool, you need the following:

- A PC with an Intel Pentium Processor (or 100% compatible)
- 32 MB RAM or higher recommended
- Hard disk (minimum 10MB space to start with)
- Windows 95, 98, 2000 or NT (Windows 2000 recommended)
- A mouse or compatible pointing device
- A VGA monitor (15 inch VGA or higher recommended)
- An Internet connection
- A suitable browser (Internet Explorer 5.0 recommended)
- MS Excel 2000

1.2. Installing GAP Tool:

- Connect to the Internet and open the browser window
- Type in the URL: www.eng.utoledo.edu/~akumar/ppistools/ppistools.htm
- Click on the icon : GAP ANALYSIS
- Download the Excel file (.xls) named Gap Assessment.
- The Following message will appear:
Figure 1

Click the second button: "Enable Macros"

Soon, an Excel spreadsheet will open and a visual basic form too. If you wish to proceed follow the instructions below from the second instruction onward.

Else, close the form and click on the save icon of the Excel file.

The following window appears:

Figure 2: “Save As” Window

Save the tool onto your desktop. The circled area in the figure above should show “Desktop” before the “save” button on the bottom right-hand corner is clicked.
1.3. Starting GAP Tool:

➤ Locate the Excel file and double click on it
➤ The Excel file also known as the spreadsheet will open
➤ Thereafter a form will also open which is displayed in Figure 3

![GAP Analysis Tool](image)

**Figure 3**

On clicking “Proceed”, the assessment begins. The next few pages describe the working of the tool.

1.4. Over view of GAP Tool

1.4.1. Screens:
Controls on the Spreadsheet

The semi-transparent area shows the location of the “Spreadsheet buttons”

By clicking on the “Plot”, you can view the chart

To view the Spreadsheet, click on “Gap Analysis”

The Figure below shows that the chart is being viewed, i.e., when the PLOT button is highlighted.

If the Gap Analysis is clicked, then the spreadsheet appears as follows:
**Interactive Components of the Spreadsheet**

**User Options**

**Figure 7**

- **“Analyse”** Option: On selecting this option, You can view the assessment forms.
- **“Clear”** Option: By selecting this option, you can clear the current analysis and start afresh.
- **“Project Name”** Option: This selection opens a form wherein, the project details, such as company/facility name and date can be entered.
User Instructions

The selections “Open File” and “Save File As” are instructions for the user to follow. In case he/she needs to open a previous gap assessment that has been saved under a different name, he/she can follow the “Open File” instructions.

If, however, the assessment first needs to be saved under a separate name, then the “Save File As” instructions provide the directions to be followed to effect this operation.

The “Open File” instructions:
The “Save File As” instructions:

![Save File As Instructions](image)

Assessment Screens

The 9 screens cover different portions of the assessment and the questions are to be answered in the Yes/No format. One such screen is displayed below.

![Assessment Screen](image)
1.4.2. Command Buttons:

**Proceed Button**

![Proceed Button Image]

Figure 13

On hitting the proceed button you will be taken to the next screen.

**Save & Exit Button**

![Save & Exit Button Image]

Figure 14

On hitting the “Save & Exit” button you can save your answers to the spreadsheet and quite the screens.

**Exit Button**

![Exit Button Image]

Figure 15

On hitting the “Exit” button, you can exit the tool.

*Be sure you save changes into your spreadsheet before you click exit.*

**Exit Analysis Button**
On hitting the “EXIT ANALYSIS” button you can exit the tool itself.

**Previous Button**

On hitting the “Previous” button you can move back to the previous form.

**Evaluate Button**

On hitting the “Evaluate” button you can view the complete spreadsheet of GAP Assessment.

**View Chart Button**

On hitting the “View Chart” button, you can view a chart that shows in detail, the extent of ISO 14000 compliance in terms of percentage.
The Spreadsheet Toolbar

![Spreadsheet Toolbar Image]

Figure 20

**Save**: Click the save button to save your excel document

**Print**: Click the print button to print out the spreadsheet or the graph

**Please note**: Whenever you will exit the tool after completing an assessment you may be prompted if you wish to save the document, please click “Yes”.

Chapter 2

Working with the GAP tool
This chapter gives an example for using the tool. We hope this helps to clear any lingering doubts that you might have.

The tool is an Excel document, which means there are two ways to open the tool:

First, Open MS Excel and select the Open option from the File option as shown below:

![Fig 21](image1.png)

This will open a window, wherein you must browse to the folder where you have saved the tool.

![Fig 22](image2.png)

The second method is to open the tool using Windows Explorer. Navigate through the Explorer to the folder where you have saved the tool.
Starting the Assessment

The first form that opens will ask you what you want to do with the tool. You can either Proceed to the Analysis or view the Spreadsheet if you wish, by clicking the Exit Analysis button. Later, if you want to start the analysis, Select Analyse from the User Options box provided on the spreadsheet.

The result of clicking Proceed or selecting the Analyse option from User Options will result in the opening of a set of questionnaires that have to be answered in Yes or No as shown below.

![Questionnaire example](image.png)

Fig 23

Fig 24
At any time that you feel that you want to exit the assessment click on **Save & Exit**. The tool closes the assessment forms but not before saving the portion of the assessment that you have already completed onto the spreadsheet which you can now view.

Now, if you have finally completed your assessment, you will at the last form which will appear as this:

![Management Review](image)

If you click on **Evaluate** you can view the completed spreadsheet. Otherwise, if you want to view the chart, then, on clicking **View Chart**, you can see a chart of the assessment.

You will probably want to enter the name of your **Project or Company Details**. You can choose the **Project Name** from **User Options**. Enter **Name and Date** of the assessment.

The **User Options** also have a **Clear** option. This option is good if you want to start the assessment afresh.

There may arise at some point of time, a need to run more than 1 assessment at the same time. The tool is basically an **Excel** file and there is no database incorporated with it. But the solution would be to use the Save As option from the File option of MS Excel as shown:
**Note!!**

Once you are through with the assessment and you want to exit the tool, always **Save** the file, or answer **Yes** to the prompt when Excel asks you if you want to save the changes to the file.

We hope you enjoy using the tool.
Chapter 3

Example of a Complete Assessment

In this example, we will consider a facility in Toledo, Ohio that manufactures auto parts and is owned and operated by Acme Corporation.

**STEP 1**

The assessor has downloaded and saved the tool as per the instructions given in Chapter 1. Now, he opens the tool on his laptop when he visits the facility. The tool opens in MS Excel and a prompt opens as shown in Figure 1. The second button “Enable Macros” is clicked to open the tool.

**STEP 2**

The first screen (Figure 3) asks whether he wants to proceed with the assessment, but the assessor prefers to look at the spreadsheet before proceeding by clicking the “Exit Analysis” button.

If however, he had wished to proceed with the assessment, he could have done so by clicking “Proceed”. The STEP 3 would then be executed at the end of the assessment.

**STEP 3**

The first thing to do would be for him to enter the Project details. For this, he chooses “Project Name” from the user options and enters the details along with the date on which the assessment is being conducted on the screen that opens up when the option is selected.

![User Options](select below)

![Analyse](Clear)

![Project Name](Figure 27)
On clicking “OK”, the values are entered onto the spreadsheet and chart.

**STEP 4**

The next step is to commence with the assessment. This is done by selecting “Analyse” from the “User Options”.

The resulting screen is the first of a series of 9.

**STEP 5**

The assessor begins to answer the questions on the screen and when he is done with all the questions on a particular screen, he clicks on the “Proceed” button to close the current screen and move to the next.
Note: Information on the command buttons on the assessment screens, including “Proceed” button described above, is available in ‘Chapter 1, section 1.4.2 Command Buttons’.

**STEP 6**

The questions are answered by clicking on the button in the box and choosing **Yes** or **No** from the options.

**Specific Instructions**

The assessor answers all the questions on the first and second screens and moves to the third. He completes the section “4.3.3 Objectives and Targets” but finds that there is no information available on the next section “4.3.3 Environmental Management Program”. He now has to quit the tool and come back later for the information. He clicks the “Save” button on the MS Excel toolbar (refer Figure 20) and quits the application.

**STEP 7**

The assessor returns to the facility and continues with the assessment. He follows **STEP 1** and when the first screen comes up (Figure 3), he clicks “**Proceed**” to open up the first assessment screen (Figure 29). The answers are already complete. The third assessment screen is now reached by clicking “**Proceed**” buttons on the assessment screens till the incomplete screen is reached.

**STEP 8**

The assessor continues where he left off and completes the assessment. He is at the last screen, which is shown below.
STEP 9

The next option available to the assessor is whether to view the spreadsheet or the chart. The assessor clicks on the “View Chart” button to generate the chart.
To view the spreadsheet, the assessor clicks on the “Gap Analysis” button on the bottom left of the sheet as shown by the arrow in the Figure 31 above. The same applies vice versa. After clicking “Evaluate” in the last screen instead of the “View Chart” button, the assessor can view the chart by clicking on the “PLOT” button which is indicated by an arrow in the Figure 32 below.
STEP 10 (Useful General Instruction)
The assessor realizes that he has that he some more assessments coming up. So to generate copies of the tool and to leave the current assessment as it is, he follows the “Save File As” Option from the User Instructions. As per the instructions, he selects the “Save File As” option from the File Options on the top left corner. This generates a new file which by default has the same name as the first file. This, however, can be changed and the assessor does so. He then opens this new file and selects “Clear” option from the User Options and this removes all the old data from the tool and it is ready for use in the next assessment. The assessor generates new files for his assessments as per his need.
USER’S MANUAL FOR MSDS MANAGER

(beta version)

Ashok Kumar
Sandys Thomas
Sunil Ojha
Amit Joshi
Chapter 1
How To Begin

1.1. System Requirements:

To run MSDS Manager software, you need the following:

- A PC with an Intel Pentium Processor (or 100% compatible)
- 32 MB RAM or higher recommended
- Hard disk (minimum 10MB space to start with)
- Windows 95, 98, 2000 or NT
- A mouse or compatible pointing device
- A VGA monitor (15 inch VGA or higher recommended)
- An Internet connection
- A suitable browser (Internet Explorer 5.0 recommended)
- A Scanner to scan MSDS sheets
- A suitable scanning software package (ScanWorks recommended)

Chapter 2
Working with MSDS Manager
The MSDS Manager starts with the main form

The main form offers three options, each of which can be accessed by clicking the appropriate button.

![Main Form](image)

**Figure 1: Main Form**

On **Click** of the first option namely “To View, Search or Display MSDS Sheets”,

The following form is opened.
The Display form, as its name suggests, displays the MSDS sheets that have been added to the database.

To view a particular MSDS sheet, click the down button of the list box as shown below:

Click on the relevant chemical

Instantly, the first page of the MSDS of that chemical shall appear
Figure 4: First page of MSDS of selected being displayed

Buttons on the Display form:

- “First” Button

Figure 5: “First” Button

The First button allows the user to instantly access the first sheet of an MSDS
“Previous” Button

Figure 6: “Previous” Button

The Previous button allows the user to view the previous sheet of an MSDS sheet.

“Next” Button

Figure 7: “Next” Button

The Next button opens the succeeding sheet of the MSDS.

“Last” Button

Figure 8: “Last” Button

The Last button displays the last sheet of an MSDS.

“Exit” Button

Figure 9: “Exit” Button

The Exit Button allows the user to return to the first form.

“Print” Button
Figure 10: “Print” button

Using this button, you can print out the sheet that is on view.

The Browse Form

On clicking the second option in the main form, namely “To Add More Chemicals or MSDS sheets”, the following form called the Browse Form is displayed.

![Figure 10: The Browse form]

Note: The MSDS sheets to be stored in the MSDS Manager database must be scanned and saved into storage devices such as zip disks, floppy disks or the PC’s hard drive as image files.

The first step:
As the Browse form shows, the Name of the Chemical and CAS number of that chemical must be entered by the user in the text boxes provided

**The second step:**
The form then directs you to select the type of image file and to click the **Browse** button in order to select the file and directory

*Image File Type List Box*

![Image File Type List Box](image11.png)

Figure 11: The image file type list box

The list box shows a default value of “All Files and Folders (*.*)

To change this setting, Click on down arrow button and select the image file type

*The “Browse” Button*

![Browse Button](image12.png)

Figure 12: The “Browse” button

After selecting the file type, clicking the browse button opens a window which allows you to select the directory and file in which you have stored the scanned documents
The third step:

After selecting the relevant file/folder from the browse window, you will find the contents of that file/folder in the window on the bottom left. Just above the window the path of the target folder is displayed.
Figure 14

Note: The files displayed in the window are just examples. No such files will accompany the package.

The fourth step:

To select the necessary image files, click on the relevant files and when done click on the “Double Arrow” Button which is displayed below:

![Double Arrow Button](image)

Figure 15: “Double Arrow” Button

On clicking the double arrow button the selected image files are transferred to the window on the right. These files can be entered into the database of MSDS Manager by clicking the “Save” Button which is displayed below:

![Save Button](image)

Figure 16: “Save” Button

Other Button Commands

- “Clear”

![Clear Button](image)

Figure 17: “Clear” Button

The “Clear” button clears the right window if any mistaken entries have been made.

- “Rescan”

![Rescan Button](image)
Wrong entries of file type can be corrected by changing the file type in the list box and clicking the Rescan Button. The left window instantly displays the file types selected in the list box.

You can go back to the main form by clicking this button.

Working with the MSDS Manager

An example to illustrate the Use of the Software

We will go through the process of adding a new chemical to the database.

The chemical is antimony 0, 0-dialkylphosphorodithioate. The CAS number is 64742-52-5.

The individual MSDS pages have been scanned and saved into a zip disk. The files can also be saved in a hard drive or floppy drive.

Start the MSM tool. The main form opens up. Click on the second option "To add more chemicals or MSDS sheets".
The browse screen opens up and we enter in the name of the chemical and its CAS number in the text boxes provided as shown below:

![Figure 21](image1.png)

The next step is to select the file type, which, in this example are all .bmp files i.e. bitmap images. See the Figure 22 below:

![Figure 22](image2.png)
**Note:** If you had selected a file in a particular format (for example: in .jpg format), then by using the rescan button, you could reselect the file type to search/browse for.

After you press the **Browse** button, a dialog box opens up; browse thru and select the folder where you have stored the image files. In this example, the zip disk is the **G:** drive. The files are in a file called *msdsfiles*. The dialog box is shown below. The folder *msdsfiles* has been highlighted because it has been selected. All that remains to be done is to click **OK**.

![Dialog box for selecting images](image)

The result of clicking **OK** is that the bitmap image files in the folder are displayed in the bottom left window. Just above the window, you can see the folder from which the files were extracted.
We have to transfer the files to the database. This is done by clicking on the file and then, clicking the double arrow button.
One by one, all the files are transferred to the database. The last step is to click “Save”. This saves the files to the database.

*Note: Please remember to transfer the files in the correct to ensure that the files are in correct order when being stored in the database.*

These saved files can now be viewed. Click **Exit** to return to the main form. Click on the first option button:

The **Display forms** opens up.
The list box that has been opened shows the chemicals that are in the database. Select the chemical that you want to view. The first page of the MSDS opens up. Navigations buttons are explained in the first chapter. Click exit to return to the main form and close.
USER MANUAL

Emission Reduction Calculator

(beta version)

Ashok Kumar
Sandys Thomas
Sunil Ojha
Amit Joshi
Chapter 1

Getting Started

1.2. System Requirements:

To run Emission Reduction Calculator software, you need the following:

- A PC with an Intel Pentium Processor (or 100% compatible)
- 32 MB RAM or higher recommended
- Hard disk (minimum 10MB space to start with)
- Windows 95, 98, 2000 or NT
- A mouse or compatible pointing device
- A VGA monitor (15 inch VGA or higher recommended)
- An Internet connection
- A suitable browser (Internet Explorer 5.0 recommended)

1.3. Installing Emission Reduction Calculator:

- Connect to the Internet and open the browser window
- Go to the site www.eng.utoledo.edu/~akumar/ppistools/ppistools.htm
- Click on the icon ERC
- Save the folder to the required directory in your PC
- Access the folder and click on setup.exe
- Follow the setup instructions

1.4. Starting Emission Reduction Calculator:
- Click on the Start button on the bottom left of the screen
- Select the programs folder
- Double click on Energy Reduction Calculator
Chapter 2

Working with Emission Reduction Calculator

The Calculator starts with the main form displayed below

![Main Form](image)

Click **Proceed** to begin.

An input box opens up that asks you for the name of your company:

![Input Box](image)

Click OK after you enter the name of your company to open the next input box.
The next input box asks for the total number of homes and/or industrial facilities for which the reduction in emissions is being computed.

*Note: The Calculator performs computations for a maximum of 30 building/industrial units only.*

Figure 3

A new screen opens up in which you have to enter the values for each residential/industrial unit under consideration. After you have entered the values for a unit, press the button, **Calculate**, which has been circled in the figure below.

Figure 4

The **Previous** button is provided so that you can start over. Clicking **Previous** takes you back to the main form.
There are three textboxes in which you have to enter the values

**Textbox 1**: You have to enter the energy saved in terms of *kilo watt hours* in that unit.

**Textbox 2**: You have to select the state in which the unit is located. This is a drop-down list, which opens on the click of a button.

**Textbox 3**: You have to enter the name of the unit in question.

As mentioned earlier, after entering all three values for a particular unit, click the **Calculate** button. The emission reduction for that unit is displayed in the table as shown:

![Calculate](image)

The operation has to be repeated for each unit, till you have entered the values for the number of units that you entered in the input box. The results of each unit are displayed in the box below. At a time, only 1 result is displayed.

Finally, once you have entered the values for all the units, the **View Results** button becomes active. Click this button to view the final summary.

![View Results](image)

On clicking the **View Results** button, the output form is generated. The next figure is a display of the output form.
The results screen displays all the calculations. Figure 7 shows a sample result table.

**Command Buttons**

**Previous** Button

This button is the access to the input screen.

**Exit** Button

Click this button to exit the software tool.

**Output Generation**

The **Results** Screen also has ability to generate the table as a spreadsheet and/or a text file. This is done by selecting the suitable option from the list, “Write Output File”, provided between the **Previous** and **Exit** buttons. The list is shown circled in the Figure 10.
The selection can be made by clicking on the arrow next to the list box. The choices available are shown in Figure 11.

As the choices suggest, the first option generates a text file and the second option generates a spreadsheet in MS Excel. A message box tells you where the file is stored in case you wish to view it.
Example

Mr Smith is a consultant who wishes to calculate the amount of emissions that have been avoided as a result of implementation of pollution prevention measures at the facilities of XYZ Corporation. XYZ has two facilities, the first in Cincinnati, Ohio and the other in Houston, Texas.
He has the following data he wishes to use:

<table>
<thead>
<tr>
<th>Facility</th>
<th>KiloWattHours saved</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cincinnati</td>
<td>447</td>
<td>Ohio</td>
</tr>
<tr>
<td>Houston</td>
<td>530</td>
<td>Texas</td>
</tr>
</tbody>
</table>

Table 1

To start the Calculator, He clicks on the Start menu, selects Programs and finally the Energy Reduction Calculator as shown in Figure 12.
This opens the first screen. (Refer Figure 1). On clicking **Proceed**, he encounters the first of two input boxes. The first **input box** asks for the name of the Company. Mr Smith enters “XYZ Corporation” and clicks **OK**.

The second input box opens up and Mr Smith enters the number of facilities for which the calculations need to be made, viz. 2.

Again, on clicking **OK**, the **Input Screen** opens up (Refer Figure 4).
The values of the first row in Table 1 are entered in their respective boxes. Clicking **Calculate** displays the result for that facility. The calculator is now ready to accept the values of the second facility, this is illustrated in Figure 14.

![Figure 14](image1.png)

This time, clicking **Calculate** not only displays the results for the second facility, it also makes the **View Results** button active. What this means is that until the number of facilities entered in the second *Input Box* are reached, the **View Results**, cannot be used. (Refer Figure 14 and 15).

![Figure 15](image2.png)

Mr Smith clicks the **View Results** button, the *Results* Screen (Refer Figure 11) opens up. Mr Smith can generate the results table (Refer Figure 16) that appears in the *Results* Screen in a text file format or a spreadsheet format by using the *list box* provided (Refer Figure 10 and Figure 11).
Figure 16
The last step is to exit the tool by clicking **Exit** (Refer Figure 9 and Figure 16).
APPENDIX C

POWER POINT PRESENTATIONS ON THE TOOLS

The PowerPoint presentations are available on the Internet on the website:

http://www.eng.utoledo.edu/~akumar/ppistools/pptools.htm