

# Dow Chemical:

## Risks for Investors

*Report prepared by Innovest Strategic Value Advisors*

### Key Issues for Strategic Investors:

- **Overall Market Risk:** Dow could be pressed by markets and regulations to reduce its production and marketing focus on organochlorine chemicals as well as many other chemicals in its product portfolio. Mounting scientific findings regarding organochlorine toxins, dioxins & furans in particular, could result in more momentum for widespread phase-out of the company's products such as vinyl chloride monomers (used in PVC plastics), as well as many of the company's pesticides. In addition, plasticizers such as phthalates have phase-out risk as well which could affect Dow's plastic-related business. As the practice of testing of human blood and other tissues for the presence of these substances grows, the result may be material levels of tort liability should the company be linked to negative health impacts caused by "persistent bioaccumulating toxins" (PBTs). Many of the company's products or pollutants associated with their manufacture, use and disposal are PBTs. Dow's business strategy appears to be fully committed to the further development of organochlorine chemicals and other chemicals with attendant PBT risk profile.
- **Agent Orange:** The recent Supreme Court decision (*Stephenson v. Dow Chemical et al.* June 9, 2003) may open the door for Vietnam veterans not covered under a previous settlement in 1984 to pursue compensation with Dow Chemical for health risks associated with the chemical defoliant commonly known as Agent Orange. Given the number of claims and the extent of damage alleged to be caused by Agent Orange, the proceedings could result in sizable ongoing liability. Numerous foreign veterans groups and Vietnamese citizens affected by Agent Orange exposure are also seeking compensation from manufacturers.
- **Bhopal:** The Bhopal disaster is an ongoing concern with significant potential to harm the company's reputation or pose material liabilities, as well as constrain investment in Asia. Continuing and heated controversy over reparations to victims, deaths and birth defects related to methyl isocyanate exposure, and pollution of the city's water supply could result in potential legal liability. Dow's wholly owned subsidiary, Union Carbide has been deemed an "absconder from justice" for failing to appear before the courts in India to face criminal charges stemming from the disaster. Efforts are underway in India to have the courts place responsibility on Dow to require Union Carbide to appear as a defendant in the criminal case. The \$2.18 trillion market currently under SRI management world-wide may remove Dow as a potential investment as a result of these controversies. Dow management has flatly claimed that it has no liability associated with these matters, but our review indicates that it appears to have settled on an inadequate strategy to address the issue prior to merging with Union Carbide.
- **Contamination in Michigan:** Dow may incur potentially material liability related to dioxin contamination of more than 22 miles of the Tittabawassee River as well as sections of the Saginaw River and Saginaw Bay in Michigan. A class-action lawsuit involving more than 300 plaintiffs is currently in discovery. In the 2003 10K, Dow has reported an accrued \$54 million in remedial liabilities for Midland – which appears inadequate to reflect the range of potential liabilities associated with this matter.
- **Semi-conductor Worker Liability:** Union Carbide, a wholly owned subsidiary of Dow since 2001, is currently involved in litigation stemming from the semiconductor industry, to which it is a supplier, involving claims of worker exposure to hazardous chemicals.
- **Current Financial Obligations:** The above issues, added to Dow's well known obligations under asbestos and breast implant litigation, and a \$10.7 billion in debt and a debt-to-capital ratio of 53%, point to further strain on company reserves and thus increase the potential financial risks associated with Dow's overall product and environmental liability scenario.

Uncovering Hidden  
Value Potential for  
Strategic Investors  
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## 1. EXECUTIVE SUMMARY

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Innovest Strategic Value Advisors, a financial services firm based in New York, Toronto, London, and Paris analyzed overall environmentally related risks for the Dow Chemical company. Partly owned by State Street Global Advisors and the Dutch Pension Fund ABP, Innovest is a leader in analyzing the financial impacts of environmental and social issues. Investors use Innovest's best-in-class ratings, ranging from AAA to CCC, to minimize risk and maximize return potential. In nearly every industry sector, companies with above average environmental scores, taken as a group, outperformed below average firms by 300-3000 basis points per year in the stock market.

Dow has, over the years, consistently rated highly in Innovest's rankings of the chemical sector, rating AA (8 out of 30 competitor firms) in a recent industry survey. This was based on the opinion that Dow's eco-efficiency leadership such as its energy use and emission reduction initiatives would pay dividends for shareholders by keeping operating costs low and lowering risks, thereby making the company more cost competitive in the industry.

Given the centrality of these programs, especially the energy program, in the CEO's letter in Dow's 2002 annual report, it appears that these conclusions were correct.

As with all large chemical concerns, Dow has a number of contaminated site liabilities and similar issues to contend with. However, there is some indication that these risks are having an increasing impact on the company. The company continually had yearly environmental accruals well above \$300 million since before 1998.<sup>1</sup> In 2003 the company had environmental accruals of \$381 million, equal to 22.02% of net income after taxes. In other words, Dow Chemical needed over \$2 billion in sales to cover its environmental accruals. This liability burden has been growing and a number of significant risks have appeared on the horizon all at once. Analysis of the overall business plan for the company and its stated goals for future growth and development show that these risks will continue and may increase over time.

Dow's environmental liabilities should be considered by investors in light of other areas of the company's financial situation such as a sizable \$10.7 billion in debt after net cash and a debt-to-capital ratio of 53%, largely as a result of a string of acquisitions.<sup>1</sup> These indicators imply that environmental cost increases, even if small, may have a direct impact on profitability.

As a result, Dow's eco-efficiency efforts alone are inadequate to keep pace with changing public policy priorities and new emerging risk factors. While the current eco-efficiency efforts are an important aspect of Dow's operations, they fail to fully address issues associated with one of the company's main revenue drivers – products that utilize chlorine in production

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<sup>1</sup> This includes Union Carbide.

and/or as a main raw material, referred to throughout this report as organochlorines.<sup>ii</sup>

New understanding about the nature of human fetal development and the endocrine system is pointing to the role of particular pollutants in various health and developmental disorders. In particular, groups of compounds known as “persistent bio-accumulative toxicants” (PBTs) or “persistent organic pollutants” (POPs) have been singled out because they do not break down easily in the environment, and they build up in the food chain and in people. This type of pollutant has the potential to vastly change the liability landscape for those companies responsible for producing them. Many of these pollutants are Dow products, past and present, or are pollutants related to their production and use.

These risks are represented by both recurring historical liabilities as well as rising awareness of the health impacts associated with the production, use, and disposal of organochlorines. Most importantly, the scientific evidence of severe health impacts surrounding exposure to dioxin, an inevitable by-product of organochlorine chemical manufacture, use, and disposal, raises questions about the viability of many products central to Dow’s profitability.

Efforts by the company to reduce dioxin emissions at its facilities, while significant, do not address the true scope of this problem for two reasons. First, controlling emissions from manufacture does not address the life cycle impacts of major chlorine-containing products, for example, polyvinyl chloride plastic (PVC), which creates dioxin when burned. Nor do emission controls address the significant dioxin-containing manufacturing wastes that must be land-filled. From a life-cycle perspective, dioxin is directly and intrinsically a by-product of the chlor-alkali process because chlorine is the key element in its formation. As one of the largest makers of vinyl chloride monomer for PVC, as well as chlorinated pesticides and solvents, efforts in the policy arena to address dioxins, furans and other chlorine-related PBT byproducts will continue to be a major issue and could have a negative impact on the company.

In addition, the merger of Dow with Union Carbide (UC) necessitates, for many investors, a reconsideration of the overall risk and opportunity profile for the new combined company. Union Carbide brought with it many known and emerging risks which have, and will continue to have, sizable negative impacts upon Dow’s financial results. These include known risks such as asbestos liabilities, with a net income statement impact of \$828 million in 2002 for Union Carbide; involvement in widespread chemical-exposure cases for semi-conductor workers, an industry that Union Carbide supplied; as well as political and legal fall out from the world’s worst industrial accident, the catastrophic failure of methyl isocyanate containment at Union Carbide’s plant in Bhopal, India. This last issue landed in India’s Supreme Court, caused Indian courts to attach all of Union Carbide’s assets in India and led to a class-action suit filed against the company in the U.S. In

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<sup>ii</sup> Organochlorines are carbon-based, manufactured chemicals that contain one or more chlorine atoms.

March 2004, the Second Circuit Court of Appeals for New York issued an order allowing litigation by Indian property owners near the Bhopal plant to proceed against Union Carbide in the New York District Court for property damages, including environmental remediation of their properties.

Regardless of the outcome of the ongoing Bhopal litigation, the company's outright refusal to address the issue despite its ongoing impact on hundreds of thousands of Bhopal's residents may have a detrimental effect on Dow's corporate reputation. There are multiple considerations for investors to note with respect to the ongoing Bhopal controversy including:

- Dow's statement regarding Bhopal that: "*some people would have us take action to resolve their concerns. **But, we are aware of potentially significant legal risks associated with such actions...***". This implies that the management is aware of outstanding risks related to Bhopal that are not being reported to shareholders, despite other statements by management to the contrary.
- Union Carbide's status as an "absconder from justice" in the Indian courts.
- The potential for Union Carbide's status to constrain Dow's involvement in India's growing chemical market.
- Long-term issues related to ground water pollution from the site.
- Negative reaction by the \$2.8 trillion managed under socially responsible investment (SRI) mandates as a result of Dow's inaction on Bhopal.

The past few years have also brought to the public's attention ever increasing examples of accounting scandals which have focused Wall Street's attention on the importance of balance sheet fundamentals. The EPA surveyed a number of firms to compare compliance violations and site liabilities with their level of disclosure under U.S. Securities and Exchange Commission (SEC) environmental financial debt accounting regulations. The EPA found that 74% of publicly traded firms surveyed openly violate these SEC rules.<sup>2</sup> As the SEC and its counterparts worldwide strengthen the transparency of corporate reporting, increasing attention is being paid to issues that effect shareholders and stakeholders that are routinely ignored or overlooked.

In Dow's case, this can be seen with the reappearance of the Agent Orange issue for the company with the potential for sizable liabilities. This issue was not mentioned in the 2002 or 2003 10K despite several factors:

- A 2003 Supreme Court decision which may have reopened the opportunity for Veterans and their families who suffered illness after 1994 to sue Dow and other companies for damages;
- Roughly 100,000 claims of Agent Orange exposure-related health problems by U.S. veterans being filed with the government since 2000;
- On Jan. 30, 2004 a class action lawsuit was filed by the Vietnam Association for Victims of Agent Orange on behalf of Vietnamese citizens;

- Detailed public knowledge about Dow’s role in Agent Orange production and attendant dioxin contamination; and
- Vastly increased medical knowledge of the health effects of exposure combined with the conclusions of the Yale University conference, The Ecological and Health Effects of the Vietnam War, that “*the use of Agent Orange as a defoliant and herbicide in Vietnam was the largest chemical warfare operation in history, producing considerable ecological as well as public health damage.*”<sup>3</sup>

All these factors make the possibility of a negative judgment against the company certainly likely enough to pass the disclosure threshold set by the SEC.<sup>iii</sup> Both SEC disclosure guidelines on environmental liability disclosure in Regulation S-K and Sarbanes Oxley delineate disclosure guidelines which slant decision making in favor of reporting and stipulate that trends which may affect future earnings are to be commented on even if outcomes are uncertain and estimations of financial impacts are not determinable at the time of reporting. Specifically SEC regulation S-K 303 requires the Management’s Discussion and Analysis of Financial Condition and Results of Operations (MD&A) to include “known trends, demands, commitments, events, or uncertainties” that are reasonably likely to affect the company’s bottom line. Materiality in this case is defined by the SEC as disclosure that would be viewed by a “reasonable” investor as having changed the “total mix” of available information in a substantial way. The Agent Orange case, given the number of claims and the uncertainty of the outcome certainly warrants comment under this determination.

Another example includes the \$2 million Dursban fine by the New York Attorney General in April, 2003. Dow Chemical advertised to consumers that its product Dursban was safe, despite a 1994 agreement with the New York attorney general's office that it would not do so.<sup>4</sup> The EPA fined the company \$732,000 in 1995 for failing to disclose reports of adverse effects associated with use and exposure to Dursban. A settlement of the resulting consumer fraud lawsuit by the New York State Attorney General occurred in mid-December 2003, but the Attorney General had sent a notice to the company notifying them of his intent to sue at least as early as April 2003. Given the removal of this product from the market for many uses and negative health impacts on fetal development that came to light as a result.<sup>5</sup>

In addition to lack of reporting, under-reporting in 2002-03 of major developments such as large-scale remediation liabilities combined with class-action lawsuits for dioxin contamination in Midland, Michigan should result in greater scrutiny by investors. The company currently reports \$54 million in accruals for investigation of dioxin contamination of the Tittabawassee and Saginaw river sediment and floodplain soils, Saginaw Bay and remediation of Midland site. Given that similar examples of river contamination have proven far more costly to remediate, and that the company fails to men-

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<sup>iii</sup> Detailed discussion of the SEC’s disclosure requirements follows in chapter on Best Practice for Environmental Disclosure.

tion the class-action lawsuit filed by property owners in Midland, the overall costs and necessary accruals could be much higher.

This report will outline the significant levels of risk facing Dow with respect to environmental liabilities both historical and current in nature, and outline the rationale for increasing levels of disclosure and analysis regarding these liabilities which have been shown to affect stock market values.

**The combined impact of these developments implies that the firm has above average risk exposure and that the sophistication of management's strategy has deteriorated in the face of increasing complexity and growing challenges to its business strategy. As a result it will likely under-perform in the stock market over the mid to long term. Dow's current rating was adjusted by Innovest in January 2004 to BB, rating 47 out of 68 competitors.**

## 2. THE RISKS OF DOW'S ORGANOCHLORINE STRATEGY

### Dow's Organochlorine Businesses

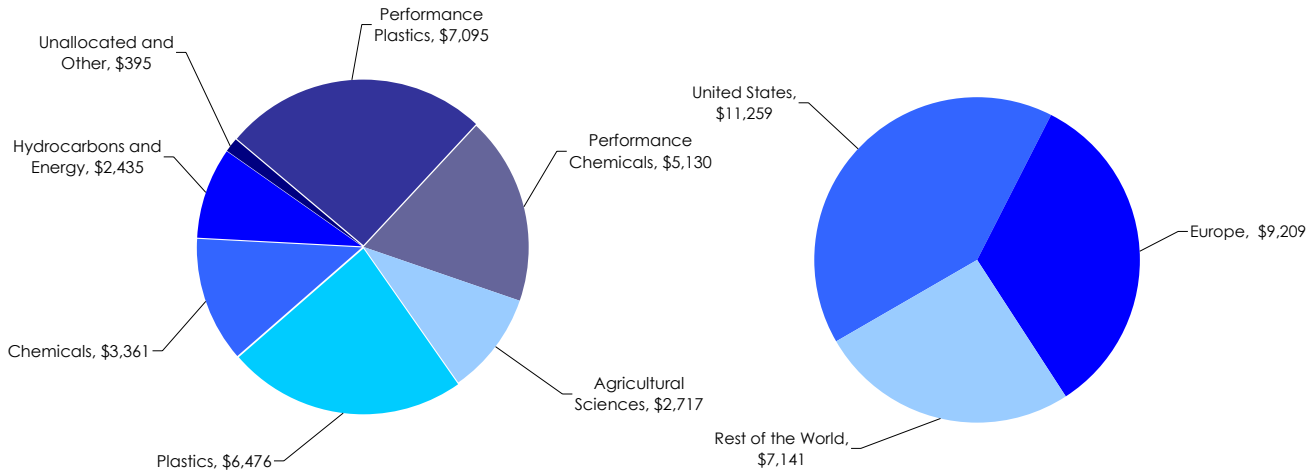


Figure 1. 2002 Operating Sales by Segment & 2002 Sales by Geographic Area  
Source: The Dow Chemical Company 2002 Annual Report

Dow had annual sales in 2003 of approximately \$33 billion, employed approximately 46,000 people and served customers in 183 countries through 180 manufacturing sites located in 37 countries supplying 3,500 products.<sup>6</sup>

According to a recent statement by Kip Howlett, Executive Director of the Chlorine Chemistry Council, chlorine chemistry is the building block for 60% of the chemical industry, 95% of crop protection chemicals, and 85% of pharmaceuticals in the United States.<sup>7</sup> Dow is one of the largest world-wide operators of chlor-alkali facilities that produce chlorine used to make many of the products listed above as well as producing many of these products themselves.

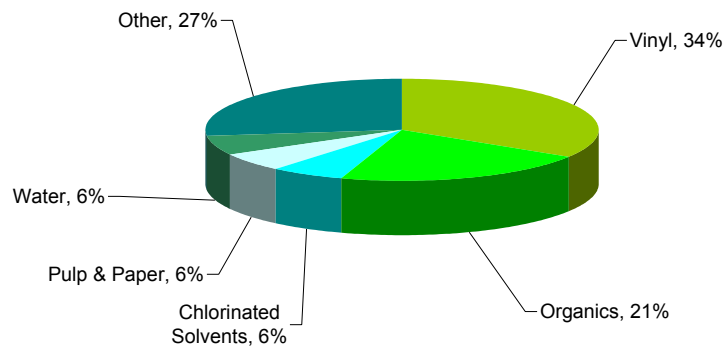


Figure 2. End Uses of Chlorine  
(Source: Chlorine Chemistry Council)

In 2000 Dow seemed to be on the leading edge of the industry having developed plant-based plastics in a joint venture with Cargill, thus beginning the industry move away from chlorine as the key element in plastics. However, the movement towards reduced environmental impact by the chemical industry has been stymied by two important developments. First, there has been increased externalization of environmental costs through shifts in production to countries with low regulatory thresholds for environmental performance. Second, there has been significant manipulation of the political process in the U.S. by the industry in an effort to eliminate environmental controls. It is instructive to consider that from 1999 through 2004 the chemical industry gave \$21,027,663 to political parties and candidates in the U.S. Dow contributed \$575,500 of that sum.<sup>8</sup> During that same time EPA enforcement has dropped considerably and the lead enforcement officer at EPA resigned in protest as a result of perceived undermining of enforcement actions.<sup>9</sup>

While this has seemed to be a boon to the industry in terms of short-term profitability, the ability to externalize environmental costs has stifled the forward progress of the chemical industry by preventing emerging new technologies with lower environmental impacts from achieving market penetration and replacing older products.

These developments may ultimately come to haunt investors as liabilities associated with these products increase over time and the industry is forced to address problems that were previously externalized to society through the political process. Superfund liability provides a good past example of this process.

## SECTION SUMMARY

The main risks to Dow shareholders from organochlorine investments stem from the risk of negative impacts to humans and the environment. These types of chemicals have and will continue to result in significant liability for the company and the chemical industry in general, both in the United States and abroad.

The following contains a summary of organochlorine risk factors with a more detailed discussion to ensue in the sections below:

1: With the exception of the breast implants and asbestos liability, most of Dow's liability problems stem directly from organochlorine pollutants and chemicals. Dow has taken steps to become one of the leading manufacturers of organochlorines and its business strategy for future profitability relies heavily on developing leading market positions in these products. This will inevitably lead to more contamination, tort claims and damage claims against the company due to the nature of chlorine chemistry. In addition, the company may ultimately face a phase-out of major product categories such as vinyl chloride monomer for PVC plastic and many pesticides, as recently happened for some uses of Dursban in the U.S. and Europe.

2: Chlorinated chemicals have posed large liabilities for Dow and other manufacturers in the past. They also have important connected characteristics. For example, some of the most troublesome chemicals, such as DDT,

PCBs, CFCs, and dioxins are all organochlorines, yet they have all been assessed and dealt with as separate problems with distinct risk characteristics. Analysis of the chlorination process shows that, in general, toxicity is increased and broadened with the introduction of chlorine. (See below.) Future regulatory approaches are likely to begin incorporating the broad-based connections between toxicity and chlorine chemistry.

3: New science-based policy trends are gaining ground which could make such chemicals prohibitively expensive or illegal to manufacture and lead to large tort claims as has been seen with many organochlorines in the past. For example, the scientific calculation of chemical toxicity has historically focused closely on “catastrophic failure” risks such as agents causing cancer or other severe, life-threatening diseases. New research shows that many of these chemicals, such as PCBs and dioxin, may have detrimental effects on child development and learning capabilities at lower levels than those of greatest concern for cancer. An international meeting of neurologists and endocrinologists concluded, “*The developing brain exhibits specific and often narrow windows during which exposure to endocrine disrupters can produce permanent changes in its structure and function...A variety of chemical challenges in humans and animals early in life can lead to profound and irreversible abnormalities in brain development at exposure levels that do not produce permanent effects in an adult. There may not be definable thresholds for responses to endocrine disrupters.*”<sup>10</sup> **This implies that much lower thresholds for chemical exposure may be needed to protect human health than have previously been set.**<sup>11</sup>

4: Recent polls<sup>12</sup> also suggest that the public is greatly concerned about the potential risks that these types of chemicals pose, but yet has the false impression that they are protected from harm by corporate and public policy through rigorous testing of persistent toxic chemicals. Health data is insufficient for the vast majority of chemicals on the market and chemicals are removed from the market only after harm has been registered. This implies that future public policy will likely move in the direction of greater analysis of chemical risks and significantly lower thresholds of exposure. These developments will result in lower profit levels, increased costs, and potential product phase-outs or product use restrictions for Dow’s organochlorine business.

## The Chlorine Phase-out Debate

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Phase out of chlorine-chemistry<sup>iv</sup> has clearly been a contentious issue that has been the subject of long running debate between regulators, industry and the public. The subject became a major concern to the industry when in February '94, the Clinton administration announced an initiative to "substitute, reduce or prohibit the usage of chlorine and chlorinated compounds." The initiative guidelines were to "restrict or prohibit the discharge of highly toxic, bio-accumulative pollutants." Targeted phase-out industries were pulp and

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<sup>iv</sup> “Chlorine phase-out” refers to phasing out industrial chlorine chemistry or more specifically phasing out the production of chlorine gas and the compounds made from it, not banning the element.

paper, plastics and solvents.<sup>v</sup> However this policy initiative was partially the result of an earlier suggestion by the International Joint Commission (IJC) which formally recommended to the governments of the U.S. and Canada in 1992 that the use of chlorine as an industrial feedstock be phased out.<sup>13</sup>

The IJC was created by treaty between the U.S. and Canada in 1909 with responsibility for water quality in the Great Lakes. The IJC began studying Great Lakes water pollution seriously in 1972. The U.S. chairperson of the IJC in 1990 and 1992 was Gordon Durnil, a conservative Republican appointed by President Bush. According to Durnil, initially the IJC proposed phasing out chlorine without any timetable. He says the Commissioners discussed privately among themselves that such a phase-out might take 50 years but that, *"At least there would be a time certain, off in the future, when such a formidable substance would be taken totally out of existence [as an industrial feedstock] without a societal disruption. Industry came to us and told us how stupid we were, that a sunseting [phase-out] of chlorine and finding a suitable alternative might take thirty years. Later they reduced that to twenty years."*<sup>14</sup> The American Public Health Association (APHA) also took a formal stand against chlorine in 1993.

The chlorine industry has so far been successful in its revolt against chlorine phase-out policy initiatives, convincing many policy makers that this was an economically damaging proposal and would be too expensive to implement. Given ample medical evidence against organochlorine chemistry (see below) the industry has generally crafted its arguments on the economic reasoning that doing so would be too expensive. However, technological advances, changing timeframes, such as examining full life-cycle costs or extending economic analysis to include health costs, often changes this calculus considerably. In addition, continued use of organochlorine chemistries axiomatically implies that the health impacts associated with their use will continue and therefore the corresponding liability will continue to be an ongoing problem for Dow. Indeed, the company continually had environmental accruals well above \$300 million yearly since before 1998.<sup>vi</sup> In 2003 the company had environmental accruals of \$381 million, equal to 22.02% of net income after taxes. Or to look at another way, Dow Chemical needed over \$2 billion in sales to cover its environmental remediation costs. These figures do not include regular insurance, legal fees, or asbestos and breast implant litigation costs. In addition, this report details how the company's liabilities are likely to exceed even its current level of accruals as well.

**The implication for investors is that the company's business plan is fraught with unstated risks and in the process of generating new revenue through the use and sale of untested or known toxic organochlorine chemicals, will create new liabilities and business risks going forward.**

The sections below outline in greater detail how risks stemming from organochlorine chemistry are manifested.

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<sup>v</sup> To some extent this phase out has begun as manufacturers phase out chlorinated solvents and chlorine-free paper gains market share.

<sup>vi</sup> This includes Union Carbide.

## ORGANOCHLORINES, DIOXINS AND HUMAN HEALTH

*“Virtually all organochlorines that have been studied exhibit at least one of a range of serious toxic effects, such as endocrine dysfunction, developmental impairment, birth defects, reproductive dysfunction and infertility, immunosuppression and cancer, often at extremely low doses, and many chlorinated organic compounds are recognized as significant workplace hazards.” – Statement by the American Public Health Association (APHA) 1994<sup>15</sup>*

A complete discussion of the toxicology of organochlorines<sup>vii</sup> is too large and complex a subject for a full discussion here. The discussion below covers some of the major issues surrounding the increasing understanding of the links between chlorination of chemicals and increased toxicological effects. Investors should note that the science behind this is evolving and that increased regulatory scrutiny is likely to accompany increasing knowledge of negative health impacts known to be associated to with organochlorines.

Many of the most serious environmental contamination issues that have been faced over the past several decades appear to be separate issues. CFCs causing a hole in the ozone layer; PCBs contaminating rivers and fish; Pesticides like DDT causing widespread ecological damage; dioxins from paper mills and incinerators contaminating the Great Lakes; PCBs from electrical transformers compromising the reproductive abilities of people living in the Arctic Circle, thousands of miles from the original source of pollution; and Vietnam Veterans with numerous health problems from exposure to “Agent Orange” – a defoliant used in the war. However, these cases of toxic pollution and many cases all share one common link. The chemical at the center of the problem was an organochlorine.<sup>16</sup>

Chlorine has found its central place in the chemical industry for a lot of practical reasons based on the extraordinary versatility of this element. Its basic properties give it the ability to make compounds both unstable, which makes them reactive, or to stabilize them, which makes them long lasting. Elemental chlorine’s highly reactive nature makes it a useful bleaching agent or solvent as well as an efficient compound for synthesizing chemicals in general. Its stabilizing properties, when bonded with the proper complementary elements, result in compounds ideal for plastics, refrigerants, and other products where extended durability is an asset.

There are thousands of different organochlorines and they comprise a large portion of the chemical industry’s product base. The majority have been on the market with little or no testing by the government for human health impacts. In 1984 the National Research Council, and later in 1997 the Environmental Defense Fund, attempted to assess the amount of data available on the toxic effects of chemicals then on the market. In both cases they found complete toxicology data almost non-existent for chemicals on the

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<sup>vii</sup> Organochlorines are carbon-based manufactured chemicals that contain one or more chlorine atoms. This discussion is not intended to address water purification through chlorination, which is a separate issue.

market and partial data for only a few chemicals with even basic data lacking for the vast majority of commercially available chemicals.<sup>17</sup> Although several voluntary industry testing programs have subsequently been launched, the number of chemicals tested remains quite limited.

The research that has been done indicates a disturbing trend with respect to chlorine chemistry. According to the International Agency for Research on Cancer (IARC), a division of the World Health Organization (WHO), there is sufficient or suggestive evidence of carcinogenicity for over 100 organochlorines or groups of organochlorines comprising over a thousand compounds.<sup>18</sup> Vinyl chloride, the main ingredient in PVC, a major product for Dow, is one such known carcinogen.<sup>19</sup> Chlorinated ethylenes, which comprise large product categories for Dow, such as vinyl chloride, trichloroethylene, perchloroethylene and dichlorotetrafluoroethane, have been found to be neurotoxins.<sup>20</sup>

A German study of organochlorines by Dr. Dietrich Henschler examined how chlorination affects the toxicity of chemicals.<sup>21, viii</sup> He looked at the health impacts of hundreds of organochlorines by examining the toxicity of the constituent elements of the chemicals and then analyzed what changed when chlorine was added. The organochlorines examined included acetylenes, benzenes, biphenyls, butadienes, butanes, chlorinated methanes, dioxins, ethanes, ethylenes, furans, parafins, phenols, propanes, and various insecticides. He had four major findings:

1. The introduction of chlorine into organic compounds is almost always associated with increases in toxicity. This applied to all types of toxic effects including mutagenicity, carcinogenicity, as well as acute, sub-chronic and chronic toxicity, and reproductive toxicity. Toxicity tended to occur at concentrations orders of magnitude lower than in constituent elements.
2. Introduction of chlorine produced entirely new toxic effects that were not present in the constituent elements.
3. Carcinogenicity increased markedly with the introduction of chlorine. Of the constituent elements of chemicals studied, only benzene was carcinogenic. However the chlorination process led to known or suspected carcinogenicity in chloromethanes, chloroethylenes, chlorinated propenes and chlorobutadienes, all but one of the chloroethanes, and many members of the other chemical groups examined.
4. Toxicity tended to increase with the number of chlorine atoms in the molecule. This is characterized as a general rule,

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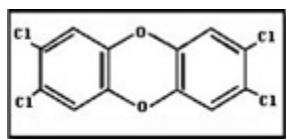
<sup>viii</sup> It should be noted that this study was done at the behest of the Society of the German Chemical Industry. Dr. Henschler is a professor and Chair of the Department of Toxicology at the University of Wurzburg, and leads the German Government's advisory commission on occupational exposure.

but one less stringent than the effects of introduction in the first place.

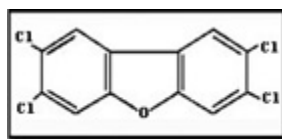
## DOW & DIOXIN

Dow and many other competitors in the chemical industry are producing or have produced in the past, chemicals that last for long periods in the environment and have attendant properties that cause them to bio-accumulate in animal tissues. The tendency for certain chemicals to behave in this manner has resulted in the designation of a class of toxicants known as persistent bio-accumulative toxicants (PBTs) or persistent organic pollutants (POPs).<sup>22</sup> At the center of the chlorine controversy is the issue of the PBTs - dioxins and related chemical compounds, which are a by-product of the chlorine industry.

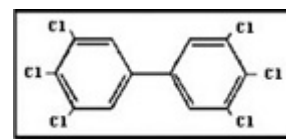
### Dioxin and Related Compounds



2,3,7,8-Tetrachlorodibenzo-p-dioxin



2,3,7,8-Tetrachlorodibenzofuran



3,3',4,4',5,5'-Hexachlorobiphenyl

Figure 3. 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin "The Most Toxic Man-made Compound" and related compounds – furans and PCBs

2,3,7,8 tetrachlorobenzo-*p*-dioxin, "dioxin" is actually a family of chemicals that are related to several similar toxic compounds including polychlorinated dibenzo-furans, polychlorinated biphenyls (PCBs, a former Dow product) and to a lesser extent polychlorinated/polybrominated naphthalenes (PCNs/PBNs) and polyhalogenated azo- and azoxy- benzenes.<sup>23</sup> Dioxin is an unintended by-product of combustion that is created when chlorine is present. Dioxin is considered the most toxic man-made compound ever tested.<sup>24</sup> While dioxin is known to occur naturally as a result of forest fires and volcanoes, its presence has increased dramatically since the development of the chlor-alkali process. Thus exposure to dioxin and its congeners is a modern and relatively new experience. Industrial production of chlorine began in earnest in the 1940's during and after WWII when U.S. production capacity reached 2 million tons per year. Analysis of dioxin deposition in sediments in the Great Lakes<sup>25,26</sup> and in Europe<sup>27,28</sup> shows that increased industrial production of chlorine exactly match increases in sediment deposition. By 1960 chlorine production in the U.S. had doubled to 4 million tons and was six times 1940 levels by 1980.<sup>29</sup>

Recent research charting dioxin contamination in human adipose (fat) and other bodily tissues by European and U.S. governmental agencies shows that average levels of contamination are still at levels of concern for the general population although some studies show some decline related to control efforts. However, dioxin has a half-life in the human body of 7 to 11 years<sup>30</sup> and the body's enzymes have no ability to break them down.<sup>31</sup> Chemically related octachlorodibenzofurans have a half-life that the EPA estimates as "infinite".<sup>32</sup> According to Dr. Linda Birnbaum, the Director of

EPA's Environmental Toxicology Division, 95% of all dioxin exposure for the general population comes from food<sup>33</sup> (people with concentrated exposures may be different) and only roughly 50% of the sources of this dioxin are traceable.<sup>34</sup> Past sources which still provide exposure are chlorinated herbicide and biocide production and leaded gasoline.<sup>35</sup>

### Dow's Dioxin Reduction Activities

In response to growing public concern and mounting scientific evidence about the toxic effects of dioxin, Dow has incorporated a reduction program aimed at reducing the company's emissions of dioxin to air and water (see Figure 4. below). There are a number of technical and market considerations that investors should consider when assessing the risks posed by dioxin and Dow's efforts to address them. From a product life cycle assessment of dioxin formation, Dow's internal production efforts, while necessary, do not address the major sources of dioxin which stem from use and end-of-life issues associated with Dow's chlorinated plastics products and pesticides.

Dow states: "According to the U.S.EPA's inventory of Sources of Dioxin in the U.S., the chlorine industry's total releases to the environment represented only 3% of total projected dioxin emissions from quantified sources for 2002/4."<sup>ix</sup>

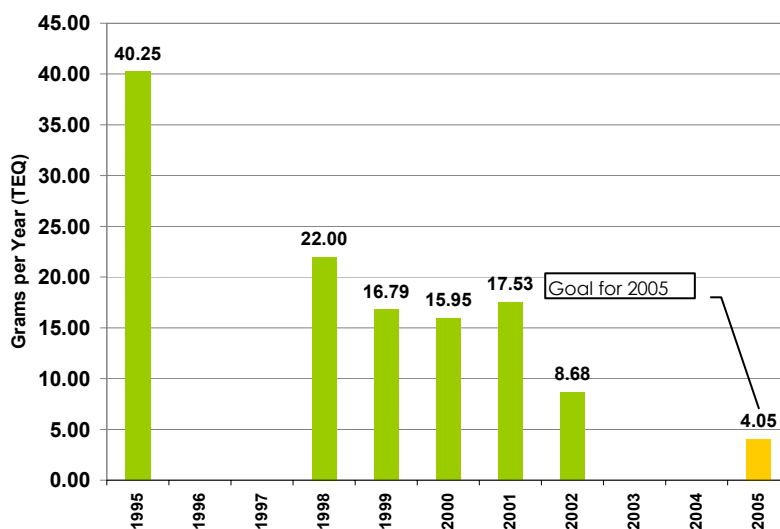


Figure 4. Dow's Reported Dioxin Emissions to Air and Water (2002)  
(Source: The Dow Global Public Report 2002)

It is not clear if the 3% figure is just for the making of chlorine and therefore does not include the manufacturing of chlorinated compounds. Most importantly, Dow's reporting ignores the amount of dioxin formed as a result of its products in commerce. Uncontrolled circumstances such as backyard trash burning as well as landfill and house fires will continue to

<sup>ix</sup> \*It should be noted that this research by the EPA is considered by the Agency to be a draft and stipulates that it should not be cited or quoted from at this stage.

create significant amounts of dioxin as a result of chlorinated products in the waste stream. **Therefore, shareholders can expect continued pressure for phase out of products that create dioxin when burned, and thus should consider the dioxin issue to be a core product risk for the company.**

From a life-cycle perspective, dioxin is directly and intrinsically a by-product of the chlor-alkali process because chlorine is the key element in its formation. Stating otherwise misleads shareholders about one of the company's most significant product phase-out risks. Dioxin is directly relevant to investors because dioxin presents a double-threat to profitability both from a liability stand point and a product risk standpoint.

In addition, Dow's reductions in Dioxin are not necessarily fully accounted for in actual reductions in dioxin-creation, but rather result partly in a transition from air and water releases to solid hazardous waste emissions. This waste is treated and in many cases would be incinerated in a hazardous waste incinerators, themselves a source of dioxin pollution. The history of the Superfund program in the U.S. and similar efforts shows that solid hazardous waste treatment can itself be a source of significant liability.

Factors for investors to consider in measured dioxin releases:

- Production has been growing overseas where regulatory pressures are lower and dioxin measurement is rarely conducted by governments. The company reported ownership of 58 facilities in Asia and Latin America in 2003 compared to 28 in 1997.
- The EPA estimates that roughly 50% of dioxin pollution measured in the environment is from historical sources which are not readily traceable. Sediment deposition studies confirm that growth in dioxin creation is directly correlated to the growth of the chlorine industry.

Lax controls overseas are likely to lead to lowered vigilance in environmental management as intense industry competition and increased energy costs put pressure on managers to lower operating costs. Externalizing environmental impact costs may lower short-term operating costs but leads to long-term liabilities which may be unsustainable.

Dow states in its 2003 10K that it has 180 manufacturing facilities world-wide. There is currently no independent authority that can verify the company's claims on dioxin reduction. Although Dow does discuss the issue of verification. The company stated that the expected benefit of doing so was far out weighed by the considerable costs associated with such a study.

As corporations become global entities and environmental factors play a greater role in corporate performance and reputation, this raises a more general question for investors, namely, how can investors get reliable information on environmental performance globally without imposing burdensome costs on the company. Given Dow's apparent success at achieving facility level reductions of dioxin emissions, additional information about how these goals were achieved would provide significant value to stakeholders without imposing undue additional costs.

## Waste Incineration and the Dow Plastics Portfolio

Combustion of wastes in either controlled or uncontrolled settings (such as backyard barrel burning) are now recognized as the largest source of dioxin world-wide. While some organochlorines such as the pesticide trichlorophenol, a Dow product,<sup>36</sup> may degrade into dioxin in the presence of ultraviolet light from the sun,<sup>37</sup> most dioxin is formed in the presence of heat from combustion.

Source Type	Percentage of all identified releases				
	World (1996) <sup>a</sup>	United States (2002 /2004) <sup>b</sup>	United States (1998) <sup>c</sup>	United States (1995) <sup>d</sup>	Great Lakes (1995) <sup>e</sup>
Municipal waste incinerators	37.6	1.1	40.1	51.4	20.1
Medical Waste incinerators	2.8	1.5	17.4	10.3	48.7
Hazardous Waste incineration	22.7	1.1	5.7	2.6	8.0
Backyard Barrel Burning	NA	57.4	NA	NA	NA
Ferrous metals production	11.7	2.6	NA	0.8	10.6
Copper smelting	2.6	0.5	19.7	2.6	4.1
Forest, Brush, Straw fires	11.7	0.1	7.6	7.7	0
Dioxin-contaminated chemicals	NA	11.0	NA	4.7	NA
Cement Kilns (no hazardous waste) <sup>x</sup>	10.7	1.6	0.6	NA	2.0
Wood Combustion	NA	8.3	3.3	5.9	1.9
Coal Combustion	NA	5.5	2.7	NA	2.5
Accidental fires	NA	NA	NA	3.7	NA
Automobile Fuels	0.4	4.1	1.4	0.4	1.4
Sewage Sludge incineration	NA	1.4	0.2	1	0.6
Aluminum smelting	NA	2.7	0.6	NA	NA
Oil Combustion	NA	1.0	0.3	0.8	NA
Pulp mill boilers	NA	0.2	0.1	0.1	NA
Lead re-Smelters	NA	0.2	0.1	NA	NA

Figure 5. Dioxin Release from Various Sources.

(Sources: As presented in Thornton J. 2000<sup>38</sup> except "b" - EPA

a: Brzuzy & Hites 1996<sup>39</sup>, b: D Winter U.S. EPA - 2002<sup>40</sup>, c: U.S. EPA - 1998<sup>41</sup>, d: Thomas & Spiro 1995<sup>42</sup>, e: Cohen et al. 1995<sup>43</sup>)

Many of Dow's production related chlorinated wastes and byproducts are burned in hazardous waste incinerators that are designed to greatly reduce emissions of compounds such as dioxins. Federal laws have recently required tighter controls on municipal and medical waste incineration, once the largest sources<sup>44</sup> of dioxin, although controls vary world-wide. The most important combustion sources of dioxin in the U.S. are now the uncontrolled burning of chlorinated materials including PVC in backyard burn barrels, or in house, landfill and car fires. These sources are increasingly significant in overall dioxin emissions to the environment. Efforts to control dioxin will likely be aimed at the construction industry as it is the largest end-user of PVC according to industry estimates. Investors should note the increasing size and influence of "green design" as heralded by the recent green building design standards by the US health care sector and others in moving the industry away from the use of materials with toxic life-cycle impacts such as PVC.

<sup>x</sup> Cement Kilns are run at high temperature and often take hazardous waste to burn.

The US Green Building Council and similar organizations internationally, which set national green building standards, are also reviewing this issue.

Control of these major dioxin sources will be difficult. Regulatory approaches to controlling dioxin from various sources will likely focus on product redesign, that is, on removing the constituent products that create dioxin. Above are several estimates of dioxin releases from various sources in different regions.

A report<sup>45</sup> published by the Global Development and Environment Institute at Tufts University in December 2003 reviewed the economics of alternatives to PVC as well as the array of environmental policies being adopted by various governments and institutions to encourage that shift. The report notes widespread action to move away from PVC around the world. The report also found that less toxic alternatives are successfully competing with PVC in many applications and markets and concluded that a PVC phase-out is now “achievable and affordable.” The Tufts study also found that life-cycle costs favor alternatives to PVC, which are less toxic and often have lower life-time maintenance costs. As production costs for less-toxic alternatives come down (PVC is 10-12 times more toxic than alternatives<sup>46</sup>), economy of scale advantages that currently favor PVC, will be lessened.

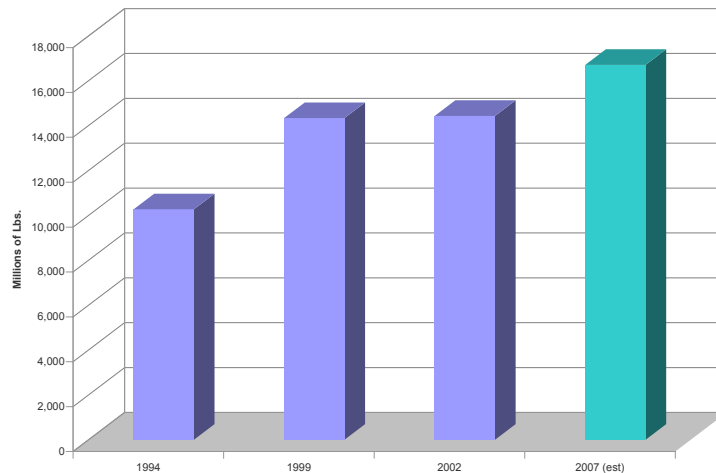


Figure 6. PVC Use in the U.S. and Canada

(Source: SRI Consulting (Menlo Park, CA), CEH (Chemical Economics Handbook) Marketing Research Report: Polyvinyl Chloride (PVC) Resins - September, 2003).

Currently, Dow operates 20% of the U.S. vinyl chloride monomer (VCM) production, which is located at 2 facilities.<sup>47</sup> Dow is one of the largest producers in the U.S., just behind Occidental (3,530 & 3,650 million lbs respectively).<sup>48</sup> Dow also operates a 140 million lbs. capacity PVC facility in Texas City, TX.<sup>49</sup>

PVC represents the largest market for chlorine, so given the role of the combustion of PVC in dioxin production, it is likely that any efforts to address dioxin will focus on PVC. Moves away from PVC may be somewhat mitigated for Dow by the fact that it is a major player in the polyethyl-

ene (PE) markets and other polyolefin plastics,<sup>50</sup> less toxic alternatives to PVC, and thus this trend will lower Dow's overall product risk profile.

## Bio-monitoring

As the polling data detailed below indicates, the general public is concerned about the existence of toxic pollutants in the environment and are especially concerned about bio-accumulating toxic pollutants, although they do not have much information on the issue and have a false impression of how well they are protected by regulatory and corporate policy. The dearth of information about POPs or PBTs is an especially important factor in the continuing development of this issue. The growing awareness of PBTs has resulted in an increasing number of regulatory efforts aimed at reducing the exposure of the general population to these types of toxins.

California Senate Bill 689, now wending its way through the state Legislature, would establish a "bio-monitoring" program that would test humans for various types of chemical contamination. If the bill passes next year, people in selected communities could volunteer their blood, urine or breast milk for a battery of analyses. For the first time, they would learn the exact nature and quantity of the pollutants in their bodies.

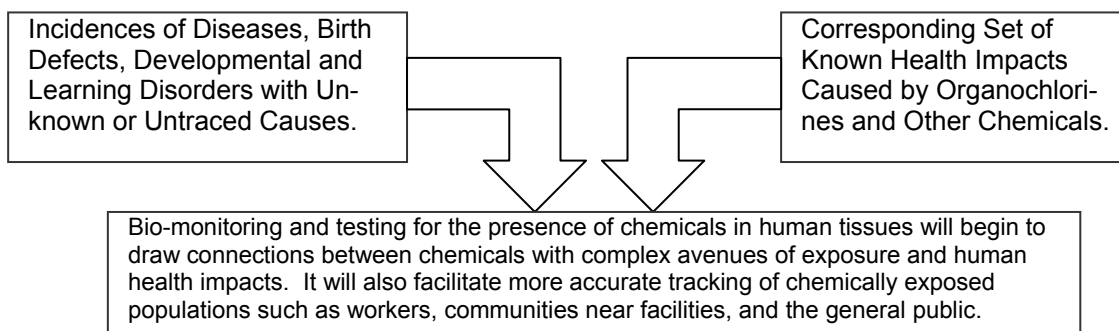


Figure 7. Diagram of Bio-monitoring Impact on Medical Knowledge and Liability

Though the Environmental Protection Agency estimates that some 75,000 industrial chemicals are used in the United States today, fewer than 10 percent have been tested for their effects on human health. Monitoring air and water quality shows where these chemicals end up in the environment, but cannot indicate how much and how many end up in the human population. Bio-monitoring represents threats to the company at several levels. First, if bio-monitoring were to be required in some circumstances, the costs could be substantial. Bio-monitoring tests can be as much as \$5000 per person,<sup>51</sup> depending on the type and complexity of testing. Testing for metals like lead is inexpensive, around \$15 per person, but a test for dioxin is much more expensive, around \$1000 per person, because the test has to be sensitive at the parts-per-trillion level.<sup>52</sup> If testing of exposed populations becomes a successful demand in mass tort claims cases, there could be increased costs to Dow in these types of cases.

Second, the increasing availability of body burden testing, despite the cost, increases the possibility that associations between Dow's releases or products and health conditions could come to light.

In the long run there are major efforts underway by governments and organizations to track pollution in humans and determine what health impacts are occurring in the general population as a result. For example, the Second National Report on Human Exposure to Environmental Chemicals, conducted by the Centers for Disease Control, specifically tracked chlorpyrifos (the active ingredient in Dursban— a product produced by Dow), a known neurotoxin and found that levels in children were twice as high as those found in adults. In addition, increased regulatory mechanisms, chemical testing and bio-monitoring programs are growing at a rapid pace in most of the world. Examples of these efforts include: the Stockholm Convention on Persistent Organic Pollutants; Centers for Disease Control (CDC) programs such as the National Health and Nutrition Examination Survey and National Environmental Health Tracking Program; EPA's National Human Exposure Assessment Survey; Interagency programs such as the National Children's Study and Agricultural Health Study; the proposed REACH initiative in Europe; and breast milk monitoring programs world wide. Similar programs have been replicated throughout Europe and Japan and independent groups such as the Environmental Working Group have set up bio-monitoring programs.

Industry-funded research groups have already moved to respond to perceived liability threats stemming from bio-monitoring data. In 2002, the Health and Environmental Sciences Institute, an industry-sponsored research group that Dow belongs to, formed the Subcommittee on Integration of Bio-monitoring Exposure Data in the Risk Assessment Process.

As testing becomes more widespread and costs decrease, bio-monitoring will become a much more common policy tool. The likely result for Dow and the chemical industry in general will be increased liabilities stemming from better understanding of chemical risks and exposure relationships.

In 2003 the European Union, through the European Commission, proposed a new Europe-wide chemical regulation program, known as REACH. REACH stands for Registration, Evaluation, and Authorization of Chemicals. Registration requires companies to provide data on their products including toxicity and information about how humans or the environment might be exposed to them. This will place the responsibility and cost for information about the industry's products on the industry. Evaluation will be required for chemicals produced in large amounts or chemicals that are especially toxic. One consequence of evaluation might be to ban certain uses of a chemical. The most toxic chemicals would require authorization. These chemicals could include carcinogens, mutagens, reproductive toxicants, and chemicals that persist and accumulate in the environment. As currently written, one potential outcome of the authorization requirement can be an outright ban on a chemical in favor of a safer alternative. This could affect many Dow Chemical products, both with costly requirements to evaluate

chemicals and potentially even prohibitions on the use of some Dow Chemicals where safer alternatives exist.

### Public Exposure Risks

In addition to bio-accumulation and endocrine disruption risks associated with product lines, Dow also faces risks stemming from more direct exposure to toxic pollutants by communities near its facilities.

The Toxic Release Inventory (TRI) run by the EPA measures toxic emissions at the facility level. Recently the EPA developed the Risk Screening Environmental Indicators database (RSEI) which analyses TRI data for chemical toxicity, the fate and transport of the chemical in the environment after it is released, the pathway of human exposure, and the number of people exposed.

As Figure 8 below indicates, while in absolute emission terms, Dow appears to have a low profile, in terms of exposure intensity for its facilities as measured by RSEI, it is very high relative to other large companies. What this implies is that Dow's toxic emissions affect more people and have greater toxic effect pound for pound relative to other large industrial concerns, despite having a lower overall emission profile. This might begin to explain why the company is facing a number of class action suits by communities in areas surrounding Dow facilities.

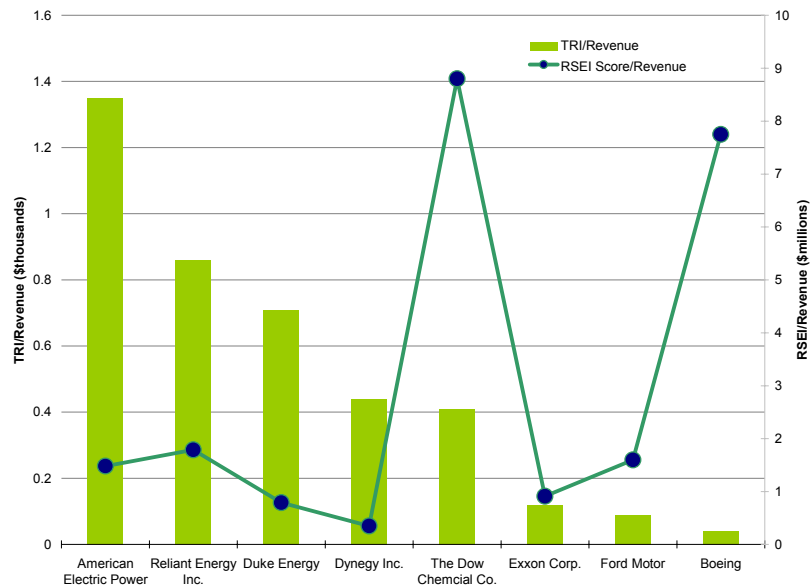


Figure 8. A Comparison of RSEI Scores and TRI Emissions For Several Large Firms (Source: U.S. Environmental Protection Agency)

The relationship between toxicity and exposure illustrated in Figure 8, indicates that reducing the overall toxicity of Dow's portfolio of products is as important an eco-efficiency goal as absolute emission reductions. As the discussion above clearly indicates, reducing reliance on chlorine in chemical production and end products would achieve a lower level of toxic-

ity in emissions and therefore a lower regulatory and liability profile for the company.

### Public Perceptions of Persistent Toxic Chemicals

The role of public perception in the treatment of chemicals with toxic properties is an important determinant of the future business environment Dow will face in getting both public and regulatory approval for its products. It is important for Dow stockholders to recognize that currently, the regulatory environment in which it operates is much less stringent than the public's perception of how it does and should operate. A recent study<sup>53</sup> done by the public opinion research firm Fairbank, Maslin, Maullin & Assoc. (FMM&A) examined the attitudes regarding persistent toxic chemicals of 1,200 people in three states (400 in each), Maine Washington and Michigan, which houses Dow's headquarters.

*“Overall the survey results show that voters in all three states are highly concerned about the health risks posed by persistent toxic chemicals and strongly support the policies to phase out such chemicals and replace them with safer alternatives.” (FMM&A 2003)*

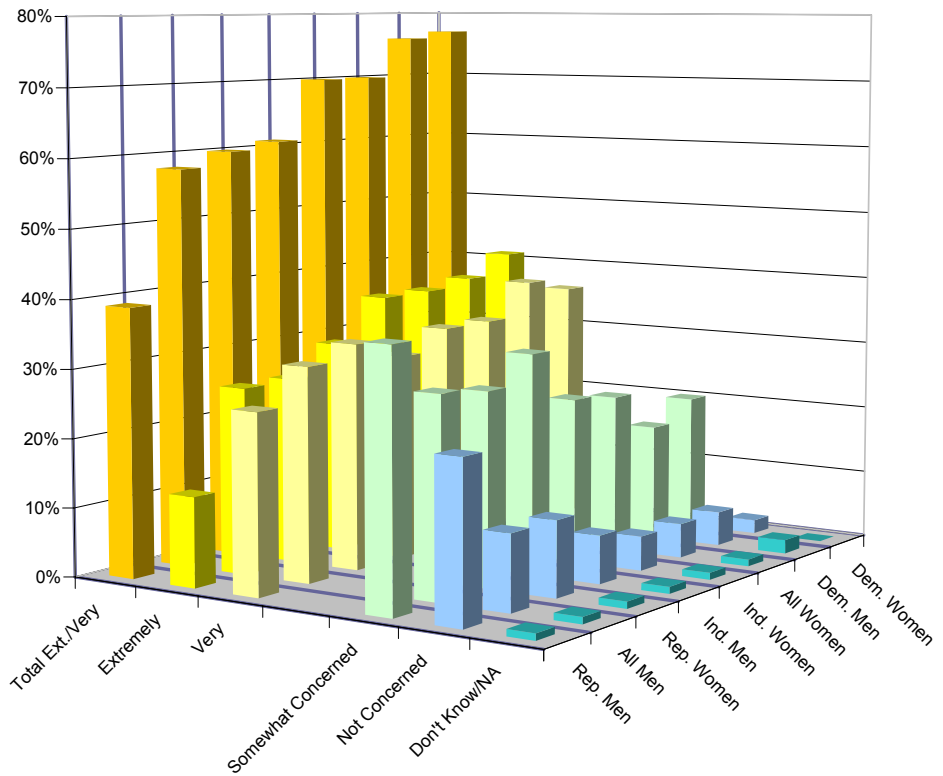


Figure 9. Level of Concern About Persistent Toxic Chemicals by Gender and Party Affiliation

(Source) FMM&A 2003 Survey Research on Persistent Toxic Chemicals

The survey found that public misperception about regulatory requirements for chemical companies was wide spread with 76% of voters in

Washington and Maine agreeing that “current regulations require chemical companies to provide information about the health impacts of the chemicals they create.” 55% in these states also agreed that “currently, the government carefully tests chemicals used in all major consumer products to make sure they are safe for people to use.” The reality is that there is little truth to either of these statements. This implies that voters have a false impression of what steps are being taken to protect them from persistent toxic chemicals. More importantly, FMM&A showed that deep concern cuts across traditional demographic lines. Their study looked at gender and party affiliation and found that in almost every category, 60% or higher identified themselves as “extremely” or “very concerned” about persistent toxic chemicals. (Figure 9 above. Combined Results for all three States.) Even with Republican men, a group which generally discounts environmentally related concerns, the study found that 39%, roughly 2 in 5 respondents, identified themselves as “extremely” or “very” concerned.

Not only did the study group register high levels of concern but they also ranked the issue highly among other major concerns such as the economy, crime and education. The problem of toxic chemicals in the air, water, food and land ranked fourth overall in a list of 13 major issues (see Figure 10 below). In Michigan, where Dow is based, it ranked third behind the cost of health care and pollution in rivers, lakes and streams, all of which came ahead of the condition of the state’s economy as the most important issues to respondents.

Two other important aspects of public opinion with regard to persistent toxic chemicals were the acknowledgement by the majority of respondents that they had heard little about problems in their state with regard to these chemicals recently (2 in 5 reported hearing “a little” or “a great deal”) and that upon learning what factors determine persistent toxic chemicals, 64% of respondents expressed serious concern. 68% of respondents did so in Michigan, Dow’s home state. Investors should be concerned because this study, because while it is somewhat limited, it implies that Dow’s business plan, which promotes many such chemicals, may run counter to public opinion and could be seriously curtailed, regulated, and phased-out if the public were better informed on this issue.

Additionally, many current trends and developments are moving in such a direction. The issue of “pollution in humans” or “body burdens”, the discovery that many common chemicals are accumulating in the bodily tissues of average citizens who do not have work-place exposure to these chemicals is gaining prominence as an on-going news item. In combination with some of the higher profile cases such as dioxin contamination downstream from Dow headquarters in Midland, MI, Agent Orange, and others, public tolerance for the existence of persistent toxic chemicals, lack of testing of chemicals, and the current lax levels of regulation and enforcement is likely to decrease.

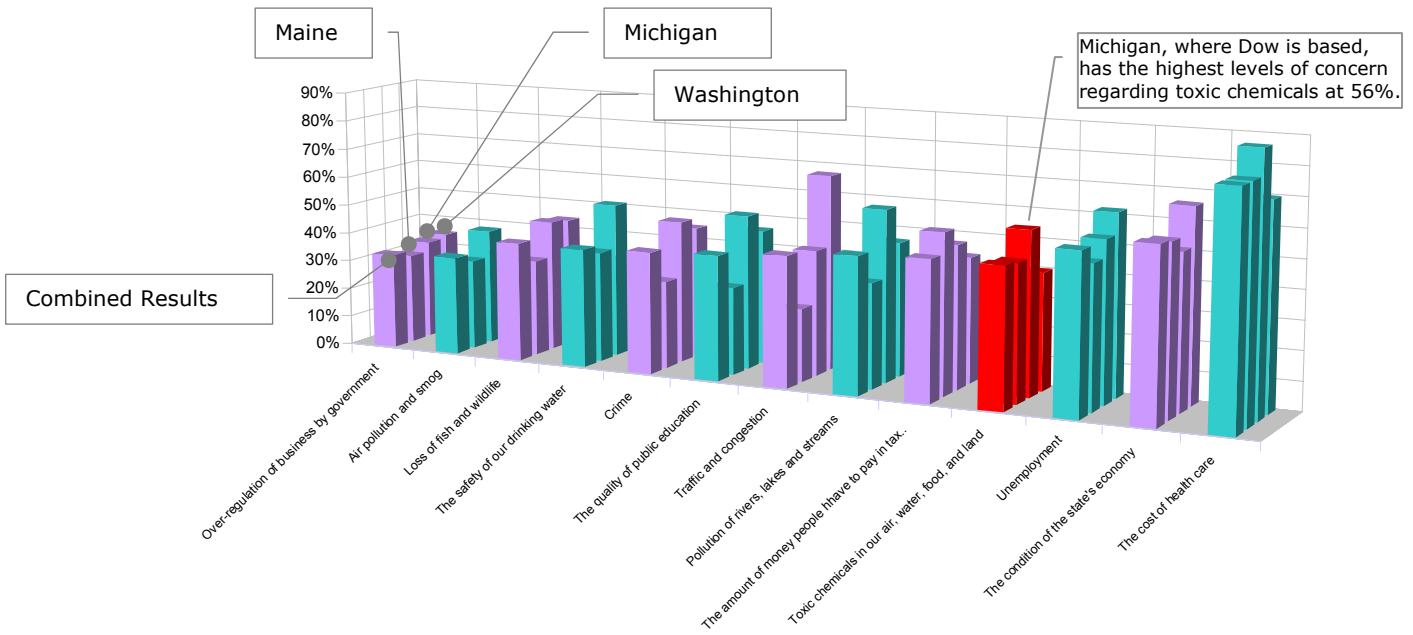


Figure 10. Respondents Rating Various Issues as "Extremely" or "Very Serious"  
 Source: Fairbank, Maslin, Maullin & Assoc. 2003

An illustration of how these public concerns have played out in the marketplace is the growth of the organic foods market, which explicitly rejects Dow's major markets in the agriculture sector. As of 2000, 7 million hectares were used to produce organic food and fiber. Global retail sales of organic food totaled \$18.2 billion in 2001, 0.7% of total food sales and Organic market growth is forecasted at 12-18% annually through to 2010.

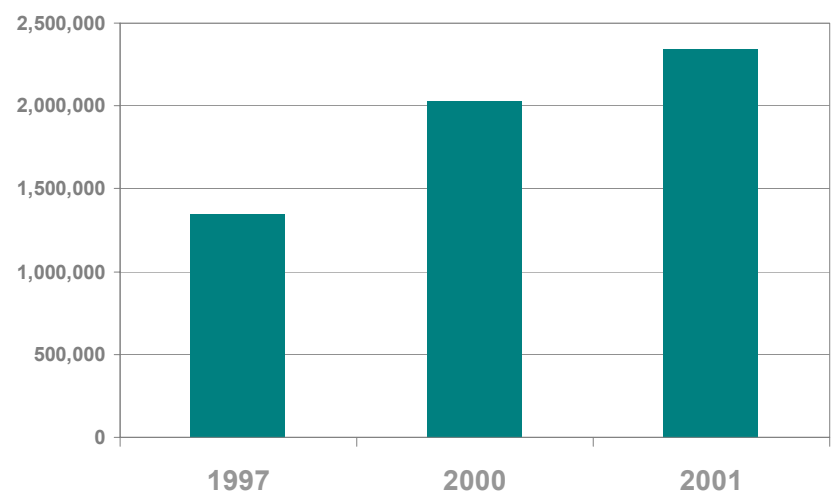


Figure 11. Market Risks - Total U.S. Certified Organic Acreage  
 (Source: U.S. Department of Agriculture, Economic Research Service)

### 3. DOW ENVIRONMENTAL LIABILITY OVERVIEW

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This section outlines major potential liabilities concerning contamination, remediation, and tort litigation facing the company which were not reported or were under-reported in Dow Chemical Corporations 10Ks for 2002 and 2003.

#### DOW AND BHOPAL, INDIA

*“Companies that don’t meet their responsibilities to all their constituencies will have a difficult time. Responsible customers won’t want to buy their products...Enlightened communities won’t want them as neighbors, and wise investors won’t entrust them with their economic futures”* (Dow's Chairman and CEO, William Stavropoulos , *The Business of Business Managing Corporate Social Responsibility: What Business Leaders are Saying and Doing 2002-2007*).

#### The Meaning of Bhopal for Investors

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The 1984 Bhopal disaster involving a catastrophic failure at a Union Carbide pesticide manufacturing plant represents a serious problem for Dow with the potential to damage the company’s reputation. Over 14,000 deaths, and 50,000+ permanent injuries have been attributed to the event and its aftermath by Indian government officials. It has been the source of ongoing legal battles in both India and the U.S. This section will cover the existing and potential financial and reputational impacts for Dow related to the Bhopal disaster as well as a general overview of the ongoing events and controversies.

While Dow claims that it has no responsibility for the incident and that it is a tragic event of the past, investors should be concerned about current developments and the possible financial ramifications that could result. Key issues include:

- Union Carbide’s Status in India: Dow’s subsidiary, Union Carbide, has been listed as an “absconder from justice” by the Chief Bhopal Magistrate for failing to appear before the court on criminal charges relating to the disaster. Likewise, an extradition order has been issued by the Indian government<sup>54</sup> for Warren Anderson, former-CEO of Union Carbide at the time of the accident, so that he may face criminal charges as well. Efforts are underway to summon Dow to deliver Union Carbide to appear in the criminal case and to have Dow clean up the Bhopal site.<sup>55</sup> While Union Carbide no longer has a presence in India, Dow does. Its current holdings<sup>xi</sup> registered in India<sup>56</sup> include:

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<sup>xi</sup> When asked about the size of its holdings in India, the company stated that the above companies were “minor holdings” and that it did not disclose information regarding the valuation of individual subsidiaries.

- Dow Chemical (India) Holdings Private Limited held by Dow Chemical Pacific
  - Dow Chemical International Pvt. Ltd.
  - Anabond Essex India Private Limited held by the Mortell Company (50%)
  - Dow Polymers Pvt. Ltd
  - DE Nocil Crop Protection Ltd (Joint venture)
  - Dow Corning India P Ltd Dow Corning Singapore Pvt. Ltd, Singapore
- **India's Increased Economic Importance:** India is a growing player in the globalized chemical industry and opportunity costs could be sizable for Dow if it is constrained in such a large and growing market by the “*substantial legal risk*” that Dow says exists regarding Bhopal. The Indian economy is projected to grow by 7.2% in 2004.<sup>57</sup> It boasts the world's 12<sup>th</sup> largest chemical industry in terms of production, which is valued at Rs 1200 Billion (\$26 bn) and has been growing at twice the rate of Asia's overall chemical market since 1998.<sup>58</sup> **In the late 1990's India became a net exporter of chemicals.**<sup>59</sup> Agribusiness is an important consumer of Dow's products and India's agricultural sector is projected to grow 13.8% in 2004.<sup>60</sup> Dow currently reports that it has 12% of revenues from Asia while only 2% of fixed assets there. This implies that for Dow to increase its market share in India it may have to acquire more fixed assets in the country and therefore increase its exposure to potential liabilities from Bhopal.

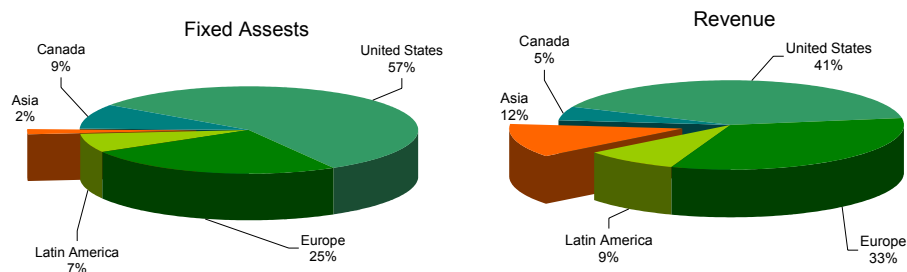


Figure 12. Breakdown of Dow's Fixed Assets and Revenue by Region

(Source: William S. Stravropoulos, Chairman and CEO, Dow Chemical, Presentation to Morgan Stanley Conference, Feb. 24, 2004)

- **Bhopal as a long-term issue:** Many serious points of contention remain between the survivors and Dow despite the funds from the civil case (\$470 million). An estimated Rs 1500 crores (approx. \$340 million) remains undistributed in the Bhopal compensation fund.<sup>61</sup> The balance of the amount remaining in the fund is committed to compensation of victims, and cannot be used for the many other needs of the community, such as the public health and economic impacts resulting from the disaster, or for remediation of the contamination left behind by Union Carbide. Ongoing issues include remediation of water pollution alleged to be from the site, cleanup of the site itself,<sup>62</sup> and further social support for widows, orphans, and

site itself,<sup>62</sup> and further social support for widows, orphans, and the many thousands who are unable to work as a result of injuries. Given this, it seems likely that legal challenges and controversies will continue regardless of the outcomes of individual cases.

- Potential for Divestment: Bhopal creates the real potential for escalating exclusions against Dow Chemical by money managers who run portfolios screened for social responsibility. In 2003 a study showed that there is now over \$2.18 Trillion under SRI management.<sup>63</sup> Corporate directors can no longer ignore this level of investment. The issue is gaining a higher profile and will likely begin to affect investment decisions among this expanding group of investors.
- Regulatory Trends: Recent events in India involving pesticides (including Dow product: chlorpyrifos) in soft drinks has led to demands for greater regulatory oversight of water quality and other aspects of environmental quality. India's economic growth and combined with renewed concern over pollution may provide the necessary funds and motivation to institute more effective environmental cleanup and monitoring laws which would affect both the status of the Bhopal site and Dow's operations in general.

For investors to put Bhopal into perspective it is important to recognize one important factor – Bhopal is not just a synonym for industrial disaster, it is a leading test case for what is alleged to be wrong with the lack of corporate social accountability in the globalized economy. The actions of Union Carbide, and now Dow, are perceived worldwide as those of foreign investors more concerned about damage control than about the hundreds of thousands of human lives their operations have destroyed.

When Dow acquired Union Carbide's shares in February of 2001, it stated that *"the company conducted an exhaustive assessment to ensure that there was absolutely **no outstanding liability** in relation to Bhopal. There was none; the company that Dow acquired retained absolutely no responsibility for either the tragedy or for the Bhopal site."*<sup>64</sup>

However, Dow states in its 2002 Global Public Report: *"We respect that for some people, responsibility for the Bhopal tragedy continues to be an unresolved issue. This doesn't change the facts that the Government of India, through the Settlement agreement, has full authority and responsibility over issues arising from the tragedy and that, upon acquiring Union Carbide, Dow inherited no responsibility. Still, some people would have us take action to resolve their concerns. **But, we are aware of potentially significant legal risks associated with such actions** and we will not compromise our obligation to protect our shareholder interests."* (Author emphasis.)

Thus, the company has stated that it cannot take additional action on Bhopal because of *"potentially significant legal risks"* but yet states that it does not have any responsibility or liability. This contradiction bears greater scrutiny by investors and thus a more detailed explanation of the nature of these risks warranted.

The management's reporting of the Bhopal case presents a number of apparent omissions, inaccuracies and contradictions that are misleading to investors. It implies that resolving outstanding concerns would raise significant legal risks. This amplifies the reality that the management is aware of outstanding risks related to Bhopal that are not being reported to shareholders, such as the fact that Union Carbide is considered an "absconder from justice" by the Bhopal magistrate.

## The Bhopal Disaster

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On the night of December 2-3, 1984 water leaked into a tank containing methyl isocyanate (MIC) at the Bhopal, India pesticide plant of Union Carbide India, Ltd. The resulting runaway reaction vaporized an estimated 30 to 40 tons of MIC releasing a massive toxic cloud of methyl isocyanate gas.<sup>xii, 65,66</sup>

The cloud drifted across Bhopal, a city of some 900,000 residents at that time. The estimates of casualties vary somewhat depending on the source. However the dense slums that sprawled right up to the wall surrounding the plant meant that the Bhopal accident would have the highest death and injury rate of any industrial disaster yet recorded. The initial death toll was officially placed at 2,500 but other estimates based on the sale of shrouds and cremation wood begin at 7,000.<sup>67</sup> The company that owned and ran the site, Union Carbide India Ltd., was a closely held company (50.9%) owned by the U.S. parent company, Union Carbide.

A little more than 16 years later, in February 2001, Dow Chemical acquired Union Carbide as a wholly owned subsidiary, purchasing 100% of its stock and consolidating its balance sheet. Dow Chemical management has gone to lengths to say that when it acquired Union Carbide it thoroughly investigated the matter and did not acquire with it any remaining liabilities with the stock purchase of the company. At the 2003 annual shareholder meeting, for instance, Dow Chemical CEO William S. Stavropoulos described Bhopal as a tragic bygone that is all but resolved in the courts, and for which the company is helpless to take any actions.

As a result of the acquisition, however, Dow has become an international target of protest and media scrutiny. The management's public denials of liability and responsibility are fueling the protest movement. Those denials may also prove to be misleading to investors in light of ongoing efforts to hold Union Carbide liable for criminal charges and environmental remediation and to link Dow with UCC in the Indian courts.

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<sup>xii</sup> In addition, some reports suggest that hydrogen cyanide was also present. When methyl isocyanate is pyrolyzed at temperatures above 427°C hydrogen cyanide is formed as a breakdown product. Union Carbide denied that cyanide gas was present, likely because the health effects of cyanide gas are more well known than methyl iso-cyanate and the company wished to reduce any potential liability. Doctors treating victims found that treatments used for addressing cyanide exposure were effective and eye witnesses reported the smell of "rotten almonds." Cyanide has an almond like odor.

## History of the Bhopal Case

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In May of 1982, Union Carbide inspected its pesticide plant in Bhopal, India and found 10 major deficiencies.<sup>68</sup> The facility had been losing money for two years already and in the four years before the accident it lost a total of \$4.5 million and the company was looking to sell it.<sup>69</sup>

Charges in the pending criminal litigation assert that Union Carbide was guilty of "culpable homicide not amounting to murder." Many issues of fault have been alleged, some of which place blame with the parent corporation rather than its Indian subsidiary. It is alleged that dangers found in safety audits of the Bhopal plant were not remedied, even though remedial measures for similar dangers were undertaken at Union Carbide's MIC plant in West Virginia.<sup>70</sup>

According to allegations made in various arenas regarding the events of December 2, 1984, water (that was being used for washing the lines) entered the tank containing MIC through leaking valves. The refrigeration unit, which should have kept the MIC close to zero degrees centigrade, was shut off by company officials to save on electricity bills.<sup>71</sup> The entrance of water to the tank, full of MIC at ambient temperature triggered off an exothermic runaway reaction and consequently the release of the lethal gas mixture. The safety systems which, in any event were not designed adequately to control such a runaway situation, were awaiting repair. To avoid having the community be unduly alarmed due to occasional leaks, the siren in the factory had been switched off.<sup>72</sup>

In addition there are allegations that the parent company had underinvested in the technologies at the plant. According to representatives of Bhopal survivors, documents obtained through discovery in cases filed against Union Carbide show that in the early 1970's in response to the Indian government's efforts to promote import substitution through the dilution of foreign equity (The Foreign Exchange Regulatory Act – FERA) the company reduced its investment in the Bhopal plant from \$28 million to \$20.6 million. Despite reducing the total cost of investment in line with FERA, the company retained its 51% share in the UCIL subsidiary by back-integrating the equity formulation for the plant. Under FERA, this reformulation required the transfer of additional technology not currently available in India.<sup>73</sup> In order to prevent the dilution of its ownership Union Carbide transferred substandard technology, which had only had a limited test run because it lowered costs in addition to meeting, on paper at least, the requirements of FERA.<sup>74</sup>

According to Himanshu Rajan Sharma – the attorney representing the Bhopal plaintiffs against Dow in the District Court for the Southern District of New York, these documents also show that the pesticide production system at Bhopal had only a trial run and that Warren Anderson, then CEO, and the management committee of the Union Carbide Corporation made the key decision to transfer inferior technology to Bhopal.<sup>75</sup> This would be especially significant as FERA stipulated that the technology transfer had to involve "state of the art" technology. Comparisons of the Bhopal plant design

and a plant owned by Union Carbide in West Virginia producing the same “Sevin” pesticide at the time allegedly show design differences between the plants.

In short, faced with losing majority ownership under FERA, it has been alleged that Union Carbide made the overall plant cheaper to build by importing inferior technology, thus putting Bhopal at risk from the plant’s inception.

Both civil and criminal cases were brought against Union Carbide and other parties including its Indian subsidiary, Union Carbide India Ltd. The civil case filed by the Indian government on behalf of the survivors was settled for \$470 million in 1989. While by the terms of the Indian Bhopal Gas Disaster Relief Act, the settlement resolves all claims of survivors for injuries resulting from the disaster, according to survivor’s organizations today the amount of the settlement was based on estimations that have proved far too low, whether quantifying the dead, the injured or the property lost. It also never accounted for future medical claims. As a result, say the survivors’ organizations, the \$470 million dollars has proved to be inadequate even to satisfy the claims of the acknowledged victims of the disaster. The balance of the amount (approx. \$340 million<sup>76</sup>) remaining in the fund is committed to compensation of victims, and cannot be used for the many other needs of the community – not the public health and economic devastation resulting from the disaster, and not for remediation of the contamination left behind by Union Carbide.

In November 1994 Union Carbide sold its interest in Union Carbide India Limited (renamed Eveready Industries India Ltd. – or EIIIL) to MacLeod Russell (India) Ltd. of Calcutta. As a consequence of that sale, Union Carbide asserted that it retained no interest in or liability for the Bhopal site.<sup>xiii</sup> However, the Chief Judicial Magistrate for Bhopal has held that Union Carbide Corp.’s transfer of shares was not bona fide because it was done to evade potential liabilities arising out of the ongoing criminal case in Bhopal. As a result, \$74 million in Union Carbide assets were attached pending appearance of Union Carbide in the criminal case.<sup>xiv</sup>

Union Carbide has never filed an appearance in the criminal case, and asserts that the courts of India lack jurisdiction to make the company appear as a defendant.

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<sup>xiii</sup> EIIIL took exclusive possession of the land under lease from the government of Madhya Pradesh.

<sup>xiv</sup> These assets have been since reallocated towards construction of a hospital for Bhopal. However, this asset transfer has not obviated the potential liability of Union Carbide in the criminal case.

## Long Term Public Health Effects

Long –term mortality as a result of exposure to gas from the Bhopal site has been determined by the Indian government to be over 14,400. Other estimates by NGOs working in Bhopal are higher.

	Initial Deaths	Initial Injuries	Permanent Disabilities	Long-term Mortality
Indian Government – ICMR	2,500+		50,000	14,400+
Congressional Research Service	2000+	100,000	50,000	
Claims filed with Indian Government			600,000	16,000
NGO Estimates	7000-8000+			15,000-20,000

Figure 13. Bhopal Disaster Casualty Figures - Multiple Estimates

(Sources: Indian Center for Medical Research –ICMR, the U.S. Congressional Research Service, Lapierre D, Moro J. 2001<sup>77</sup>)

Long term analysis of the Bhopal population and the events of the tragedy itself have yielded some alarming statistics. In Nov '89 the Deptment of Relief and Rehabilitation placed the death toll at over 6000. In December 1992 the official agency for monitoring exposure related deaths was closed. Studies showed that some areas experienced 150 times the normal mortality rate weeks after the disaster.<sup>78</sup> Data published by the Department of Relief and Rehabilitation in December 1998 shows that in the year 1997 the mortality rates were 10.4 out of 1000 in the gas-exposed population compared to 6.07 in the unexposed population. Based on an exposed population of 572,242 [ICMR's estimate] this works out to over 2000 deaths attributable to exposure in the year 1997 alone. Health effects stemming from methyl isocyanate exposure produced a number of long-term health effects which have been the impetus behind calls for UCC and Dow to further assist survivors.

Medical Studies<sup>79</sup> have shown a range of long-term impacts. Symptom prevalence surveys conducted by the ICMR<sup>80</sup> indicate that morbidity<sup>xv</sup> was higher in the exposed area (26%) as compared with the control area (18%) when assessed during the period November 1988 to March 1990. Results from the survey carried out by the International Medical Commission on Bhopal show that a large number of subjects reported general health problems (exposed 94% vs unexposed 52%) and episodes of fever (exposed 7.5 per year vs unexposed 2.5 per year). Respiratory, neurological, psychiatric and ophthalmic symptoms also showed a strong gradient by exposure category. Another study<sup>81</sup> found growth retardation in boys who were exposed as toddlers or were born to exposed parents. Major medical problems associated with gas exposure at Bhopal include **ocular problems** including a condition known as “Bhopal eye”<sup>82,83,84</sup>; **Respiratory Toxicity**<sup>85,86,87</sup>; **Reproductive toxicity**<sup>88,89,90</sup>; **Genotoxicity**<sup>91,92</sup>; **Immunotoxicity**<sup>93</sup>; **Psychological and Neuro-behavioural Impacts**<sup>94,95</sup>; and **Neuromuscular Toxicity**<sup>96,97</sup>.

<sup>xv</sup> Incidence of medical conditions.

## After the Dow Chemical Acquisition of Union Carbide

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Many investors may erroneously take at face value the management's statements that the company acquired no liability for Bhopal. For instance, on the company's web page regarding the Bhopal tragedy, Dow Chemical notes that when Dow acquired Union Carbide's shares in February of 2001, *"the company conducted an exhaustive assessment to ensure that there was absolutely no outstanding liability in relation to Bhopal. There was none; the company that Dow acquired retained absolutely no responsibility for either the tragedy or for the Bhopal site."* The company cites a number of issues and developments to back up this claim.<sup>98</sup>

This statement is misleading, because as will be discussed further below, Union Carbide remains a named accused in the criminal case in India. Dow Chemical assets in India may be subject to attachment in the ongoing case. In addition, the Indian government is reportedly processing a request to sue Dow to engage in remediation of the site.

### Union Carbide's Pending Criminal Charges in Bhopal

A criminal case was filed against 12 defendants, including Union Carbide, alleging the crime of "culpable homicide not amounting to murder."<sup>xvi</sup> As part of the Indian government's 1989 settlement, outstanding criminal liabilities against Union Carbide Corporation and other accused were quashed. However, India's Supreme Court reviewed this component of its order and reinstated criminal charges against all accused in 1991.<sup>99</sup>

Indian courts are based on a British system of jurisprudence which means that penalties of restitution can be levied in criminal cases. In the case of the crimes that Union Carbide is charged with, there is no upper limit for the penalty amount. According to Indian lawyer S. Muralidhar, the penalty amount is left to the discretion of the Court, and usually depends upon the magnitude of the crime and the ability of the criminal to pay.

In 1992, the Chief Judicial Magistrate ordered that Union Carbide Corporation be proclaimed an absconder for repeatedly failing to honor summons to face trial. Thus, in India, Union Carbide is considered a criminal fugitive.

Dow continues to have a presence in India in the form of several subsidiaries and at least two joint ventures with assets and businesses. (See above.) The continuing presence of these assets, regardless of their size, may give the Indian courts some leverage to attempt to enforce the cooperation of the parent corporation Dow Chemical in producing its subsidiary Union Carbide in court.<sup>xvii</sup>

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<sup>xvi</sup> Some of the Indian defendants have had their charges reduced to lesser charges of criminal negligence in the intervening years. However the charges against Union Carbide and former CEO Warren Anderson remain as culpable homicide.

<sup>xvii</sup> In addition, on February 26, 2004, the Bhopal court was petitioned by a group of Bhopal survivors (the Bhopal Group for Information and Action) to issue a summons to Dow Chemical to produce Union Carbide for the criminal case. In an initial hearing, the government prosecutors (CBI) took the position that such a procedure is unavail-

## Toxic Wastes and Contaminated Groundwater

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Union Carbide operated waste evaporation ponds on a 14 hectare (35 acres) plot 400 meters from the factory.<sup>100</sup> These ponds received toxic effluents. Such effluents were also discharged through an open drain flowing nearby. Several tons of obsolete pesticides and process wastes lie strewn around the factory site.

The environmental contamination of the site – much of it created prior to the chemical disaster – has rendered the city a dangerous place to live. Thousands of tons of toxic wastes, including obsolete pesticides such as the persistent and bio-accumulative poison HCH and persistent metals such as mercury, have been abandoned at the factory site.<sup>101</sup> Mercury levels in some areas are 6 million times the background values. The groundwater carries high loads of heavy metals, persistent chemicals and solvents, and chlorinated chemicals. Although a portion of the residents have access to overhead tanks of clean water, many of the nearly 20,000 people living in the vicinity are routinely exposed to these chemicals in their drinking water from local wells.<sup>102</sup>

Numerous studies, including by Union Carbide itself, acknowledge the presence of contamination and toxic wastes on and off site. A 1999 Greenpeace study confirmed the presence of persistent organic pollutant chemicals, such as DDT and Lindane (as contamination) and hexachlorocyclohexane (as stockpiles) among others.<sup>103</sup>

Though the factory was returned to the Madhya Pradesh state government in 1998, the condition in which the property was returned may violate the lease agreement. Members of the Indian government and survivor organizations assert that Union Carbide was bound under the terms of their site lease to return the land to the Indian government in usable and habitable condition. Instead, they say, the company undertook some cosmetic remediation work, which community residents assert did nothing to diminish the danger of contamination to local aquifers, before requesting local government departments to take back the lease. Though the government took the site back from Carbide, the Madhya Pradesh government is reportedly working to sue Dow as current owner of Union Carbide asserting a failure of the company to abide by the lease terms.<sup>104</sup>

Dow Chemical's management has declined any responsibility for cleanup of the toxic wastes stating, among other reasons, that the 1989 compensation settlement covers all liabilities. However, the Supreme Court order states that the settlement amount “. . . shall be made to the Union of India as claimant and for the benefit of all victims of the Bhopal Gas disaster under the Bhopal Gas Leak Disaster (Registration and Processing of Claims)

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able under Indian law, however at this writing the court had not yet decided for or against the application. Application to issue summons BEFORE THE COURT OF HON'BLE CHIEF JUDICIAL MAGISTRATE, BHOPAL IN THE MATTER OF CBI Prosecution Versus Warren Anderson & Others Accused, Bhopal Group for Information & Action [BGIA], Bhopal, Applicant, February 26, 2004.

Scheme, 1985...” The Bhopal Gas Leak Disaster Act, 1985, which describes the framework of the above mentioned scheme clearly refers to four kinds of claims that can be addressed using the settlement money. All these are claims “. . . arising out of, or connected with, the disaster.”

The toxic wastes, obsolete stockpiles and groundwater contamination were a result of the routine operation of the factory rather than primarily arising out of or connected with the disaster. Therefore, it appears that the liability for clean-up of the toxic wastes and remediation of contaminated groundwater were not necessarily extinguished by the 1989 settlement.

The courts of India have formally adopted a “polluter pays” principle, which requires that where possible, environmental contamination costs will be charged to the entities causing pollution. The Indian Supreme court has adopted this as a binding principle of law:

“... once the activity carried on is hazardous or inherently dangerous, the person carrying on such activity is liable to make good the loss caused to any other person by his activity irrespective of the fact whether he took reasonable care while carrying on his activity. The rule is premised upon the very nature of the activity carried on.”<sup>105</sup>

Consequently, polluting industries are "absolutely liable to compensate for the harm caused by them to villagers in the affected area, to the soil and to the underground water and, hence, they are bound to take all necessary measures to remove sludge and other pollutants lying in the affected areas".

In the case of Vellore Citizens Forum the Indian Supreme court clarified further that the "Polluter Pays Principle" as interpreted by this Court means that the absolute liability for harm to the environment extends not only to compensate the victims of pollution but also the cost of restoring the environmental degradation. Remediation of the damaged environment is part of the process of "Sustainable Development" and as such the polluter is liable to pay the cost to the individual sufferers as well as the cost of reversing the damaged ecology.<sup>106</sup>

By the Polluter Pays principle it may be expected that Union Carbide may ultimately be found to be at least one of the responsible parties.

In addition to activities in India, a class action suit brought by survivors against Union Carbide regarding environmental remediation is currently pending on appeal in New York, after having been resolved in favor of the company in the district court. The suit also seeks additional compensation for the long-term health damages that the plaintiffs assert to have not been addressed in the original Indian government settlement. An Amicus Brief filed by 18 Congressmen on behalf of the victims in response to the court's ruling stated, *“There is strong support in Congress for holding those responsible for this horrific tragedy accountable for their actions. It is unacceptable to allow an American company not only to exploit international borders and legal jurisdictions but also the ability to evade civil and criminal liability for environmental pollution and abuses committed overseas.”*<sup>107</sup>

In March 2004, the Second Circuit Court of Appeals for New York issued an order allowing litigation by Indian property owners near the Bhopal plant to proceed against Union Carbide in the New York District Court for property damages, including environmental remediation of their properties. The case that is being allowed relates to contamination that is not from the gas disaster, but rather from the operation and abandonment of the plant site.

In addition, the Circuit Court left an opening for the District Court to allow litigation regarding remediation of the Bhopal plant site itself. The district court had denied the case for remediation of contamination of the UCIL site itself primarily because it would require cooperation of the government of Madyha Pradesh, which currently holds ownership of the site. The appeals court allowed that if the Madyha Pradesh government were to intervene in the N.Y. litigation, that aspect of the case could also be revived. The MP government has been looking for a mechanism by which to hold Union Carbide Corp. and Dow Chemical Co. responsible for remediation costs. Given that Union Carbide Corp. has denied the Indian government the ability to assert jurisdiction over the company in India, cooperation by the MP government in the New York case may be forthcoming, thus potentially reviving a large case for remediation of the plant site. It should also be noted that the recent Circuit Court decision provides an opening for personal injury cases related to the contamination to be pursued in the New York litigation, provided that they are not barred by the statute of limitations.<sup>108</sup>

The decision also upheld the plaintiffs' right to seek medical monitoring from UCC for injuries and symptoms associated with groundwater contamination. UCC may be held liable for funding a medical monitoring program for the benefit of the exposed population of 20,000 persons.<sup>109</sup>

### **Impact on Dow Chemical's Reputation**

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Aside from direct financial liabilities, investors should recognize the international significance and historical resonance of the Bhopal chemical disaster, and therefore its powerful effect on corporate reputation. Since the purchase of Union Carbide in 2001, Dow has been subjected to escalating public scrutiny and demands for action refocused from Union Carbide to Dow Chemical as the new parent corporation. These include:

- In 2001 and 2002, survivors of the Bhopal disaster and their representatives met with the management of Dow regarding its completed acquisition of Union Carbide. The discussion ended inconclusively after Dow Chemical's CEO was replaced.
- In a letter to Dow management of March 11, 2002, the survivors wrote in follow-up to conversations with the management requesting that the company address the needs of survivors which remain substantially unmet including clean up of the site and ground water, medical monitoring of survivors, further economic compensation and economic rehabilitation for those whose livelihoods are impaired by injury and social support for widows and orphaned children.

- Survivors appeared at the 2003 Dow Chemical shareholder meeting, where CEO William Stavropoulos repeatedly stated that there was nothing the company could do to answer the survivors' pleas for help – that the company had neither liability nor responsibility for the prior disaster nor its continuing after effects.
- In December 2003, the 19th anniversary of the Bhopal disaster, protests erupted at Dow facilities worldwide. This included the first organized student protest of Dow Chemical since Viet Nam on 25 American campuses. A total of 65 activities worldwide protested against Dow calling for “Justice for Bhopal.”
- A large coalition of organizations met in Bhopal in January 2004 and announced an escalating campaign against Dow in the coming months, to culminate in December 2004 with this year's 20th anniversary of the Bhopal disaster.<sup>110</sup>
- On January 19, 2004, more than 500 people including Bhopal survivors, and representatives from Dow-impacted communities in Vietnam (Agent Orange) and Saginaw, Michigan demonstrated outside the Dow Chemical India headquarters in Chembur, Mumbai. An 8-member delegation, including an Agent Orange victim and a former parliamentarian from Belgium, presented a memorandum to Dow Chief Ravi Muthukrishnan. Among other things, the memo urged Dow to present itself to the court in the ongoing criminal proceedings in Bhopal.
- Eighteen members of Congress sent a letter to Dow management on July 18<sup>th</sup>, 2003 urging the company to provide medical rehabilitation and economic reparations for the victims of the tragedy, clean up contamination in and around the former factory site in Bhopal, provide alternative supplies of fresh water to the affected communities, and ensure that the Union Carbide Corporation appears before the Chief Judicial Magistrate's court in Bhopal where it faces criminal charges of culpable homicide. Similar declarations have also been proffered by 50+ parliamentarians in the UK.

In light of these developments, it is reasonable for investors analyzing the situation to determine that the Bhopal controversy will not go away on its own and indeed will always be a black mark on the company's record. Increased attention to Bhopal heightens the real potential that money managers who run portfolios that incorporate environmental and social analysis will screen out Dow stock. There is over \$2.18 trillion under socially responsible investment management.<sup>111</sup> The issue is gaining a higher profile as a result of continuing inaction by Union Carbide and Dow and will likely affect investment decisions among this group of investors.

## DIOXIN AND DOW IN MIDLAND MICHIGAN

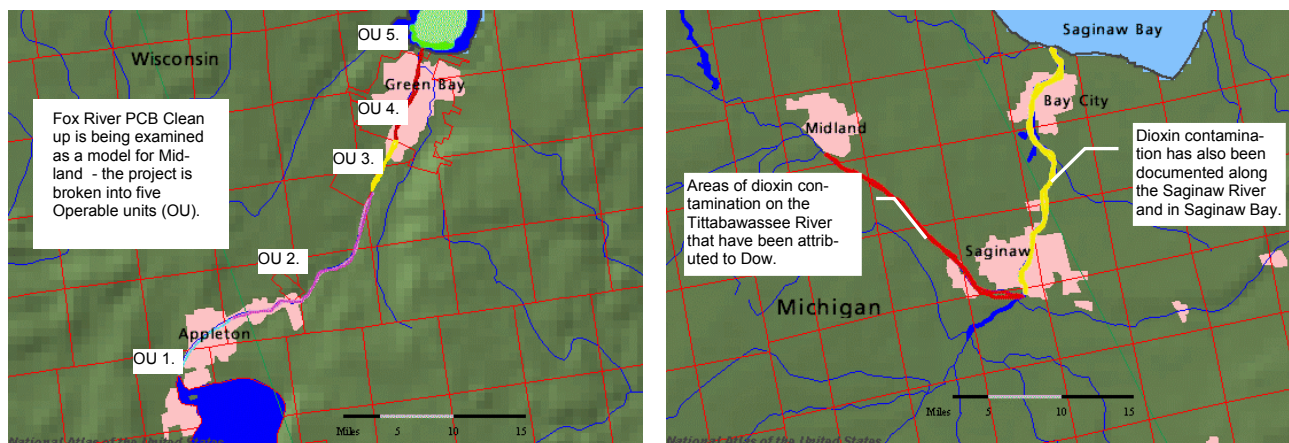


Figure 14. Geographic Comparison of the Fox River/Green Bay and Midland Contamination Cases

(Sources: Maps – USGS; Contamination areas – Wisconsin DNR & Michigan DEQ.)

### The Tittabawassee River

Dow’s headquarters has been in Midland, Michigan since the company’s founding in 1897 and its facility there has been producing chlorinated compounds and associated chemicals for most of that tenure. This section analyses the status of dioxin pollution in Midland and surrounding waterways.

In 2001 the state of Michigan’s Department of Environmental Quality (DEQ) investigated a preliminary finding of high dioxin levels downstream from Dow Chemical. The DEQ found dioxin contamination downstream from Dow’s facility in excess of the state of Michigan’s “Residential Direct Contact Criteria” of 90 parts-per-trillion for dioxin. In its 2003 10K report to shareholders, Dow reported the following:

*“Similar to the Freeport site, in the early days of operations at the Midland site, manufacturing wastes were usually disposed of on-site, resulting in soil and groundwater contamination, which has been contained and managed on-site under a series of RCRA permits and regulatory agreements. The most recent Hazardous Waste Operating License for the Midland site, issued in 2003, also included provisions for the Company to conduct an investigation to determine the nature and extent of off-site contamination from historic Midland site operations. The scope of the investigation includes Midland area soils; Tittabawassee and Saginaw River sediment and floodplain soils; and Saginaw Bay. On December 31, 2003, the Company had an accrual of \$54 million for environmental remediation and investigation associated with the Midland site. In 2003, the Company spent \$8 million on environmental remediation at the Midland site.”<sup>112</sup> 2003 Dow Chemical 10K filed on Feb.20<sup>th</sup> 2004*

Testing in the area has found downstream locations contaminated with dioxin which will probably be the responsibility of Dow Chemical to

remediate. There is reason to believe, given the costs of similar contamination cases, that the ultimate costs of cleanup, and other resulting liabilities, could be substantially in excess of the amount accrued.

Study samples of the sediment in the Tittabawassee River show contamination in the entire 22 mile stretch from Dow's facility downstream to the confluence with the Saginaw River. Samples of dioxins and furans in the river sediment show levels of contamination up to 2100 ppt TEQ<sup>xviii</sup>. More recent sampling has confirmed widespread contamination throughout the floodplain, including in the backyards and gardens of residents living along the river. One recent sample in a neighbor's backyard was 5,600 ppt, more than 60 times the state cleanup standard and samples registering 7261 ppt, have been discovered in soil at a wildlife refuge at the confluence of the Tittabawassee and Saginaw rivers.

Flooding over the years has deposited the dioxins on private properties along the river, including farms. As a result over 300 plaintiffs have joined in filing a class action lawsuit against Dow seeking damages for lost property value and the establishment of a medical monitoring trust fund for residents.

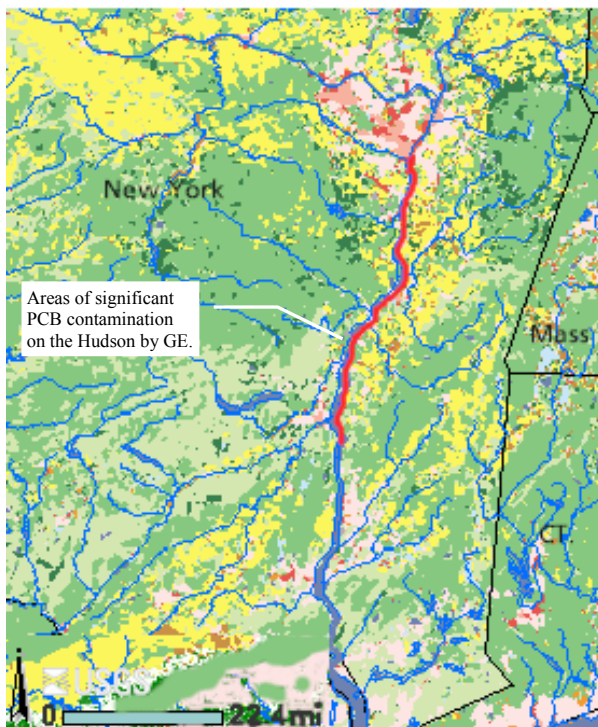


Figure 15. Hudson River Contamination

(Source: NOAA)

Extensive studies of wildlife along the Tittabawassee show high levels of dioxin contamination accumulating up the food chain.<sup>113</sup> Studies found dioxin in the bodies of fish and fish-eating carnivores as well as in chicken eggs along the river. The state urged residents to take precautions such as wearing face masks when mowing grass and showering after yard work.<sup>114</sup> The state will soon begin a pilot investigation to test the blood of residents along the Tittabawassee floodplain to find out to what extent the dioxin may be working its way into the human population.<sup>115</sup> There are more than 2000 parcels of land along the 22 mile stretch of the river between Midland and Saginaw that could potentially be affected by the contamination.

The remediation costs are likely to be considerable given the projected cleanup costs at similar sites. State officials are looking at other sites to help

<sup>xviii</sup> TEQ stands for Total Toxic Equivalence and measures the concentrations of dioxins and furans which have varying levels of toxicity. TEQ measures toxicity based on 2,3,7,8 TCDD (See above) which has the highest toxicity level rated at "1" and its variants, known as "congeners" are measured as equal to or as a fraction of that. (See dioxin section above for a complete discussion of dioxin as a toxicant.)

design cleanup plans and obtain an estimate for the potential costs of cleaning up the river.

PCB cleanup on the Fox River in Wisconsin, which the Michigan Dept. of Environmental Quality is studying as a similar case has costs projected to exceed \$300 million.<sup>116</sup> (See Figure 14 above.) The remediation on the Fox River is broken up into 5 “Operable Units” (OU) along the length of the cleanup site. Costs for remedial action at OU’s 3 & 4 are estimated at \$284 million and costs at OU 5 at \$39.6 million. Costs for OU 1 & 2 had not been estimated at the time of publication.

## **The Saginaw River and Saginaw Bay**

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The Tittabawassee River flows into the Saginaw River which in turn flows into Saginaw Bay, and eventually to Lake Huron. This leads to the question of whether dioxin contamination from Dow’s Midland facility extends into the Saginaw River and Bay. State officials have been examining sediment in the Saginaw and dioxin has indeed been found in concentrations above Michigan safe levels in the lower Saginaw and Saginaw Bay. However a number of known and suspected additional sources are located on the lower Saginaw as well. These include three General Motors facilities and two waste water treatment plants.<sup>117</sup> (See map on page 44.) The DEQ is currently conducting a four year study of the Saginaw River and floodplain to determine attribution for the contamination. The study is due to be completed by mid-June 2007, although remediation plans may begin prior to completion of the study. There have also been decades of research<sup>118</sup> on wildlife that nest on islands near the mouth of Saginaw Bay. Those studies have shown elevated levels of dioxin in birds, and consequent health impacts. In addition, there are state fish advisories on several species of fish in Lake Huron as a result of dioxin contamination.

General Electric’s PCB contamination on the Hudson River (NY) provides the most well-known model that investors might consider in estimating what the full costs of remediation on the Tittabawassee and Saginaw might end up costing Dow. Remediation is projected to cost General Electric \$500 million. In addition, GE spent decades fighting expensive legal battles with regulators at an additional cost of some \$200 million. The Hudson project is certainly larger than the current scope of the Tittabawassee/Saginaw case. Both are roughly 50 miles in length, but the Hudson has lower levels of contamination extending another 40 miles. However, contamination of Saginaw Bay and the greater ease of navigation on the Hudson, a cost-reducing factor, may ultimately make the two cases relatively comparable.

## **Disclosure**

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SEC disclosure by the company has underreported the scale and scope of the contamination around Midland, and does not mention any lawsuits pending against the company regarding contamination, the number of properties involved, nor does it even mention that dioxin is the contaminant.

According to recent assessments by the Michigan Dept. of Environmental Quality, portions of property subjected to frequent flooding by the Tittabawassee River contain elevated concentrations of dioxin. Concentra-

tions ranging as high as 5,660 parts per trillion (ppt) of dioxin toxic equivalence (TEQ) were identified within frequently flooded portions of these properties. The DEQ has currently established that dioxin concentrations below 90 ppt TEQ in soil are acceptable for human direct contact for residential property.<sup>119</sup> Court proceedings and state environmental assessments of contaminated sediments and properties have been ongoing since 2001, however, Dow's financial reporting has not reflected the situation to the degree known nor the likelihood that the cost of remediation far exceeds its current level accruals dedicated to cleanup costs in Midland. As mentioned above, the Fox river cleanup plans, which represent a comparable case, currently range above \$300 million indicating that if similar expenditures are required, current accruals for Midland remediation may have to increase by some 450%.

This will be a long-term issue for investors to track. Given the contamination on the Tittabawassee, (See the following page) Dow will certainly be included in the list of responsible parties for dioxin contamination of the Saginaw River and Saginaw Bay. Legal costs could be a factor given that there are a several responsible parties on the Saginaw and class action suits by a large number of plaintiffs have been filed regarding property damage. Again, similar issues of sediment contamination remediation have been costly, drawn-out affairs, so investors should keep an eye on developments in this case as they emerge and track company accruals.

# Tittabawassee and Saginaw Rivers, and Saginaw Bay Sediment and Floodplain Soil Data in ppt TEQ

## Figure 1 - WHO Mammalian

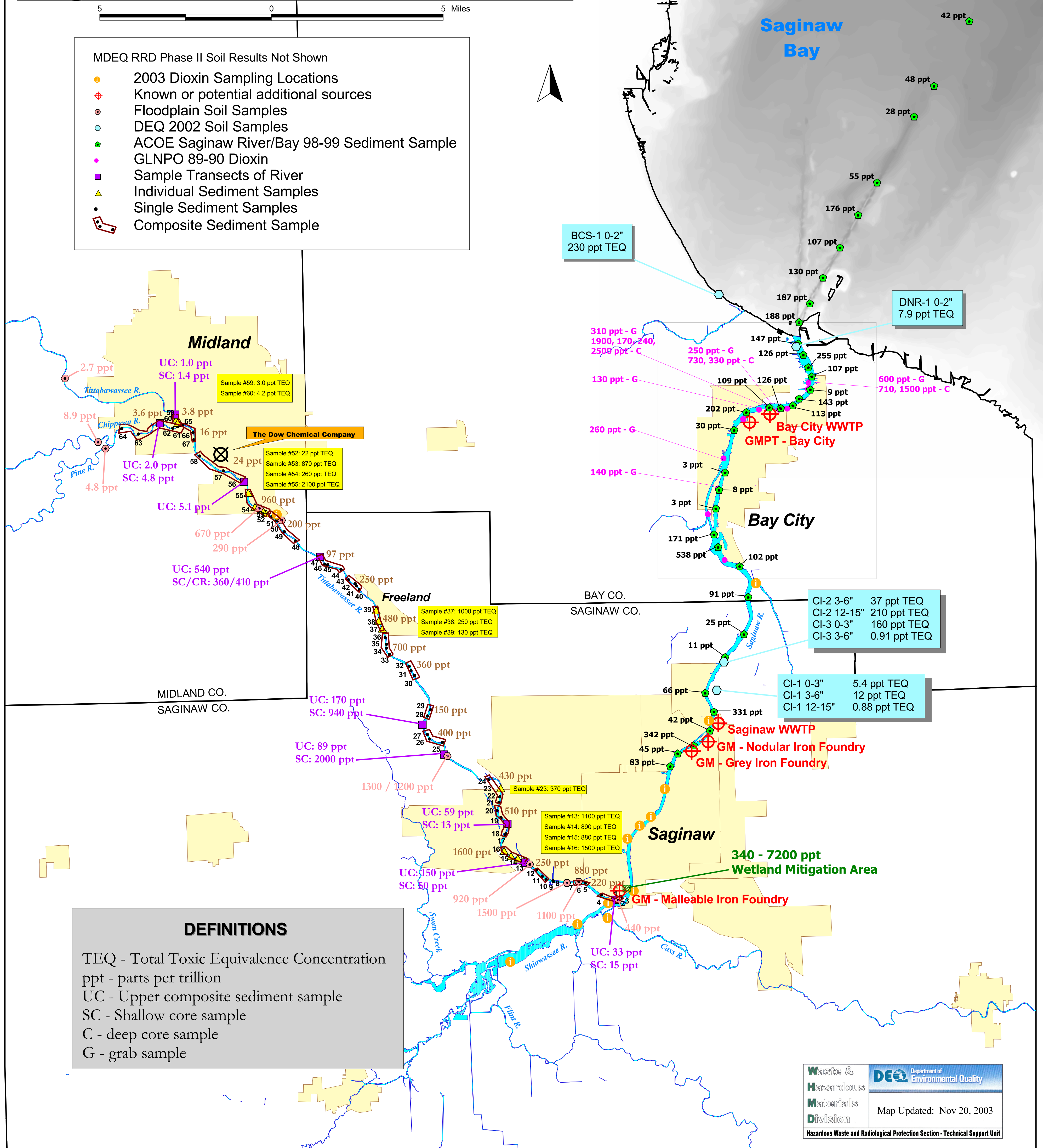


Figure .16 Soil and Sediment Contamination on the Tittabawassee and Saginaw (Source: Michigan Department of Environmental Quality)

## AGENT ORANGE

*“When we initiated the herbicide program in the 1960’s we were aware of the potential damage due to dioxin contamination in the herbicide, however because the material was to be used on the enemy, none of us were overly concerned.” – Dr. James Clary, military scientist in a letter to congress.<sup>120</sup>*

### Agent Orange Overview & the 1984 Settlement

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During the Vietnam War, Dow was one of the major manufacturers of “Agent Orange”,<sup>xix</sup> a chemical defoliant which was used as an anti-guerrilla war tactic to deny North Vietnamese forces cover in the jungle. In addition to Dow, other manufacturers included Monsanto Company, Hercules Inc., Diamond Shamrock Chemicals Company, Uniroyal Inc., Thompson Chemical and T-H Agriculture and Nutrition Company. Dow and Monsanto were the largest producers of Agent Orange (28.6% and 29.5% respectively) with the other companies manufacturing lesser fractions of the chemical.

Agent Orange was extremely toxic and contaminated to varying degrees with dioxins, which even at that time were known both inside and outside Dow to have severely toxic properties. As a result of health impacts arising from Agent Orange exposure, the Veterans Administration maintains a medical registry to track the health of veterans who’ve been exposed.

The US Government now recognizes the following conditions are related to exposure to Agent Orange: Type II diabetes, spina bifida, various cancers,<sup>121</sup> Hodgkins disease, acute and sub-acute neuropathy, a large number of soft tissue sarcomas and multiple myeloma.<sup>122</sup> (See appendix D. for a full list)

The health effects of Agent Orange on U.S. soldiers led to extensive court battles over responsibility for the damage caused by exposure. Dow and its fellow defendants maintain that as government contractors, they are shielded from prosecution. In addition, they maintain that the government knew about the dioxin contamination and ordered them to continue production for the war effort in Vietnam. Judge Weinstein, who oversaw the case in the early eighties, determined that long term litigation was not in the best interest of the litigants and brokered an out of court settlement fund of \$180 million for the veterans in 1984.<sup>123</sup> Observers at the time indicate that the defendants might have settled for as much as \$400 million.<sup>124</sup>

According to the Dept. of Veterans Affairs, 52,000 veterans received payouts from the fund which disbursed the last monies in 1994, after which it was closed for lack of funds. The issue, however, appears to be expanding rather than receding. Recent studies<sup>125</sup> of U.S. veterans have confirmed the connection between Type II diabetes and exposure to Agent Orange, in particular the dioxin component of the herbicide, as well as a plethora of other diseases that emerge long after exposure occurs. The Supreme Court re-

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<sup>xix</sup> A number of herbicides were used in the war, known as the “rainbow herbicides” due to the colored stripes denoting the chemicals on the storage barrels, Agent Orange being the most prominent among them.

cently ruled in favor<sup>126</sup> of a new group of veterans who say their Agent-Orange exposure related illnesses occurred after the 1984 settlement funds were closed to new applicants in 1994, and thus reopened the possibility of another payout to veterans. The case has currently been remanded back to lower courts for a final determination.

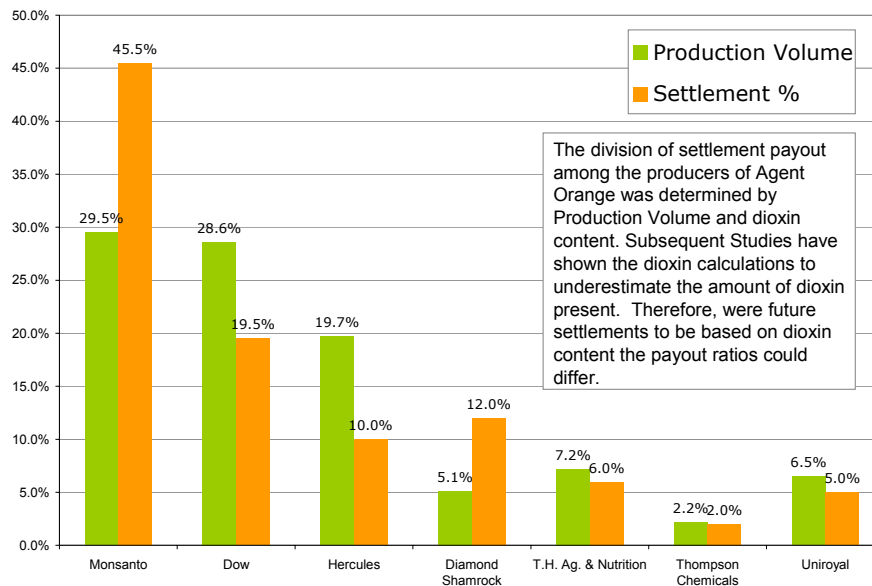


Figure 17. 1984 Agent Orange Settlement Allocation  
(Source: Schuck P. 1986<sup>127</sup>)

In the 1984 settlement roughly 50% of the applicants received compensation. It should be noted that the scope of health problems linked to Agent Orange exposure through scientific studies has widened significantly and includes damage to the health of children of veterans born after exposure.<sup>128</sup> The implication is that a greater proportion of claims could be honored as a result of better scientific understanding of the links between Agent Orange exposure and disease/birth defects.

### United States Veterans and Agent Orange –Claims to US Government

Number of vets who took exams under the Agent Orange Registry prior to 1984	70,600 <sup>129</sup>
Total number of claims received by 1994 under Payment Program set up in the out of court settlement.	105,000
Number of vets receiving VA disability compensation for Agent Orange-related causes.	52,000
Number of vets who've taken exams under the Agent Orange registry since March 2000.	297,194
Number of claims filed alleging Agent Orange exposure-related health effects as of 2003.	99,266

Figure 18. U.S. Veterans Affected by Agent Orange Exposure  
Source: U.S. Office of Veterans Affairs

## Agent Orange Concerns Beyond U.S. Vietnam Veterans

Agent Orange exposure has also become an issue for military personnel stationed outside of combat zones and for U.S. civilians as well. Soldiers stationed on Guam who handled Agent Orange have become ill and



symptoms of TCDD (dioxin) poisoning are apparent in the general population of the island as well.<sup>130</sup> TCDD contamination as a result of Agent Orange handling has been measured at up to 1900 ppm in some areas of Andersen Air Force Base on Guam.<sup>131</sup> Given that safe levels of TCDD have been placed at below 1 ppb by the EPA and even lower by many state regulatory agencies (toxic effects have been measured at parts per trillion), this implies an extraordinary level of contamination. TCDD has been shown in laboratory animals to have multigenerational impacts, not just on the offspring of exposed animals, but on the next generation as well.

Figure 19. Agent Orange Spraying in Vietnam  
(Source: BBC)

In addition to new studies detailing health impacts, there is ongoing research to more accurately calculate levels of TCDD contamination of Agent Orange, and thus, exposure as a result of the use of Agent Orange. According to recent studies by Columbia University's Mailman School of Public Health<sup>132,133</sup> the amounts of TCDD contaminant in Agent Orange were up to four times greater than previously estimated. The equivalent of 600 kg of pure TCDD was sprayed and spilled in Vietnam. Given that this is a compound for which yearly emissions by the chemical industry are measured in grams and exposure thresholds are calculated in picograms, this represents an extraordinary amount of dioxin.

According to Dr. Arthur Galston, Professor Emeritus at the Yale School of Forestry & Environmental Studies, who spoke at the Yale University conference, *The Ecological and Health Effects of the Vietnam War*, "*the use of Agent Orange as a defoliant and herbicide in Vietnam was the largest chemical warfare operation in history, producing considerable ecological as well as public health damage.*"<sup>134</sup> Further studies<sup>135</sup> show that dioxin levels remain high in many Vietnamese exposed to Agent Orange and even their children. U.S. bases, such as Bien Hoa for instance, still show dioxin contamination levels of 1.2 ppm<sup>136</sup> and food samples taken from the area in 2002<sup>137</sup> show dioxin levels approaching those found during the Vietnam War. As a result of exposure to TCDD contamination and Agent Orange, numerous groups are seeking restitution from Dow and other Agent Orange manu-

facturers. According to various estimates,<sup>138</sup> from 500,000 to 1,000,000<sup>139</sup> Vietnamese are suffering from exposure to chemical defoliants used during the war and up to 500,000 have died as a result of such exposure, according to the Vancouver-based Hatfield Associates, an environmental research consultancy. On Jan. 30, 2004, a class action lawsuit was filed by the Vietnam Association for Victims of Agent Orange on behalf of three Vietnamese citizens listed as plaintiffs. The case was filed in Brooklyn, New York listing the manufacturers of Agent Orange as defendants. Nguyen Trong Nhan, the organization's vice president, said more than 20 American companies engaged in the production of Agent Orange were named in the suit, including Dow Chemical and Monsanto.<sup>140</sup> The amount of money the three plaintiffs are seeking in damages has not yet been disclosed.

Additionally, legal challenges and appeals have been brought by New Zealand and South Korean troops who served in Vietnam and were exposed to Agent Orange. Veterans organizations in South Korea estimate that the number of those exposed is in the tens of thousands.<sup>141</sup> 300,000 South Koreans fought with U.S. forces in Vietnam between 1965 and 1973.

Given Dow's intimate connection with Agent Orange production, this implies a significant level of liability outside the U.S. in addition to the issue of U.S. veterans. Also the recent spate of activity around the issue, such as lawsuits, conferences, diplomatic pressure for assistance, and protests by foreign veterans, implies that the issue could have a detrimental effect on the company's reputation with unknown consequences for future profitability.

## UNION CARBIDE AND SEMICONDUCTOR LIABILITY

Union Carbide, as a supplier of chemicals to the semiconductor industry, has been named in lawsuits along with **IBM** and **National Semiconductor**, potentially signaling the advent of billions of dollars worth of claims against the entire semiconductor industry and its suppliers. Cases allege a connection between clean-room working conditions and chemicals and a variety of cancers, miscarriages and birth defects.

By end of 2003, more than 220 claims on behalf of former and deceased IBM employees who worked at IBM's East Fishkill, New York fabrication facility will enter into effect. A case involving 50 former employees of National Semiconductor (37 of them worked at the Greenock, Scotland facility) is underway in California.<sup>142</sup>

The possibility that employees of other companies could file claims may be contingent upon initial settlement amounts, manufacturing history/profile, brand visibility, and corporate culture. For point of reference, IBM settled one claim with two former employees who claimed that toxic fumes they breathed in the Fishkill facility were to blame for their son's birth defects. The amount of the settlement was not disclosed but the initial amount sought was \$40 million. Legal experts have suggested that this settlement will serve as a bellwether, and that all other cases would likely be settled out of court. As a major supplier of these chemicals to the semiconductor industry, Union

Carbide is exposed to liabilities stemming from these cases and will likely be named in any new suits going forward.

All of this implies that for current or potential investors there is a significant outstanding legal risk that is unaccounted for in the current valuation of Dow, Union Carbide's owner. However, the true nature of the investment-relevant risk is as yet unclear. Items of interest include the following:

- *Number of lawsuits throughout the sector.* Semiconductor production has been in operation since the early 1970s, thus implying that there is a significant pool of potentially affected former employees. It is widely known that a majority of semiconductor fabrication workers are women of childbearing age. High concentrations of fabrication workers at many of the smaller manufacturers are low-wage, non-English-speaking immigrants unaware of health hazards or workers rights.<sup>143</sup>
- *The scale of individual liability.* Lack of clear precedent and quantitative information hinders assessment of potential legal awards.
- *Impact on corporate reputation.* Even the perception of risk could impact labor relations and corporate image.

While the sector is characterized by its high rate of capital investment and more pro-active application of environmental, health and safety management methods, early fabrication production processes and technologies are clearly the focus for risk. Worker accounts from the early 1980s describe production conditions in which workers dressed in the characteristic "bunny suits" -- designed to protect the product rather than the worker -- routinely ended up saturated through to their skin in chemicals when work stations were malfunctioning. Union Carbide, as the supplier of these chemicals, would have responsibility for safety testing of the products during development and prior to sale.

Clean-rooms are designed to remove particulate matter from the air but ventilation systems may not have been sufficient to remove aerosolized chemicals. Over the years, and even today, the mix of chemicals used in doping and photolithography may include certain chemicals identified as endocrine disruptors and carcinogens. Proactive companies work to find substitutes for the chemicals, and manufacturing processes have rapidly evolved that allow for reduced chemical use. But the EPA's Toxic Release Inventory shows that some smaller firms may still use the carcinogen<sup>144</sup> **trichloroethylene** – a Dow and Union Carbide product, although its use is largely being phased out across the industry. The photo-resist process involves a mixture of xylenes, formaldehyde-based resins and genotoxic photoactive compounds.

Health Studies have revealed that exposure to clean-room chemicals had negative effects on workers.

Three studies, done at the University of Massachusetts in Worcester, the University of California at Davis<sup>145</sup> and Johns Hopkins found that the rate of spontaneous abortions increased 50 to 100 percent among clean-room workers.<sup>146</sup> The British government sponsored a study in 2001 of cancer rates

among all workers at National's Greenock plant. This small-scale study found a statistically significant rise in the cancer rate among very young, mostly female workers that otherwise should not have high cancer rates.<sup>147</sup>

Union Carbide and other chemical manufacturers who supplied chemicals to the industry, and who would have had knowledge of potential health effects from exposure, have been named in the semi-conductor lawsuits. It is unclear at this time whether and how the chemical producers have been involved in the out-of-court settlements that have resulted from some of the cases in New York.

## 4. OTHER RISKS FOR DOW SHAREHOLDERS

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### DOW AND GENETIC MODIFICATION

#### Catastrophic Failure Risks

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##### **"Adventitious Presence" [Contamination]**

*"(...) the detection of unintended trace amounts (adventitious presence) of biotechnology traits in pre-commercial seed, seed varieties or the grain and products produced can negatively affect our business or results of operations. (...)In addition, concerns have been expressed about **the potential for adventitious presence of proteins in food, resulting from the development and production of pharmaceutical proteins in food crop plants.** Monsanto's Protein Technologies business is one of several businesses engaged in this research."* – From the Monsanto 2002 Annual Report pgs.36-7 (Author's emphasis)

<sup>xx</sup>Monsanto, the industry leader in genetically modified crop development, has admitted in its latest annual report that research and development of genetically engineered (GE) crops will result in the spreading of GE traits to non-GE crops.<sup>148</sup> This is a major admission for the industry and implies that the risk of contamination and negative impacts is very high going forward. The report acknowledges concerns about research and development of both traditional biotechnology as well as pharmaceutical proteins appearing in food crops. Recent assessments by third party consultants retained by the Union of Concerned Scientists found that at "the most conservative expression", half the maize and soyabeans and 83 per cent of the oilseed rape were contaminated with GM genes - just eight years after the modified varieties were first cultivated on a large scale in the US.

This is of concern to Dow share holders as Dow AgroSciences is developing leading positions in providing crop biotechnology products by building a plant genetics and biotechnology business in crop seeds and traits for seeds as well as industrial biotechnology and pharmaceutical biotech production techniques.

Given Dow's growing involvement in this area of industrial agriculture, these same risks apply and investors should be aware of the risks facing any company that engages in this type of business. The admission by the market leader in GE trait development of the possibility that both approved GE traits as well as unapproved traits still in the development process could end up in the human food supply-chain implies that the industry as a whole is aware of these risks. Dow, despite increasing involvement in this area, including working with Monsanto, has not reported to investors on such risks.

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<sup>xx</sup> Further analysis on the financial risks of genetically modified crops, focusing on the market leader, Monsanto, are available from Innovest – "Monsanto & Genetic Engineering: Risks for Investors". Please visit the publications page on Innovest's website.

Contamination can occur, for example, through the following paths: cross pollination; so-called “volunteers” – seeds from previous crops that are herbicide resistant that grow as weeds the following year; and also through the mixing of grain in silos. Even one gene with unapproved characteristics escaping into the general population of food crops could impugn the entire industry, and could result in major business losses for the company as was seen with the StarLink contamination episode. General contamination will make expansion into necessary markets, such as Europe, much more difficult if consumers there are unable to exercise consumer choice once GE crops enter the market. New controversies and negative financial impacts for investors are highly likely. Dow, as a large company with a varied and broad agricultural inputs business, will likely make short term earnings targets in these business areas. However, the issue of inevitable contamination implies that a serious contamination problem is a matter of when, not if. Investors, take note.

### StarLink Contamination Costs

*“...year-to-date, US exports of corn, wheat, and soy products were down 65 million bushels. And that was compared with projections by USDA that call for exports to be up by 330 million bushels. So that shows you the order of magnitude of what's happened. And I don't think it's that we've been uncompetitive price wise with other people around the world. I just think South Americans in particular have been able to take advantage of the situation and take some of the business formerly supplied by US farmers and merchandisers on the basis of having GMO free material. That's happened in Europe. That's happened in Korea. It's happened in Japan.”* – Larry Cunningham, Senior Vice-President of Corporate Affairs of ADM, commenting on the effects of the Star Link contamination in an April 23, 2001 quarterly analysts’ conference call.

In the fall of 2001, independent analysis of grocery store food products uncovered wide-spread contamination by a GE corn variety known as “StarLink.” The corn contained an insecticidal protein from the *Bacillus thuringiensis* bacterium which had not been approved for human consumption due to potential allergic reactions. While less than 1% of the U.S. corn crop was planted with StarLink corn, upwards of 10% of the U.S. corn crop was contaminated. The recall cost companies along the food chain hundreds of millions of US Dollars as they attempted to find, retrieve and replace products that used the corn.<sup>149</sup> StarLink corn also turned up in Japan – the top foreign buyer of U.S. corn – where the GE corn has no approval for use as food or feed. In 2001, Japanese imports of U.S. corn fell by about 1.3 million metric tons due to the StarLink issue.<sup>150</sup> To date, this event has cost StarLink’s developer, Aventis, **an estimated \$1 billion**. Recently, in February of 2003, Aventis and the StarLink distributor agreed to pay \$110 million to farmers who say they were financially hurt by the incident.<sup>151</sup> Starlink is still being found in the U.S. corn crops at this time.

### ProdiGene and “Pharma-crops”

*“It is possible that crops transformed to produce pharmaceutical or other industrial compounds might mate with plantations grown for human consumption, with the unanticipated result of novel chemicals in the human food*

In the wake of the StarLink fiasco, a second contamination case has raised serious questions about the safety procedures surrounding the development of genetically engineered crops containing industrial or pharmaceutical proteins which produce medicines or vaccines.

ProdiGene, a small Texas-based genetic engineering firm, was found to have mishandled genetically engineered pharmaceutical corn that produced pig vaccines in Iowa and Nebraska. A test plot of ProdiGene pharmaceutical corn was grown on a Nebraska field in 2001. Ordinary soybeans that were planted in the same field in 2002 got contaminated by the GE corn and mixed with 500,000 bushels of soybeans, worth roughly \$2.7 million, at a commercial grain elevator. The company was fined \$250,000 and had to spend up to \$3 million to destroy the soybeans. The company will also have to post a \$1 million bond to guarantee its financial responsibility for future problems.<sup>152</sup> The company's CEO acknowledged that no formal human safety testing had been done on the pig vaccine protein contained in the corn.<sup>153</sup>

In a similar incident, the USDA ordered ProdiGene to destroy several thousand bushels of corn in Pocahontas County, Iowa after the company failed to follow procedures designed to stop the spread of the engineered genes to other fields containing food crops.<sup>154</sup> The seed distributor, Stauffer Seeds (owned by ProdiGene), ran ads in farm journals telling farmers they could grow "*genetically enhanced corn containing industrial and pharmaceutical products*" with "*No change in current farming practices.*"

While Dow states that it has developed stringent guidelines and procedures for its pharmaceutical crop operations and is highly regulated, the ProdiGene case shows how risky these operations can be and implies that the activities of another firm could also hurt Dow's business were there to be further contamination problems. Dow itself was also fined in Dec., 2002 for mishandling experimental bio-tech crops in Hawaii by failing to properly isolate its insect resistant corn variety and failing to plant enough trees to prevent cross contamination.

Dow also states that it has developed guidelines and procedures for its pharmaceutical crop operations and is highly regulated, the ProdiGene case shows how risky these operations can be and implies that the activities of another firm could hurt Dow's business were there to be further contamination problems. Dow itself was also fined in Dec., 2002 for mishandling experimental bio-tech crops in Hawaii by failing to properly isolate its insect resistant corn variety and failing to plant enough trees to prevent cross contamination.

These incidents have galvanized the food industry in opposition to the further development and commercialization of food crops genetically altered to contain industrial or pharmaceutical proteins. Politically powerful trade groups for the \$500 billion food sector such as the National Food Processors Association and the National Grocery Manufacturers of America have

been pressuring the genetic engineering industry to change its approach to the development of these crops by staying away from food crops and switching to non-food crops such as tobacco. These industries see pharma-crops as a financial threat and don't want to repeat the StarLink fiasco. *"If need be, we could even go to the public"* stated Rhoda Applebaum, Executive V.P. of Scientific and Regulatory Affairs at the National Food Processors Association.<sup>155</sup> This is significant opposition coming from an industry that has previously been supportive of genetic engineering.

The editors of the journal *Nature Biotechnology* and the U.S. National Academy of Sciences have both stated that cross-pollination with non-GE crop varieties was a potential problem.<sup>156,157</sup>

All this implies that Dow will face increasing pressure to limit the development of pharmaceutical crop varieties. Potential contamination of food crops by pharma-crops, even those of a competitor, could further galvanize market rejection to its products including the genetically engineered food crops which could hurt the profitability of this business unit.

## GLOBAL WARMING

Global warming, caused by the emission of greenhouse gases from the burning of fossil fuels, has been designated by national and corporate leaders at the World Economic Forum to be the greatest threat to human civilization. Dow's operations require large amounts of fossil fuels which are used for energy and feed-stocks. While the company's energy use reduction goal of 20% by 2005 over a 1994 baseline is a good step towards addressing the issue of global warming, it still leaves the company overly exposed to energy price fluctuations and carbon costs.<sup>xxi</sup> The company stated that its expenditures for hydrocarbons and energy accounted for 36 percent of its production costs and operating expenses in 2003.<sup>158</sup>

The state of the science underpinning global warming has substantially moved in the direction of greater certainty about the role of human impacts upon the climate and the accelerations of warming trends in recent decades with significant warming predicted over the coming century.<sup>159</sup>

Current delays in public policy to address global warming, especially in the United States, are at odds with these scientific conclusions. These delays are significant in light of the major weather related catastrophes which have occurred world-wide over the past few years, such as wide spread and persistent droughts, massive flooding in the EU and China, heat waves in France and India that killed tens of thousands, all of which were likely the result of climate warming according to the World Meteorological Organization.<sup>160</sup> Recent reports by the UN and others state that global warming cur-

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<sup>xxi</sup> Carbon costs relate to the price of carbon dioxide emissions which have either been proposed or enacted in many regions where Dow operates. Dow has been shifting production to Europe, particularly Germany to take advantage of cheaper natural gas prices. The EU has made Kyoto goals legally binding and has made climate change mitigation a priority. For more information on the economics carbon pricing please visit the Innovest website: [www.innovestgroup.com](http://www.innovestgroup.com)

rently costs the world economy over \$150 billion yearly and causes the deaths of an estimated 150,000 due to increased incidents of tropical disease and social dislocations cause by more erratic and powerful weather systems.

Dow notes in its 2002 annual report<sup>161</sup> that volume growth for its Agricultural Sciences Division was hampered by drought, indicating that global warming may already be beginning to impact the industry.

*“Agricultural Sciences sales were \$2.7 billion in 2002, compared with \$2.6 billion in 2001 and \$2.3 billion in 2000. Volume increased 6 percent versus 2001, while prices declined 2 percent. The addition of Rohm and Haas’ agricultural chemicals business, acquired in June of 2001, was the key driver behind the 2002 volume increase. Excluding the impact of this acquisition, volume declined 2 percent. **Volume growth in 2002 was hampered by drought and reduced demand for insecticides in key geographic areas.** (author’s emphasis) The competitive environment remained challenging in 2002 with continued industry consolidation and an increasing presence of generic products. Sales in 2001 improved versus 2000, as a 15 percent increase in volume, primarily due to acquisitions, was partially offset by a 4 percent decline in prices.”* (Dow Annual Report 2003)

Innovest has noted similar observations by Monsanto, Dow’s competitor in this business area as well.

The implication for Dow’s investors is that the tension between public policy delays in addressing global warming and the reality on the ground will likely result in the future in sudden sweeping and dramatic changes to economic and public policy when delay cannot or will not be tolerated further. The longer this delay lasts, the more dramatic the response is likely to become. Already, many individual countries and U.S. states are taking steps to force reductions of the green house gas emissions responsible for global warming.

Dow should seek to reduce its exposure to global warming risks by continuing to conserve energy, search for alternatives to fossil fuel based energy and examine alternatives to petroleum based feed-stocks. Significant synergies may be found in addressing the issue of global warming for the company and addressing the main concerns regarding chlorinated chemicals discussed in this report because of the energy intensive nature of the chlorine industry. Dow’s collaboration with Cargill on corn-based plastics points to the potential for profitable alternative chemistries that may be able to address both these issues simultaneously.

## REVIEW OF OTHER LIABILITIES

There are a number of potentially significant developments which warrant brief mention here that investors should be aware of. These issues are either nascent or resolved in favor of the company. Mention here is due to the possibility that these issues may become factors in the future or reappear as a liabilities in other venues and regions.

### Early Developments

- New research by EPA shows that trichloroethylene (TCE) is 40-60 times more toxic than previously thought. The current major producers of TCE in the U.S. are Dow and PPG Industries Inc. Based upon the toxicity factors included in the draft assessment, TCE risk standards are likely to be reduced significantly for water and air exposures. This could add billions to current cleanup costs for numerous TCE contamination sites around the country. TCE is one of the most common pollutants listed at contaminated sites. As a result of the toxicity reassessment new exposure standards are being developed.<sup>162</sup> The current water standard of 5 parts per billion (ppb) could be reduced to approximately 0.26 ppb. The current inhalation standard of 1 microgram per cubic meter (ug/m<sup>3</sup>) could be reduced to approximately 0.016 ug/m<sup>3</sup>. The possible new standards represent reductions in the risk limits of approximately 20 times the current water standard and 60 times the current air standard. The revised water standard of less than 1 ppb would present a formidable cleanup goal for many ground water remedial systems. The likely standard is only about two times greater than most laboratories' ability to detect TCE using standard techniques. In addition, the revised toxicity data for TCE could negatively impact Union Carbide's ability to defend itself against tort claims in the semiconductor industry.
- Myrtle Grove: A lawsuit has been filed alleging vinyl chloride monomer contamination of the water supply in Myrtle Grove, a community outside the company's Plaquemine Louisiana vinyl chloride plant.
- Dursban (chlorpyrifos): According to the New York Attorney General's office, Dow Chemical advertised to consumers that its product Dursban was safe, despite a 1994 agreement with the New York attorney general's office that it would not do so.<sup>163</sup> The Dow pesticide Dursban (chlorpyrifos) is believed to be associated with illness in thousands of exposed people, including potential neurological damage to children. The EPA fined the company \$732,000 in 1995 for failing to disclose reports of adverse effects associated with use and exposure to Dursban. In 2003, the company settled a threatened consumer fraud lawsuit by the New York State Attorney General for \$2 million, a record level for a consumer pesticides suit in New York, due to the company's continued marketing of the products as safe for various uses.

Back in 1994, Dow had agreed to review and change its advertising claims. Underlying the Attorney General's threatened suit were several label claims, advertisements and web publications. For instance, as late as 2003, the Dow Chemical website claimed: "Consumer exposure from labeled use of chlorpyrifos products provides wide margins of safety for both adults and children." By contrast, according to Dr. Philip Landrigan, chair of the Department of Community and Preventative Medicine at Mount Sinai Medical Center, "Excellent studies conducted by independent scientists have clearly shown that chlorpyrifos, the active ingredient in Dursban, is toxic to the human brain and nervous system and is especially dangerous to the developing brain of infants." Serious negative health impacts on fetal development have come to light since its removal from New York markets.<sup>164</sup>

A study by the Delhi based Centre for Science and the Environment tested 36 samples of soft drinks in India. "Chlorpyrifos was detected in 100% of the

36 samples analyzed . The range of concentration in the 12 brands varied from 0.0015-0.0072 mg/L. Minimum concentration of 0.0015 mg/L was detected in Sprite, a Coke product and maximum was detected in Mirinda lemon flavor, a Pepsico product, which is 72 times higher than the EEC [European Economic Council] limit of 0.0001 mg/L for individual pesticides. Average concentration of 0.0042 mg/L of chlorpyrifos was detected in all the samples that is 42 times higher than the EEC limit.”<sup>165</sup>

### Ongoing Issues Currently Resolved in Dow’s Favor

- DBCP and Banana Workers: Dole Foods Co., Dow Chemical, and Royal Dutch Shell won the dismissal of a complaint seeking to enforce \$489 million in judgments obtained by Nicaraguan banana workers in their country for injuries caused by dibromochloropropane (DBCP). DBCP has been linked to cancer and sterility and has been banned in the United States. Suits on behalf of at least 16,000 Latin American workers have been filed in U.S. courts over the past two decades seeking restitution for damages caused by DBCP.<sup>166</sup> According to co-defendant, Dole Foods’ 2003 10K report to the SEC, that company is still involved in a number of legal efforts by those claiming health damage from exposure to the chemical and reports extensively on the issue. Dow stated in its Sept. 30, 2003, 3<sup>rd</sup> Quarter 10Q that: “*Numerous lawsuits have been brought against the Company, both inside and outside the United States, alleging that the manufacture, distribution or use of pesticides containing dibromochloropropane (“DBCP”) has caused personal injury and property damage, including contamination of groundwater. It is the opinion of the Company’s management that the possibility is remote that the resolution of such lawsuits will have a material adverse impact on the Company’s consolidated financial statements.*”
- Union Carbide Uranium Issues: Twenty years after the Union Carbide uranium mill in Uravan, Colorado closed in 1984, a group of 82 former Uravan residents and descendants of company employees is suing Union Carbide and its wholly owned subsidiary Umetco Minerals Corp., blaming the companies for a variety of suspected mining- and milling-related illnesses and genetic disorders. The lawsuit, asking for unspecified monetary damages, was filed Jan. 23, 2004 in Denver federal court. Similar suits by other workers were resolved in favor of Dow on the basis of the “contractor defense” meaning that the company was indemnified from liability as a government contractor.

## 5. BEST PRACTICE FOR ENVIRONMENTAL DISCLOSURE

This section will cover the way risks to investors stemming from environmental liabilities are reported by Dow. This section will also evaluate the transparency of the company's required reporting under relevant rules and regulations and note accounting methods available to Dow that would allow for increased levels of transparency with respect to environmental liability.

### Remediation, Insurance & Legal Costs

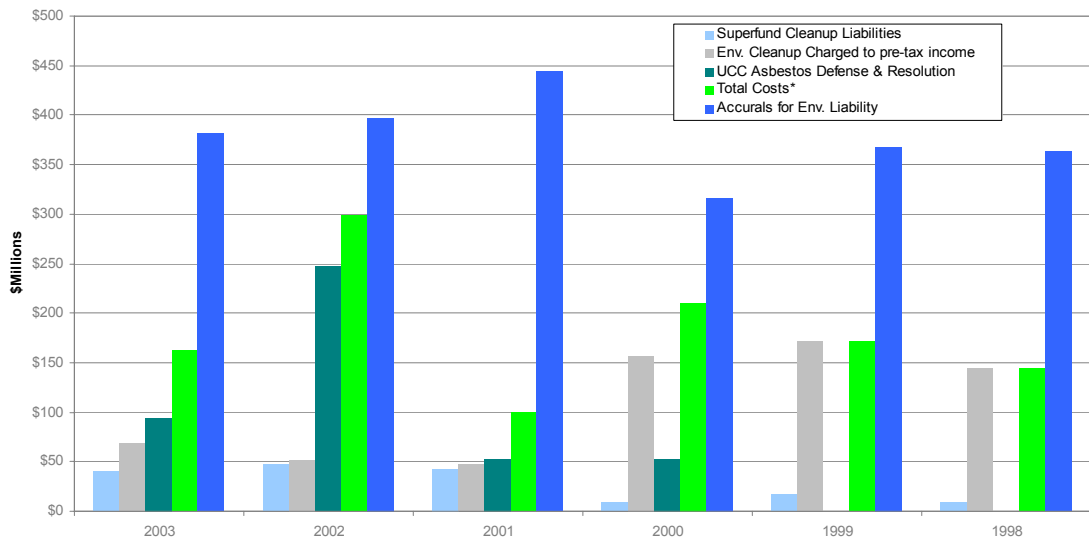


Figure 20. Environmental Remediation and Asbestos Defense & Resolution Charges on Dow's Balance Sheet, 1998 to 2002.<sup>xxii</sup>  
 (Source: Dow & Union Carbide 10K Financial Filings to the SEC: 1998 - 2003)

In its 2003 10K filing to the SEC, Dow Chemical states: *“In total, the Company's accrued liability for probable environmental remediation and restoration costs was \$381 million at December 31, 2003, compared with \$394 million at the end of 2002. This is management's best estimate of the costs for remediation and restoration with respect to environmental matters for which the Company has accrued liabilities, although the ultimate cost with respect to these particular matters could range up to twice that amount”*

Dow's environmental remediation expenditures are difficult to track over the course of the merger as Union Carbide and Dow accounted for these expenditures differently. For example, in Union Carbide's 2001 10K, the company stated that:

<sup>xxii</sup> In most cases these do not include legal fees and environmental insurance costs which are accounted for in the company's Selling, General & Administrative (SG&A) costs.

\* Dow and UCC had difference accounting methods for environmental liabilities.

*“While estimating such future costs is inherently imprecise, taking into consideration the corporation's experience to date regarding environmental matters of a similar nature and facts currently known, the corporation estimates that worldwide expenses related to environmental protection, expressed in 2000 dollars, should average about \$105 million annually over the next five years.”*

However, these numbers are not reflected in the following years under Dow's consolidated balance sheet. According to the investor relations department at Dow, this is because Union Carbide included costs associated with other aspects of environmental remediation that Dow tracks in other areas of the balance sheet. It should be noted that the number of sites listed for remediation by the company varies insubstantially from 2002-2003, 219 to 216 respectively, so the drop in expenses cannot be explained by a corresponding drop in sites closed out through remediation.

One of the major hidden costs of all this liability is the legal and insurance costs the company incurs. Even in cases where issues are resolved in the company's favor, such as winning court cases or receiving an insurance payout, the costs of legal representation and increases in insurance premiums can result in hidden costs that erode profitability.

**While the asbestos cases and breast implant liability are well known to investors, the cumulative effect of decreasing the company's cash reserves makes Dow more financially vulnerable to other problems. Environmental liabilities should be considered by investors in light of other areas of the company's financial situation such as a sizable \$10.7 billion in debt after net cash and a debt-to-capital ratio of 53%, largely as a result of a string of acquisitions.<sup>167</sup> These indicators imply that environmental cost increases, even if small, may have a direct impact on profitability.**

As a result, investors may see the unreported liabilities in a different light knowing that the company has already expended large amounts of liquid capital to fend off these large-scale product liability cases.

## **SEC Regulations**

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In early 2002 the EPA surveyed a number of firms to compare compliance violations and site liabilities with their level of disclosure under U.S. Securities and Exchange Commission (SEC) environmental financial debt accounting regulations. **The EPA found that 74% of publicly traded firms surveyed openly violate these SEC rules.**<sup>168</sup>

SEC reporting requirements mandate quarterly and annual financial reporting of corporate environmental liability and debt exposure in incidences of violations of U.S. environmental laws. In addition, companies rarely, if ever, report on such liability outside the U.S. despite, as in Dow's case, having thoroughly globalized operations.

For reporting of U.S. liability, SEC regulation S-K stipulates that disclosure include:<sup>169</sup>

### Item 101

All environmentally related proceedings, including governmental proceedings, which are material to the business or financial condition of the registrant.

### Item 103

Damage actions or governmental proceedings involving potential fines, capital expenditures or other charges in which the amount involved exceeds 10% of current assets. In addition, governmental proceedings, unless the registrant reasonably believes such proceedings will result in fines of less than \$100,000 are required to be reported regardless of materiality.

### Item 303

In the Management's Discussion and Analysis of Financial Condition and Results of Operation (MD&A), discussion should disclose "any known trends, demands, commitments, events or uncertainties" that are reasonably likely to have a material effect on the company's bottom line. The SEC has developed a two-part test to aid in reporting of this general requirement. To avoid disclosure of a pending issue, management must determine that a trend or event is not "reasonably likely" to occur. If management is unable to make such a determination then disclosure is required unless management can determine that the event would not be material were it to occur. The SEC has emphasized that doubts in these cases should be resolved in favor of disclosure.

### Materiality

Materiality in environmental disclosure as defined by the SEC and the courts is determined by whether there is a substantial likelihood that its disclosure would be viewed by a "reasonable investor" as having changed the "total mix" of available information in a substantial way.

The SEC warned companies that they should not use "rules of thumb" such as a percent of total assets as the only criterion for assessing materiality. The key issue is whether shareholders would find the information in question to be of interest within the total mix of information available.<sup>170</sup>

As EPA research shows, these regulations are routinely flouted in corporate reporting. This is partly due to extremely lax enforcement by the SEC. In the past 20 years the SEC has only once enforced its Reg. S-K environmental disclosure requirements.<sup>171</sup> This is also reinforced by the fact that SEC reporting requirements for reg. S-K are often considered satisfied by accounting firms if boilerplate language, such as blanket claims of non-materiality, is utilized.

### Sarbanes Oxley

The scope and quality of environmental liability reporting has changed under the new disclosure rules determined by Sarbanes Oxley adopted in early 2002. As Dow's directors will now have to personally sign off on financial reporting,<sup>172</sup> closer scrutiny of environmental disclosure along Reg.

S-K guidelines will likely result. This is also due to the fact that Sarbanes Oxley has altered the context in which Reg. S-K is interpreted. The new regulations require the adoption of rules and procedures for disclosing material information and for the CEO and CFO to evaluate the effectiveness of these systems and get personal certifications of responsibility for them.

This requirement will also be enhanced by the adoption of attorney conduct rules under the Sarbanes-Oxley Act<sup>173</sup> which stipulate “up the ladder” reporting of material violations that are discovered by counsel to the chief legal counsel or the chief executive officer. CEOs and CFOs will also have to delegate specific responsibility for identifying and documenting emerging trends in environmental regulation.

Most importantly, Sarbanes Oxley goes beyond GAAP in terms of “fair presentation” of financial condition.<sup>174</sup>

SEC states the following interpretation of “fair presentation” with respect to Sarbanes Oxley: [...] ***‘fair presentation’ of an issuer’s financial condition, results of operations and cash flows encompasses the selection of appropriate accounting policies, proper application of appropriate accounting policies, disclosure of financial information that is informative and reasonably reflects the underlying transaction and events and the inclusion of any additional disclosure necessary to provide investors with a materially accurate and complete picture of an issuer’s financial condition, results of operations and cash flows.*** (Author’s emphasis.)

Given the new guidelines, it is highly unlikely that the major and potentially material issues covered in this report such as Bhopal, Agent Orange, and general environmental liability and market and regulatory risks stemming from chlorine operations, should go unmentioned on in the MD&A of Dow’s financial statements.

### **AICPA Statement of Position 96-1**

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*“All entities that prepare their financial statements in accordance with generally accepted accounting principles (GAAP) should rely on SOP 96-1 for guidance.” - The Journal of Corporate Accounting and Finance<sup>175</sup>*

In October of 1996, SOP 96-1 was issued by the American Institute of Certified Public Accountants to address inconsistencies in the reporting of environmental cleanup liabilities, and deficiencies in overall accounting literature.

SOP 96-1 outlines the recommended steps for GAAP reporting on environmental cleanup liabilities and stipulates that the following criteria should be followed:

- Under SOP 96-1 such criteria are met when (1) litigation either has commenced, a claim asserted or based on available information the commencement of either is probable and (2) it is probable that the outcome of such litigation or claim would be unfavorable. However, the second test is presumptively met by showing that the company whose financial statements are under consideration is or was associ-

ated with the subject site. Association consists of present or prior ownership or operation of a site, transportation of waste to the site or contribution of waste that is transported to the site by others.

- FAS 5 requires that an estimated loss or expense from a loss contingency shall be accrued by a charge to income if it is probable that an asset has been impaired, or a liability incurred, provided the amount of such asset impairment or liability incurrence can be reasonably estimated. If a loss is not probable or not estimable, then footnote disclosure of the contingency shall be made when there is at least a reasonable possibility that a loss may have been incurred, with an estimate of the possible loss or range of loss if it can be made.

### **FAS 143**

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In June of 2001, FASB issued its Statement of Financial Accounting Standards No. 143, Accounting for Asset Retirement Obligations, effective after June 15<sup>th</sup> 2002. FAS 143 requires companies to disclose the fair legal value of obligations connected to the retirement of tangible long-lived assets. FAS 143 cites numerous examples of asset retirement obligations arising under environmental laws which are especially applicable to the chemical industry (although the ruling was developed to focus on the retirement of nuclear power plants).

In contrast to FAS 5, no legal action is required to trigger reporting obligations for the purposes of FAS 143. The ruling helps capture costs associated with remediation expenditures triggered by sale, decommissioning, or disposal of assets even though the cleanup obligation may be the result of much earlier events. Since FAS 143, unlike FAS 5, requires reporting regardless of the probability of future government enforcement, uncertainty about remediation costs, or absence of legal proceedings, reporting will likely increase. Dow's changing production patterns and shifting assets related to the merger with Union Carbide and other similar activities should be closely examined for adherence to FAS 143.

### **ASTM Guidelines**

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In response to the fact that environmental disclosure rules lack precise guidelines for determining what is reportable, in 2001, the American Society of Testing and Materials (ASTM) developed two sets of guidelines to address these deficiencies in financial reporting.

#### **ASTM 2137**

This guideline addresses the deficiencies in reporting associated with lack of disclosure based on claims of uncertainty by proposing a hierarchy of estimated approaches based upon the quality and quantity of information available. Four established cost estimation methods are discussed in ASTM 2137 and ordered according preference – most to least – based on the level of detail elucidated by each method.

1. The most preferred evaluation method according to ASTM is the “expected value” approach. This means that each proceeding or

event is assessed according to the weighted average over the range of values for the known possible outcomes. This method is used when the probability and cost of the range of outcomes is known or can be estimated.

2. The next approach is the “most likely value” approach. This is applied when one scenario or set of scenarios has a much higher probability of occurrence than others.
3. The third approach is the “range of values” approach which is utilized in the absence of data for calculating the probability of expected outcomes. Therefore, this approach only provides a range of values for the possible outcomes without probabilities.
4. The least preferred approach according to ASTM is the “known minimum value” approach which is utilized when it is premature to estimate the probabilities of outcomes and associated costs because the uncertainties are so great that a range of values or most likely value cannot be determined. In this case disclosure involves only those costs that are reasonable certain to be incurred.

### ASTM 2173

This guideline addresses the deficiency that reporting of materiality for environmental liabilities does not have to be based on the total aggregate of liability that a company faces. Environmental liabilities are typically reported on and accounted for as separate individual events. Therefore, investors are often denied a more accurate picture of risks facing the company as the disclosure threshold for environmental liability under S-K item 103 is applied individually to each proceeding. ASTM 2137 addresses this by requiring companies to consider environmental liability in the aggregate and establish more explicit minimum requirements with regard to the content of the company’s disclosures.

ASTM 2173 would also establish minimum requirements for disclosure in greater detail than current regulations. When total aggregate liability for the company was determined to be material, the company would be required to disclose the following:

- The “number of sites for which the reporting entity has been named as a PRP and the number of claims, suits, actions, demands, requests for payment, notices, or cases that have been presented to the reporting entity for environmental liabilities.”
- The “reporting entity’s estimate of its environmental liabilities, a description of the approach used to estimate the amounts, and the amounts accrued by the reporting entity for environmental liabilities.”
- The “cost estimation methodology employed for accrued liabilities and a characterization of any material loss contingencies.”

- The “nature and terms of cost-sharing arrangements with other PRPs.”<sup>xxiii</sup>

Given the extent to which environmental liabilities have been under-reported by corporations in general, and with Dow in particular, investors should raise their expectations on reporting thresholds by using the ASTM guidelines as measure of best practice against which Dow’s reporting methods should be judged. When and where reporting appears lacking, investors should demand more information as past cases have shown that these issues are often material both in the aggregate and for particular proceedings. When issues are reported, the level and timing of disclosure and estimation should be assessed using the ASTM guidelines. Where these issues yield large unreported liabilities in the future, senior management will be accountable for explaining why estimation and disclosure could not have been made earlier.

## Summary

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**Based on the contents of this report, it is the author’s opinion that in its 2002 and 2003 Annual Reports, Dow Chemical is clearly not in compliance with the spirit of SEC regulations and guidelines regarding environmental disclosure. The contents of this report also raise questions regarding whether the reporting is a “fair presentation” of the company’s financial condition consistent with the management’s Sarbanes Oxley certification.**

The insurance industry is not picking up much of the liability for Dow and its colleagues in the chemical industry. Despite self-insurance by many chemical companies, in 2001 the global insurance service firm A.M. Best reported that they expect the insurance industry to incur over \$121 billion in costs in order to provide coverage for the compliance, cleanup and legal fees of environmental liability problems across all industries.<sup>176</sup> Dow has many business units that “self insure” their operations.<sup>177</sup> While this is a common practice in the chemical industry, and may, in some cases, be the most cost-effective option, the level of risk and the size of potential payouts in the event of lost court cases, implies that Dow’s investors are facing significant levels of essentially uninsured risk.

The company's reporting regarding remediation only relates to accrued liabilities, and accrued liabilities are only established "*when it is probable that a liability has been incurred and the amount of the liability can reasonably be estimated, based on current law and existing technology.*"

The failure to mention a number of environmental matters in the MD&A seems to fly in the face of existing SEC requirements - for example "*to avoid disclosure of a pending issue, management must determine that a trend or event is not reasonably likely to occur.*" Yet, on Midland, there is no discussion of the extensive contamination and the company's struggle with state regulatory officials to come up with a way of reducing those li-

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<sup>xxiii</sup> PRPs: Potentially responsible parties at superfund sites.

abilities. On Agent Orange, not even the June 9, 2003 Supreme Court decision is reported in the company's MD&A. So, it appears that the company is not resolving its doubts in favor of disclosure, but rather in favor of nondisclosure.

ASTM 2137 suggests four different evaluation methods for liabilities, ranging from the best to the least preferred approach. With regard to liabilities for sites such as Midland, it appears that the company may be using a minimum value- because of the uncertainty involved. Certainly, it should be possible at this point to at least identify a range of values that are possible--for instance a value based on the cost to the company if it is required to dredge contaminated soil in the river and relocate all the people in the area. Instead of reporting on the Midland, Michigan class action of 2000 households or the Agent Orange suit, potentially on behalf of thousands of veterans, the company dismisses such lawsuits collectively by stating that *"some of these actions purport to be class actions seeking damages in very large amounts...Except for the possible effect of Union Carbide's asbestos related liability described above and the possible effect on the company's net income for breast implant litigation, also described above, it is the opinion of the Company's management that the possibility is remote that the aggregate of all claims and lawsuits will have a material adverse impact on the Company's consolidated financial statements."*

Liabilities associated with Midland, Michigan and Agent Orange each seem reasonably likely to total at least hundreds of millions of dollars. Yet the accrued liabilities reported for Midland are currently \$54 million dollars, with no disaggregated calculation of the range of possible liabilities associated with that site. **And there is no reporting in the 2003 10K MD&A regarding the Agent Orange cases.** Again, a range of possible liabilities associated with that litigation would seem appropriate.

Given that markets discount equities in the face of uncertainty, it is in the interest of investors to ensure that they have a proper accounting of these risks and the probable outcome if they are not to be fiscally harmed by sudden negative disclosures. It is in the company's interest to more accurately account for its liabilities in order to reassure its investors, creditors, and insurers, as well as provide management with a solid understanding of the true cost/benefit accounting of its operations over time. In light of this, the company should address the issues raised in this report in its next fiscal report to the SEC. The company should adopt ATSM standards regarding environmental disclosure and move its estimation and disclosure practices up the hierarchy of options prescribed by the ASTM.

In addition, an extensive assessment of the life-cycle impacts of the company's products, focusing on organochlorines, and, in particular, on PBTs such as dioxin, should be conducted in order to assess the magnitude of future liabilities stemming from current activities. This will likely also facilitate management discussions regarding R&D and capital expenditures for developing and expanding alternatives to those core chemicals which pose the greatest risks to future profitability.

## 6. CONCLUSIONS: WHAT IS THE FUTURE FOR DOW CHEMICAL?

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The issues for Dow shareholders can be summed up as follows:

Dow is at the cross roads of two developing trends which are placing significant strains on its future profitability. The first trend is litigation surrounding historical liabilities such as asbestos, Agent Orange, chemical exposure for workers in the semi-conductor industry, contamination of the Tittabawassee River downstream from its global headquarters, and numerous other potential site liabilities, including Bhopal – the worst industrial accident ever recorded.

Some of these problems will undoubtedly have a negative impact on the company's bottom line. This litany of problems, regardless of the financial outcomes of individual cases, will also have a significant deleterious affect on the company's reputation.

The second trend is the growing scientific understanding of the human health impacts of many organochlorines and the recognition that thresholds of "safe" exposure levels based on cancer and other catastrophic health impacts leaves fetuses and infants vulnerable to damage that impairs development and mental capabilities.

The combination of bioaccumulation and toxicity – particularly endocrine disruption – two characteristics shared by many organochlorines, implies that the problem will increase over time, have cross generational impacts and expose increasing numbers of people through complex exposure pathways that are not controllable by the company or by those affected. The increasing understanding of the toxicity of organochlorines even at low doses, and the ability to measure lower and lower levels of these contaminants in bodily tissues, will only increase the potential liability. The general public, not just factory workers or residents in local communities where plants are located, carries chemical burdens in their bodies. The entire planet's population is exposed to these compounds, because these chemicals have spread through the biosphere to every corner of the globe. They can be found in deep sea creatures,<sup>178</sup> people living in remote areas, and appear in every test of the general population to varying degrees.

Given the increasing level of understanding of how this group of chemicals harms human health and causes ecological damage, management at Dow needs to make a detailed examination of how these risks will affect profitability and what changes to the overall business plan need to be made to address these risks. It is likely that given the human health impacts of these chemicals and pollutant byproducts, such as dioxin, and the growing public awareness of these factors, that regulatory testing and phase-out requirements will only increase over time.

## Questions for Management

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Ultimately this report raises more questions than it answers because the information required to answer those questions is not forthcoming from Dow's financial reporting. Inquiries made to Dow's Management in the preparation of this report (Appendix D) also went unanswered or were inadequately addressed in conversations with Dow officials. However, Dow's willingness for open dialogues and yearly reporting should be commended.

There are still outstanding issues for which stakeholders require additional information. Investors should therefore seek answers to the following questions:

1. Dow refers to actions taken with respect to resolving the Bhopal issue as having “*potentially significant legal risks associated with such actions.*” Given that the company does not define these risks in its reporting to shareholders and stakeholders and that this assessment contradicts Dow's position that it has no outstanding liability with respect to Bhopal, can the company define specifically what these risks are?
2. Prior to the merger with Union Carbide, management at Dow would have been required by rules of fiduciary responsibility to assess its environmental liabilities. Did the internal decisions made regarding the liability for Bhopal reflect an accurate assessment of the outstanding liabilities facing Union Carbide? How will the management now avoid damage to Dow's reputation, as well as other potential liabilities, in light of increasing stakeholder attention on Dow as the new owner of Union Carbide?
3. Given the centrality of environmental costs to Dow's operations it is highly likely that investors and regulators will continue to increase pressure on the company to increase its level of reporting on these types of liabilities. How would the company's reporting of its environmental liabilities change under the ASTM guidelines?
4. Dioxin is known to science as one of the most toxic synthetic compounds ever studied. Dow, as a leader in making chlorinated chemicals is therefore responsible for the generation of significant amounts of dioxin. Given the severe health risks and ecological risks that dioxin, and by extension Dow's chlorinated chemicals pose, how has the company strategy been adjusted to reflect the lifecycle impacts of its products and the market and regulatory risks that come with such impacts?
5. Under Sarbanes-Oxley, Dow's management must have an established protocol for identifying, tracking, estimating and judging the materiality of environmental matters. Will the company publish this protocol for investors and stakeholders?
6. Given the role of Dow's products in the creation of dioxin pollution, will Dow's future dioxin assessment reporting include a life-cycle

approach? Dow is one of the world's major producers of chlorinated products. Life cycle assessment of these products would help management estimate, given its various uses, roughly how much dioxin the company's products create through the entire life cycle of a product both in a US and a global context. The dioxin report should assess the likely effects of the presence of dioxin congeners in the general public for assessing liability. It should provide management with enough information to address these potential liabilities through product and process changes and public policy initiatives. Examples of such activities might include:

- a. Shifting production to products with low or no chlorinated components.
  - b. Devising new methods of hazardous waste disposal that address the concerns of secondary emissions or contamination resulting from the various disposal methods utilized.
  - c. Developing market leadership for all product areas with alternatives to traditional chlorinated products. The company has already demonstrated the potential viability of this strategy with the development of water-based solvents, and corn-based plastics, among others.
  - d. Complete cessation of all hazardous and toxic waste transfers to cement kiln facilities.
7. The company has stated that it has accrued \$54 million for remediation in Midland. Given that cleanup estimates for similar cases of river and watershed contamination are many times larger than Dow's estimation in this case, what is the management's best estimate for the upper range of costs for remediation of Midland, the Tittabawassee River, the Saginaw River, and Saginaw Bay? Examples may include sites such as the Fox River project in Wisconsin or GE's PCB contamination on the Hudson.
8. The company has commented on DBCP liability in its yearly financial statements by stating the extent or number of these cases. While the Nicaraguan banana workers case was dismissed on a technicality by a New York judge in 2003, the size of the initial verdict, \$489 million implies sizable liabilities for the company. Can Dow comment more extensively on its outstanding DBCP related liabilities in the U.S. and other countries? Are there similar liabilities associated with any other pesticides that Dow produces? For example, for Dursban?

## APPENDIX A – ABOUT INNOVEST

Innovest Strategic Value Advisors is an internationally recognized investment research and advisory firm specializing in analyzing companies' performance on environmental, social, and strategic governance issues, with a particular focus on their impact on competitiveness, profitability, and share price performance.

Innovest provides its clients with three basic types of products and services:

- Industry, company and specialized reports
- Asset management sub-advisory services
- Custom research, consulting and portfolio analysis

Founded in 1995 with the mission of identifying non-traditional sources of risk and value potential for investors, the firm currently has over US \$1 billion under direct sub-advisory mandates with partners including ABN-AMRO, Mellon Capital, Brown Brothers Harriman, T. Rowe Price, and Credit Lyonnais. Innovest also provides custom portfolio analysis and research to leading fund managers including Schroders, State Street Global Advisors, and Rockefeller & Co. Innovest's institutional clients include two of the largest pension funds in the world – CalPERS (USA) and ABP (Netherlands). In addition, the firm provides research and strategic advice to senior executives of Global Fortune 500 industrial companies.

Innovest's chairman Jim Martin was chief investment officer for North America's largest pension fund for over fifteen years. The firm's founder, Dr. Matthew Kiernan, is a former partner with KPMG and director of the World Business Council for Sustainable Development and its co-founder, Hewson Baltzell, is a former banker and investor from Lehman Brothers and JP Morgan Chase. Innovest's other principals and advisory include former senior executives from several of the world's leading financial companies, as a former G7 finance minister, and the former chairman of Royal Dutch/Shell. Innovest's flagship product is the EcoValue<sup>21</sup>® investment analytics platform, which was developed in conjunction with strategic partners including Pricewaterhouse Coopers and Morgan Stanley Asset Management. Innovest has offices in New York, London, Paris and Toronto.

## Innovest's Directors and Senior Advisors

### Advisory Directors

*Innovest's Directors, Advisors, and Technical Advisors are among the leading thinkers in their fields.*

- Mr. Jim Martin: Chairman, Innovest Strategic Value Advisors; formerly Chief Investment Officer, TIAA-CREF.
- Mr. David Van Pelt: Vice Chairman, Former Executive Vice President, Citicorp.
- Mr. Alan Silberstein: CEO, Western Union
- Mr. Arthur Lipper III: Founder, The Arthur Lipper Corporation.
- Mr. Ken McCready: Former CEO, Transalta Corporation.
- Sir Mark Moody-Stuart (Emeritus): Chairman, Anglo-American Mining, former Chairman, Royal Dutch Shell Group
- The Rt. Hon. Lord Nigel Lawson (Emeritus): Chairman, Central Europe Trust, former Chancellor of the Exchequer, United Kingdom.

### Technical Advisory Committee

- Derek Osborn, Chair, former Director of the U.K. and European Environment Agencies
- Dr. Stuart Hart, Professor, University of North Carolina
- William Russell, former Director, U.S. Environmental Practice, Pricewaterhouse Coopers
- Dr. Andrew King, Professor, Tuck School of Business, Dartmouth
- Alan Willis, Advisor, Global Reporting Initiative
- Franz Knecht, former head of environment management, Swiss Bank Corporation
- Stephen Viederman, former President, Jessie Smith Noyes Foundation

## APPENDIX B - LEADING-EDGE INVESTMENT RESEARCH: "NON-TRADITIONAL" RISK FACTORS

"Financial performance tells me what a company has already done. Non-financial performance tells me what it is likely to do."

Ernst & Young, Measures that Matter, 2000

### Investment Risk and the "Iceberg Balance Sheet"

The recent accounting scandals at Enron, WorldCom, Tyco and elsewhere have exposed some, but by no means all, of the limitations of accounting-based investment analysis. Accounting numbers provide at best a static, "rear-view mirror" indication of *past* performance. Differing accounting conventions and assumptions can distort the true financial picture even further. But perhaps the most serious limitation of all is the fact that they can assess only a small and shrinking proportion of companies' true competitive dynamics, risk profiles, and potential for sustainable earnings growth.

As recently as the mid-1980's, financial statements were able to capture at least 75% on average of the true market value of major corporations. As we move deeper and deeper into the era of "knowledge-value" and intangibles, however, conventional balance sheets and profit and loss statements are reflecting less and less of a company's true risk profile and competitive potential<sup>xxiv</sup>.

Today, some of the most powerful risk factors and value drivers for companies are hidden "below the waterline", and cannot be fully assessed by traditional investment analytics. What is needed now, therefore, is a new, more dynamic and forward-looking "iceberg balance sheet" approach to investment analysis, focused on the 60-70% of companies' real competitive and financial prospects which *cannot* be explained by traditional, accounting-based securities analysis.

Innovest Strategic Value Advisors was formed in 1998 specifically to research and analyze these non-traditional risk factors for investors. Innovest's largest external shareholder is ABP, a major Dutch pension fund which is one of the largest and most highly-regarded in the world. Innovest clients include some of the world's leading financial institutions, as well as a number of Fortune Global 500 industrial companies.

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<sup>xxiv</sup> See, for example, Baruch Lev (2001), [Intangibles: Management, Measurement and Reporting](#). Washington, D.C., Brookings Institutions.

Innovest focuses primarily on four key sets of non-traditional risk and value drivers:

- Strategic Governance
- Environment
- Human Capital and Labor Relations
- Stakeholder Capital



## Investment Results To Date

There is every indication that Innovest’s proprietary investment algorithms can indeed generate alpha. To date, each of the 5 strategies built on the Innovest research platform has out-performed its benchmarks since inception:

STRATEGY	INCEPTION	FUND SIZE	ALPHA
Global Active	5/2001	\$180 M	+300 bps
Global Enhanced Index	7/2001	\$150 M	+150 bps
Global Enhanced Index	2/2002	\$50 M	+140 bps
US Enhanced Index	3/2002	\$150 M	+150 bps
UK Enhanced Index	1/2003	£20 M	+30 bps

## Tomorrow's Alpha Potential

In addition to the out-performance which has already been demonstrated, at least five powerful “mega-trends” are currently converging to make non-traditional risk factors even *more* important for investors in future:

- Post-Enron, WorldCom skepticism about the accuracy, objectivity, and value of traditional, accounting-based Wall Street research.
- Tougher legal requirements for the disclosure of “non-financial” risks by both companies and institutional investors. Eg. Sarbanes-Oxley, recent SEC rules, European pension reform.
- A substantial broadening of the scope of fiduciary responsibility to include companies’ ability to manage “non-traditional” business risks including environmental, social, and governance issues.
- Record levels of institutional shareholder activism on environmental and social issues, e.g. climate change.
- The expansion of both industry competition and investment into emerging markets, exponentially increasing the level of exposure to non-traditional business risks.

## Benefits for Investors and Fiduciaries

Supplementing their traditional research processes with Innovest’s analytical overlay can create significant benefits for investors:

- **Risk Control:** Identifies hidden sources of risk to portfolio companies – eg. Asbestos, climate change, human rights, labor, business costs of HIV/AIDS.
- **Alpha Diversification:** Consistent demonstrated source of non-correlated alpha.
- **Reputational Capital:** Enhances institutions’ reputational capital with both internal and external stakeholders.
- **Fiduciary Responsibility:** Meets or exceeds emerging global fiduciary requirements – eg. New U.K., Swedish, German, French, Swiss, Australian pension regulations.
- **Strategic Reinforcement:** Aligns investment strategy with clients’ social, environmental, and governance concerns.
- **Management Proxy:** Helps investors identify companies with superior management and agility to deal with *other* emerging issues in the future.

## How Can Innovest Add Value?

### An “Early Warning System” for Investors

Innovest’s proprietary research on non-traditional risk factors has provided clients with early warning signals months and in some cases years before the

general market picked up its own negative signals and punished companies' share price and/or credit rating. Some of the "problem companies" identified by Innovest's research before Wall Street and the City of London are:

- HealthSouth – strategic governance and transparency
- GE – asbestos and other environmental liabilities
- Monsanto – genetically modified foods
- Anglo-American – costs of HIV/AIDS in the workforce
- Tyco – strategic governance and transparency
- American Electric Power – climate change
- Federal Mogul - (now bankrupt) asbestos liability

## Adding Value on the Upside

It is also increasingly well-established by leading-edge investors and financial analysts that there is a strong and growing link between companies' ability to manage non-traditional business risks and their financial performance.<sup>xxv</sup> Simply put, a company's ability to manage these complex risks better than its competitors has proven to be a robust – but largely neglected – proxy for superior management quality overall, the most significant single driver of excess returns.

Innovest has systematically analyzed the non-traditional risk profiles of over 1,500 large and mid-cap firms around the world in nearly 50 industry sectors. Companies with a demonstrably superior capacity to manage those risks have generated a wide range of financial and strategic benefits:

- Enhanced market access in difficult countries and regions (e.g. Royal/Dutch/Shell)
- Reduced regulatory risk exposure (e.g. BHP Billiton)
- Reduced energy and materials costs (e.g. BASF)
- Improved relations with regulators and other stakeholders (e.g. Intel)
- Greater ability to attract and retain a high-quality workforce (e.g. 3M)
- Lower cost of capital and insurance (e.g. Real Estate Investment Trusts)

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<sup>xxv</sup> See, for example, West LB Panmure (2002) [More Gain than Pain: Sustainability Pays Off](#), and (2002) [From Economics to Sustainomics: SRI – Investment Style with a Future](#); UBS Warburg (2001) [Sustainability Investment: The Merits of Socially Responsible Investment](#); Bank Sarasin (1999) [Sustainable Investments: an Analysis of Returns in Relation to Environmental and Social Criteria](#); and (1998) [Environmental Shareholder Value](#).

## Empirical Tests of Innovest Ratings

### 1. Ongoing work by Innovest

A major U.S. public pension fund wanted to investigate whether or not environmental and social (SRI) analysis can be used as part of decision-making in its investment process without adverse impacts on its portfolios' risk-adjusted return, and to pursue this, the client engaged Innovest. We applied Innovest ratings as an overlay to the investment portfolios of six third-party money managers that the client currently uses. Innovest created a number of live simulations, or “shadow portfolios”, to investigate possible uses and impacts of the ratings. The goal of this initiative was to have a live simulation of the effects of Innovest ratings (rather than a back test), to use actual portfolios, to apply actual current Innovest ratings, to track performance, and to repeat the procedure during the course of one full year. The client wanted to answer two questions in particular: 1. What effect, if any, does adding SRI considerations to an existing investment? 2. Which investment styles, capitalization levels, and regional focus lend themselves to an SRI overlay?

To perform the simulations, Innovest obtained from the client's managers the actual holdings of each of the six portfolios as of 12/31/01, and at the end of each quarter thereafter through 12/31/02. For each quarter, we applied the Innovest ratings to the portfolios and created three simulations per portfolio (i.e. 18 simulations in total per quarter). This is analogous to “turning up the volume” of the Innovest signal to three different levels. This was accomplished using a portfolio optimization model such as is commonly used in the investment management business, and setting the “tracking error” to three different levels – 50 basis points, 100 basis points and 200 basis points. In these simulations, we maximized the Innovest ratings subject to these tracking errors.

After one year of simulations, the results generally indicate that the application of Innovest ratings to the investment process has a positive effect on investment performance. In five of the six investment portfolios, use of Innovest ratings significantly improved investment return relative to the performance of the underlying portfolio. In most cases, this improvement increases as the “volume” of the Innovest signal increases (see **Figure A1**), that is, as the weight for the Innovest information is increased. Note, however, that the addition of Innovest information to the Manager 5 portfolio did not help its overall performance, as is clear from Figure A1. We believe that the risk minimization dynamics of the optimization model and its internal restraints did not support the mechanics of the Innovest overlay for the Manager 5 portfolio (as more fully explained in our study, available through Innovest).

These results would seem to be significant, inasmuch as the portfolios to which the Innovest overlay was applied represent a considerable range of investment styles (growth, value, active, enhanced index), capitalization levels (large cap, mid and small cap), and geographic exposures (U.S., EAFE, global). Due to the use of the portfolio optimization model, the out-

performance realized in these simulations is achieved without industry sector biases.

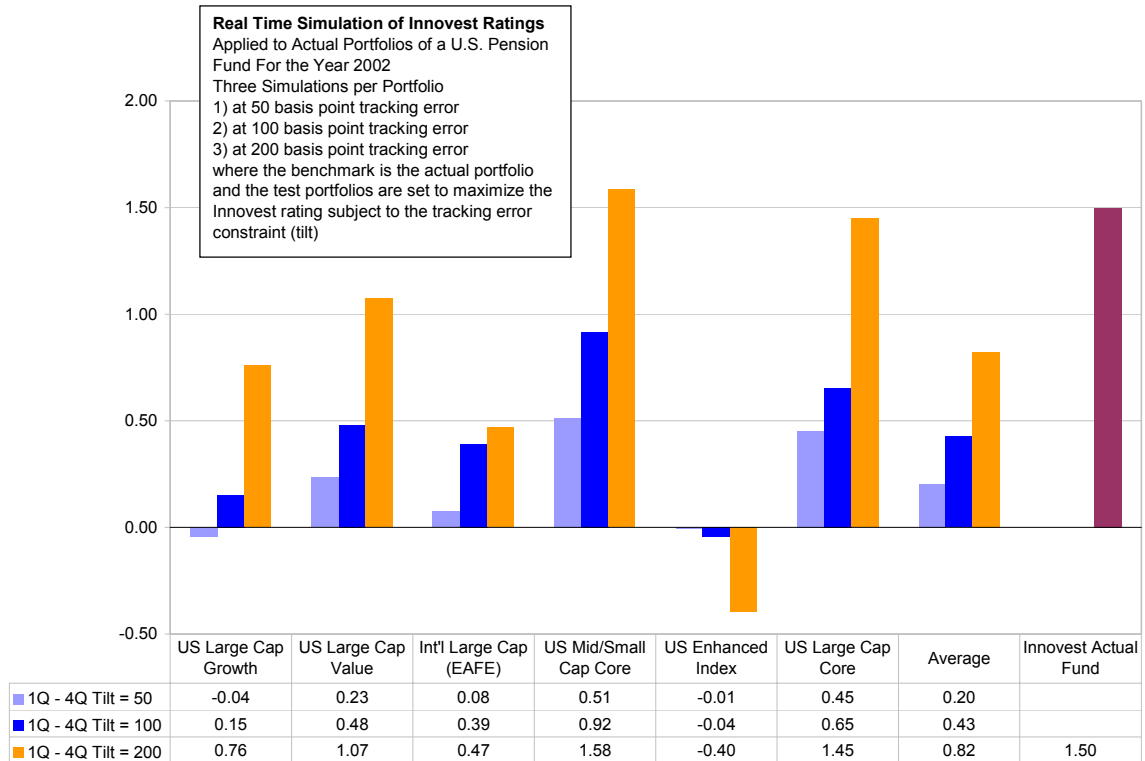


Figure A1 - Relative Performance of Innovest Enhanced Portfolios vs. Underlying Portfolios

Source: Innovest's EcoValue21® Rating Model and databases, 2002.

The study confirms that portfolio managers can indeed add value by incorporating a comprehensive assessment of companies' environmental and social performance into their investment analyses.

While the results are entirely consistent with other academic findings, it must be acknowledged here that the study results *are* specific to the Innovest methodology. In other words, a different rating system, especially one less heavily weighted towards financial performance considerations, could yield different results. What *can* be said with certainty is that the Innovest methodology did indeed generate out-performance in five out of the six portfolios, and that the greater emphasis given to the Innovest rankings, the greater the out-performance.

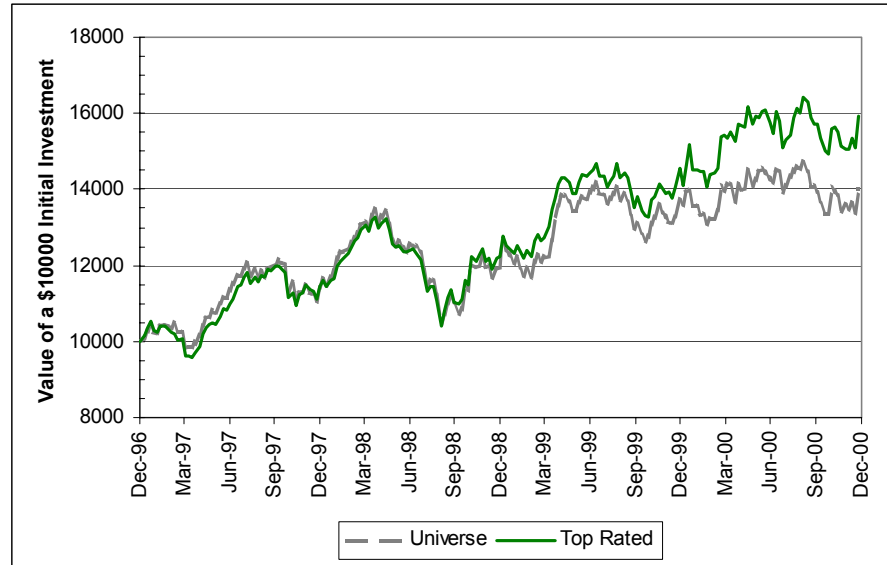
Note: This simulation work is ongoing, and Innovest will continue to update performance figures as they become available.

## 2. QED International Analysis

In tests performed by QED International Associates, a quantitative financial analysis firm, the returns of equally weighted portfolios composed of the highest-rated companies (ratings equal to AAA or AA) were compared to the returns of the equally weighted total universe of all rated companies. The

portfolios were rebalanced at each year-end, over the period from December 31, 1996 through year-end 2000. The highly rated portfolio outperformed the universe by over 700 basis points (7.21%) over the four-year period.

The following chart demonstrates the ability of Innovest ratings to generate investment out-performance.



Characteristics	1997	1998	1999	2000
Rating Date	Dec-96	Dec-97	Dec-98	Dec-99
No. of Stocks in Top-Rated Portfolio	49	61	89	130
No. of Stocks in Innovest Universe	184	190	342	490
Ann. Weekly Std. Dev. Of Top-Rated (%)	9.51	10.59	12.59	13.82
Ann. Weekly Std. Dev. Of Universe (%)	10.00	10.89	14.02	15.11
Average Rating of Top-Rated Stocks (%)	5.33	5.38	5.48	5.55
Average Rating of the Universe (%)	3.11	3.25	2.89	2.94
Return of Top-Rated Stocks (%)	14.45	6.91	19.00	9.52
Return of Innovest Universe (%)	13.97	4.93	14.74	2.31
<b>Difference in Basis Points</b>	<b>48</b>	<b>198</b>	<b>426</b>	<b>721</b>

Figure A2: Innovest Test Portfolio – 4 Year Performance.

Source: QED International Associates

Given the sophisticated normalization techniques used in the study, none of this out-performance can be explained by traditional securities analysis; it appears to be purely a function of companies' management quality, as evidenced by their performance in managing these non-traditional risk factors.

## APPENDIX C - INNOVEST RATING METHODOLOGIES

The EcoValue'21® and Intangible Value Assessment™ analytical models have been developed to enable investors and industry analysts to assess companies' relative environmental and social performance, risk, and strategic positioning as well as the financial consequences of these factors. The following section describes the models.

### METHODOLOGY – THE ECOVALUE'21® AND INTANGIBLE VALUE ASSESSMENT™ RATING MODELS

*Rating a company means examining not only environmental and social risk, but also a company's ability to manage that risk.*

At the heart of EcoValue'21® analytical model and risk algorithms is the attempt to balance the level of environmental risk with the companies' capacity to manage that risk strategically and profitably into the future. It is the product of these two variables, not the absolute level of risk alone, which determines the ultimate financial consequences of environmental risk for industrial companies and their investors.

The Intangible Value Assessment™ (IVA™) analytical model makes use of a similar approach: balancing the level of social sustainability risk with management's capacity to manage that risk. Further, the IVA™ model is specifically designed to draw out variances in corporate strategies on a range of intangible factors. These factors – including corporate governance, management of human capital, and quality of strategic partnerships - are widely perceived to be highly relevant to corporate profitability and investor returns.

From a broad perspective, the two methodologies can be outlined as follows:

#### EcoValue'21®

The EcoValue'21® model addresses three fundamental types and sources of environmental risk factors:

- **Historical Liabilities** - Ongoing risk exposure arising from past actions.
- **Operating Risk** - Risk exposure arising from current operations.
- **Sustainability and Eco-Efficiency Risk** - Future risk exposure caused by potential undermining of the company's material sources of long-term profitability and competitiveness. For example, electric utility companies emitting more pollutants per megawatthours (MWH) generated than their competitors would have greater financial and competitive exposure to the likely imposition of more stringent emission restrictions.

*Advanced sustainability analysis means that risks, management, and profit opportunities are all considered.*

In addition, the model evaluates:

- The company's capacity to manage environmental risk effectively; and

- The company's ability to position itself to profit from environmentally-driven business opportunities.

## Intangible Value Assessment™

The IVA™ model uses over 80 different performance metrics to assess relative corporate positioning in each of the five major categories addressed by the model. The following list provides a broad outline of the analytical approach taken within each of these five categories:

**Sustainable Governance** – Does the firm's overall strategy and demonstrable strategic capacity/adaptability map well against its risk profile? Is the firm's traditional corporate governance closely aligned with shareholder interests and industry best practice?

**Human Capital:** How well does the company manage its human capital from a variety of financially-relevant perspectives: recruitment/retention strategies, training and development programs, employee motivation initiatives, labor relations and health and safety performance.

**Stakeholder Capital:** Relative to industry peers, how does the firm compare in building value through strategic relationships/partnerships with key stakeholder groups (e.g. customers, regulators, local communities, supply chain)?

**Products/Services:** Does the firm hold any proprietary knowledge related to sustainability/social issues? Are there any product safety programs and policies and are there any outstanding controversies for any of the firm's product lines?

**Emerging Markets:** What amount of risk does the firm carry through its presence in emerging markets, and how well has management responded with strategies to mitigate these risks? How sophisticated are the firm's policies and programs to detect and manage unique emerging market risks such as human rights challenges, working conditions and operating in oppressive regimes?

## Performance Data

Broadly speaking, the EcoValue'21® and IVA™ models use two kinds of inputs and data:

- **Quantitative data** on the sources and levels of corporate environmental and social risk and performance relative to industry competitors; and
- **Qualitative judgments** about future, financially-relevant environmental and social performance and risk, based on an expert assessment of the companies' environmental and sustainability risk management capabilities.

*If properly performed, environmental and intangible value analysis takes a comprehensive and detailed look at both quantitative and qualitative indicators.*

Examples of the types of data used in the model include:

### Quantitative Sustainability Risk Indicators

- Historical environmental/social risk profile of the company's industrial sector;
- Number of Superfund sites relative to industry average;
- Officially estimated capital cost of remediation and clean-up liability exposures, relative to industry averages;
- Ratio of environment-related fines (RCRA, CAA, CWA, etc.) to revenues, relative to industry averages;
- Corporate governance statistics (percentage of independent board members, board/management diversity);
- Concentration of high-risk products in company product portfolio;
- Site-specific emissions data on individual plant sites;
- Employee and customer turnover rates;
- Employee and contractor injury rates;
- Adequacy of environmental insurance cover.

### Qualitative Risk Mitigation Factors

- Adequacy of board-level mechanisms for environmental/social reporting and management;
- Company-wide environmental/social management capability;
- Staff resource commitment to sustainability management;
- Environmental/social audit capacity, frequency and transparency;
- Sustainability cost accounting and measurement systems;
- Adequacy and universality of staff training on environmental/social risk management;
- Capacity to manage supplier relations for environmental/social performance;
- Sustainability innovation capacity;
- Mechanisms for corporate reporting of sustainability performance;
- Integration of environmental/social performance with staff compensation; and
- Potential for successful commercialization of sustainability research and development.

*A significant factor to examine is the future capability of a company to handle controversial sustainability issues.*

While companies' current performance levels are obviously important to the analysis, the EcoValue'21® and IVA™ models are designed to move beyond simply providing a static snapshot of the present situation. Instead, they attempt to provide dynamic, predictive indication of companies' relative ability to manage sustainability issues profitably into the future. Accordingly, the models place considerable emphasis on the trajectory and rate of performance improvement (if any), and on the robustness of the company's strategic management capability.

The EcoValue'21® rating model can be expressed schematically as shown below:



Figure C1: Schematic of EcoValue'21® Analysis Factors.  
Source: Innovest

The following schematic outlines the focus areas for the Intangible Value Assessment™.



Figure C2: Schematic of Intangible Value Assessment™ Analysis Factors.  
Source: Innovest

## Data Sources

*Eco-efficiency and intangibles analysis demands thorough data acquisition and disciplined examination.*

Information needed to complete EcoValue'21® and IVA™ ratings is gathered from several sources, including company literature (sustainability reports, annual reports, 10Ks, 10Qs, websites, etc.), environmental/social groups and other NGOs, trade groups and other industry associations, government data bases, periodical searches, and financial analysts' reports. Following a review of the literature, Innovest analysts usually interview senior executives at the companies responsible for environmental, human resources and other intangibles management. When comparing companies, data is normalized by the most relevant, available factor, such as domestic sales or production levels.

*The end result is the translation of complex sustainability issues into financially relevant measures.*

## The Scoring System

For most categories, the data is then converted to a relative score, by allocating the company with the best performance within its industry sector in a given category a ten, the top score, giving the company with the worst performance a zero, the lowest, and scoring the remainder pro-rata between ten and zero. This system is designed to clarify and highlight performance differentials that would otherwise be more difficult to discern.

All of this data is then input into the scoring matrix, where it is adjusted by weightings for each category. We originally developed the weightings through extensive back-testing with over 350 Fortune 500 companies. The weightings were then further refined through beta-testing with our strategic partners such as PriceWaterhouseCoopers, with financial institutions such as Union Bank of Switzerland and the Zurich Insurance Group, and with specialist environmental engineers and other colleagues. Further, our Director of Quantitative Research conducts continuous testing on the analytical platform. The weightings reflect our view of the relative importance of each category in determining companies' medium-term profitability and share price performance.

The final EcoValue'21® and IVA™ relative score is intended for comparison within industry sectors. The scores have been converted into the familiar letter categories used by bond rating agencies.

## APPENDIX D: QUESTIONS SUBMITTED TO DOW BY INNOVEST

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The following questions were submitted to the Dow Chemical Corporation prior to Innovest producing this report. The company categorically refused to answer any of these questions.

1. Of the following potential liabilities which will be individually quantified in the 2003 10K? Which will be discussed on a narrative basis in the Management Discussion and Analysis?
  - Bhopal
  - Vietnam veterans lawsuit on agent Orange: Dow Chemical v. Stephenson, case no. 02-0271
  - Potential Agent Orange issues in Vietnam (Remediation/reparations)
  - Midland MI
  - Myrtle Grove
  - Overall superfund liabilities
  - Asbestos claims
  - Union Carbide suit involving semiconductor clean-room chemicals
  - Dow Corning Breast Implant litigation
2. Is the company maintaining that each of these issues will not materially affect the company in each of these cases?
3. Does the company utilize accounting principles which disclose only the low-end liability projections when there are uncertainties as to the range of projected liabilities?
4. What are the top end estimates for liability for each of the issues cited above, for the next 17 years (following the asbestos model)?
5. When Dow states that its environmental remedial liabilities are not expected to exceed double the amount held in the reserve, what assumptions and estimation models are utilized to draw this conclusion?
6. Does the company aggregate the probability-weighted projections of liability at each site, or does it utilize low end liability projections based on uncertainties of liabilities?
7. To what extent is liability projection deferred until the completion of government-required studies, or does the company develop a reasonable estimate of potential liability based on comparisons with other sites and trends (consistent with the company's consultant's report on asbestos liabilities)?
8. What timeframe is utilized in projecting liabilities?
9. Does the company discount its liabilities?
10. How much money does the company estimate it has spent on legal fees in the past 5 years fighting environmentally related claims?
11. Please provide yearly breakdown. How much money does the company expect to spend on legal fees for environmentally related claims over the next five years?

12. What steps are being taken to permanently resolve the continuing public and legal pressures on the company and its Union Carbide subsidiary in the Bhopal, India case?
13. Specifically, how is the company addressing the expressed concerns regarding: Failure of Union Carbide to disclose its toxicological information regarding MIC; Warren Anderson extradition request by Indian Government, and requirement for Union Carbide to appear in the criminal case; Community concerns regarding remediation of the Union Carbide site (groundwater and soil); Community concerns regarding economic and social rehabilitation; Community concerns regarding the need for medical monitoring and medical care.
14. What is the meaning of the company's statement that any further involvement would be legally detrimental to the company? How is this legal concern weighted against the detriment to the company's reputation and Asia expansion plans in declining to address the Bhopal issues?
15. Were there any environmental issues with potential monetary sanction of more than \$100,000 which were not disclosed during 2002?
16. Are there any which will be reported in 2003 but were not yet reported in 2002?
17. Has the company received a settlement from Equitas? If so, how much was that settlement and which projects did those funds go to?
18. How much does the company spend yearly on insurance for environmentally related coverage? What is the trend on premiums for the past 5 years?
19. Does the company's environmentally related liability estimate exceed recoverable insurance?
20. Given the history of bans and limits on other known persistent bioaccumulative toxins (PBTs), almost all of which are organohalogenes, such as PCBs and DDT and PBDEs, why is Dow's business strategy to expand production of product categories that are known to be PBTs or known to produce PBTs, and which in some cases such as vinyl monomer for PVC which has the highest levels of PBTs in the product category?
  - a. What percentage of the company's products, by volume of sales, are classified as organochlorines?
  - b. Organohalogenes?
  - c. Is sale of those products projected to increase or decrease?
  - d. How do public policy trends affect those projections, if at all?
  - e. Of the company's organochlorine and organohalogen product lines, which ones face competition (either substantial current competition or emerging market entries) from non-organochlorine/organohalogen alternatives?
  - f. How many have non-organochlorine replacements developed in-house at Dow? If possible please list these products or give their generic chemical names.

- g. What are current Dow plans to promote any non-organochlorine alternatives, and/or to move away or-  
ganochlorine production?
  - h. In the event that NGO's and others succeed in pressing for  
elimination of product lines, does Dow have worst case sce-  
nario planning to address these prospects? Or is the Dow  
plan to be the "last out of the market" in relation to such  
products?
21. Has the company done life-cycle analysis (LCA) to quantify the di-  
oxin that Dow products produce during production/use / end-of-life /  
recycling in order to counter the assertions being made that those  
products should be phased out?
    - a. If so, will the results of these studies be made public? What  
were the results?
  22. Has the company done LCA on all its products to see which ones are  
or create PBTs, very persistent very bio-accumulative compounds  
and/or endocrine disrupters?
    - a. What percentage of the company's revenues come from  
products that have such risk?
    - b. What percentage from those that have no such risk?
  23. In light of these concerns how much R&D (\$ & % of total R&D) is  
being invested on development of non-toxic or less toxic chemis-  
tries?
  24. What Dow products would be affected by the current proposal for  
REACH in Europe?
    - a. Which products would be required to comply with the dis-  
closure provisions of REACH?
    - b. With the authorization provisions?
  25. How much profit does the company get from production of vinyl  
chloride and EDC?
    - a. Are these major profit centers within Dow and how does this  
compare with other major products?
  26. How much net income is derived from the production and sale of  
2,4D? Chlorpyrifos?
    - a. What is the status of the NY State lawsuit on chlorpyrifos  
threatened by NY Attorney General Eliot Spitzer?
  27. Please calculate the worst case liabilities relative to each remedial  
site and the total liability that could be associated with remediation if  
all sites were to require that level of financing?
  28. What does Dow spend yearly for lobbying on environmentally re-  
lated legislation?
    - a. In particular, how much has Dow spent in 2002 and 2003 on  
lobbying relative to asbestos, Midland, Michigan and other  
major issues?
    - b. Which PACs has Dow contributed to?
    - c. What amounts were given?
    - d. What firms does Dow engage for lobbying purposes?

## APPENDIX E: AGENT ORANGE EXPOSURE RELATED DISEASES

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\*Recognized by the Veterans Administration

- Prostate cancer
- Peripheral neuropathy (acute and sub-acute)
- Diabetes Type II
- Spina Bifida in children of Vietnam Veterans
- Chloracne [one year]
- Non-Hodgkin's Lymphoma, including any diagnosis of a lymphoma [except Hodgkin's lymphoma], mycosis fungoides, and old terms such as lymphosarcoma, reticulum cell sarcoma and Kaposi's sarcoma
- Porphyria cutanea tarda [one year]
- Respiratory cancers, including cancer of the
  - lung
  - bronchus
  - larynx
  - trachea
- Multiple myeloma
- Hodgkin's disease
- Soft Tissue Sarcomas, including:
  - Adult fibrosarcoma
  - Dermatofibrosarcoma protuberans
  - Malignant fibrous histiocytoma
  - Liposarcoma
  - Leiomyosarcoma
  - Epithelioid leiomyosarcoma (malignant leiomyoblastoma)
  - Rhabdomyosarcoma
  - Ectomesenchymoma
  - Angiosarcoma (hemangiosarcoma and lymphangiosarcoma)
  - Proliferating (systemic) angioendotheliomatosis
  - Malignant glomus tumor
  - Malignant hemangiopericytoma
  - Synovial sarcoma (malignant synovioma)
  - Malignant giant cell tumor of tendon sheath
  - Malignant schwannoma, including malignant schwannoma with rhabdomyoblastic differentiation (malignant Triton tumor), glandular and epithelioid malignant schwannomas
  - Malignant mesenchymoma
  - Malignant granular cell tumor
  - Alveolar soft part sarcoma
  - Epithelioid sarcoma
  - Clear cell sarcoma of tendons and aponeuroses
  - Extraskeletal Ewing's sarcoma
  - Congenital and infantile fibrosarcoma
  - Malignant ganglioneuroma

## APPENDIX F: REFERENCES

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1. Herrick T. (Feb. 26, 2004) Chemical Stock Run-Up Belies Woes, The Wall Street Journal.
2. Sutherland, Donald; (Oct. 14, 2003) **EPA Reveals US Publicly Traded corporations Hide Environmental Debt in SEC Filings to Shareholders.**
3. **Conference to 'put a human face' on the Vietnam War;** Yale Bulletin and Calendar August 30, 2002 | Volume 31, Number 1
4. Office of New York State Attorney General Elliot Spitzer, Press Release April 2, 2003, **State to Sue Dow Chemical Subsidiary Over Misleading Ads: Dow Chemical Co. Subsidiary Said to Reneg on Earlier Agreement.**
5. Pérez-Peña, Richard. (March 22, 2004) Babies are Larger After Ban on 2 Pesticides, Study Finds. New York Times.
6. The Dow Chemical Corporation, 2003 10-K Annual Report; pg 16.
7. As reported in Cohen, Julie, Bureau of National Affairs, International Environmental Reporter. **Chemical Safety: Author Seeks Global "Chlorine Sunset" Citing Danger to Health, Environment;** Vol.23 Number 13, June 21, 2000
8. All political contribution data comes from the Center for Responsive Politics database on political giving available at [www.opensecrets.org](http://www.opensecrets.org) (Figures as of March 7, 2004) Dow's numbers include Union Carbide but do not include individual gifts by senior management.
9. Fialka, John J. **EPA's Enforcement Branch Gets Poor Grades in Report Prosecution Rate for Cases Is Low Amid Problems In Morale and Management** (March 31, 2004) THE WALL STREET JOURNAL; (see also)  
  
U.S. E.P.A Office of Inspector General. **Special Report Congressional Request on EPA Enforcement Resources and Accomplishments Report 2004-S-00001** October 10, 2003 ;  
  
Memorandum: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY December 15, 2003 OFFICE OF ENFORCEMENT AND COMPLIANCE ASSURANCE - SUBJECT: Management Review of the Office of Criminal Enforcement, Forensics and Training. John Peter Suarez Assistant ;  
  
Public Employees for Environmental Protection. Press Release Wednesday, March 31, 2004 Contact: Chas Offutt (202) 265-7337 **LEAVITT DAMPENS EPA CRIMINAL ENFORCEMENT Promised Reforms Not Implemented, Vacancies Unfilled, Prosecutions Falling**
10. Alleva E, Brock J, Brouwer A, Colborn T, Fossi MC, Gray E, Guillette L, Hauser P, Leatherland J, MacLusky N, Mutti A, Palza P, Parmigiani S, Porterfield S, Santti R, Stein SA, vom Saal F, Weiss B. **Statement from the work session on environmental endocrine-disrupting chemicals: Neural, endocrine and behavioral effects.** Erice, Italy:Ettore Majorana Center for Scientific Culture, 1995.
11. *ibid.* ;  
  
For a discussion of the scientific methodologies behind risk thresholds and the problematic issues associated with them see: Moore, Colleen. **Silent Scourge: Children, Pollution, and Why Scientists Disagree**, Oxford University Press, 2003

---

12. Fairbank, Maslin, Maullin & Assoc. **Key Findings of Recent Survey Research on Persistent Toxic Chemicals**. April 7, 2003

13. International Joint Commission (IJC), **SIXTH BIENNIAL REPORT ON GREAT LAKES WATER QUALITY** (Ottawa, Canada, and Washington, DC: International Joint Commission, 1992), pg. 30.

14. Durnil, Gordon. **The Making of a Conservative Environmentalist**. Indiana University Press, Bloomington, Indiana 1995, pg. 78.

15. American Public Health Association. **Resolution 9304: Recognizing and addressing the environmental and occupational health problems posed by chlorinated organic chemicals**. American Journal of Public Health 84:514-515, 1994.

16. This argument was developed by Joe Thornton, Ph.D. in the book, **Pandora's Poison: Chlorine, Health, and a New Environmental Strategy**; MIT Press, Massachusetts Institute of Technology, Cambridge MA. 2000. Many of the scientific references listed in this report were culled from this research. It provides a useful reference for readers wishing a more in-depth analysis.

17. NRC (National Research Council) **Toxicity Testing: Strategies to Determine Needs and Priorities**. Washington, DC: National Academy Press, 1984;

Roe D, Pease W, Florinei K, Leiserson K, Below C, Chang J, Abercrombie D. **Toxic Ignorance: The Continuing Absence of Basic health Testing for Top-Selling Chemicals in the United States**. New York: Environmental Defense Fund, 1997.

18. Known, probable & possible human carcinogens from IARC (1997); see also: IARC, Globocan: International Cancer Incidence and Mortality, 1990 Lyon, 1998. & Hazardous Substances Databank. Bethesda, MD: National Library of Medicine, 1997

19. *ibid.*

20. Landrigan, PJ, Graham DG, Anger WK, Barker J, Damstra T, Harris D, Langston W, Lowndes HE, Marwah J, Morell P, Narahashi T, Nelson PP, Reiter LW, RodierP, Rodricks J, Silbergeld EK, Spencer PS, Weiss B, Qyzga R, Mattison D, Emmergson JL, Thomas RD, Stratton KR, Paxton MB, Scheiderman MA, Pope AM, Grossblatt N, Sprague AM, Bennett GJ, Nisbet ICT, Tilson H, Leoard LV, **Environmental Neurotoxicology**. Washington, D.C. National Academy Press, 1992 ;

See also: the list of neurotoxic chemicals maintained by the National Research Council.

21. Henschler D. **Toxicology of Chlorinated Organic Compounds: Effects of the Introduction of Chlorine in Organic Molecules**. *Angewandte Chemie International Edition (English)*, 33:1920-1935, 1994.

22. In November 1999, the EPA issued a policy statement under the Toxic Substances Control Act (TSCA) establishing a category for new persistent, bio-accumulative, and toxic (PBT) substances.

23. Birnbaum, L and Farland, W, **Health Risk Characterization of Dioxin and Related Compounds**; Office of Research and Development, U.S. Environmental Protection Agency (\*Author Note\* The views expressed are those of the authors and do not necessarily reflect the views or policies of the U.S. EPA) – Innovest note: It should be recognized that these authors are the lead researchers on Dioxin at the EPA.)

- 
24. Ibid.; & Huff J. **Dioxins and Mammalian Carcinogenesis**. In: Schecter A, ed. *Dioxins and Health*. New York: Plenum, 1994: 389-408 ;
25. Czuczwa JM, Hites RA. **Environmental Fate of Combustion-Generated Polychlorinated Dioxins and Furans**. *Environmental Science and Technology* 186:444-449, 1984.
26. Czuczwa JM, Hites RA. **Historical Record of Polychlorinated Dioxins and Furans in Lake Huron Sediments**. In Keith LH, Rappe C, Choudhary G, eds. *Chlorinated Dioxins and Dibenzofurans in the Total Environment II*. Boston: Butterworth, 1985:59-63.
27. Juttner I, Henkelmann B, Schramm KW, Steinberg CEW, Winkler R, Kettrup A. **Occurrence of PCDD/F in Dated Lake Sediments of the Black Forest, Southwestern Germany**. *Environmental Science and Technology* 31:806-812, 1997.
28. Kjeller LO, Rappe C. **Time Trends in Levels, Patterns, and Profiles for Polychlorinated Dibenzo-p-Dioxins, Dibenzofurans, and Biphenyls in a Sediment Core from the Baltic Proper**. *Environmental Science and Technology* 29:346-355, 1995.
29. The Chlorine Institute
30. EPA (U.S. Environmental Protection Agency). **Estimating Exposures of Dioxin-like Compounds, Volumes 1-3** , Review Draft. Washington, DC: U.S. EPA Office of Research and Development (EPA/600/6-88-005), 1994
31. Webster T. **Why Dioxins and Other Halogenated Hydrocarbons are Bad News**. *Journal of Pesticide Reform* 9:32-35, 1990.
32. EPA (U.S. Environmental Protection Agency). **Estimating Exposures of Dioxin-like Compounds, Volumes 1-3** , Review Draft. Washington, DC: U.S. EPA Office of Research and Development (EPA/600/6-88-005), 1994
33. Birnbaum, Linda S. **Re-Evaluation of Dioxin**. 102nd Meeting of the Great Lakes Water Quality Board, Chicago, Illinois; July 15, 1993
34. Ibid.
35. Birnbaum, Linda S. **Presentation: Risk Characterization of Dioxins**. United States Environmental Protection Agency Note: Tetraethyl Lead, an octane booster used to reduce "knocking" in combustion engines from the 20's through 70's
36. U.S. Patent No.#1,991,329(1935) & No.#2,039,434 (1936)
37. Catabeni F,Cavallero A, Galli G. **Dioxin: Toxicological and Chemical Aspects**. New York: Spectrum, 1985
38. Thornton, Joe. **Pandora's Poison: Chlorine Health, and a New Environmental Strategy**. MIT Press, Massachusetts Institute of Technology, Cambridge Mass. 2000
39. Brzuzy LP, Hites RA. **Global Mass Balance for Polychlorinated dibenzo-p-dioxins**. *Environmental Science and Technology*. 30:1797-1804, 1996
40. **Estimating Dioxins/Furan Emissions: The US Dioxin Inventory**. Presented by Dwain Winter, EPA, at the Joint SMOC-PRTR meeting held 17 October 2002 North American Commission for Environmental Cooperation

- 
41. EPA (U.S. Environmental Protection Agency). **The Inventory of Sources of Dioxin in the United States** (Review Draft) Washington, DC: U.S. EPA Office of Research and Development (EPA/744-B-98-001), 1998
42. Thomas V, Spiro C. **An Estimation of Dioxin Emissions in the United States.** *Toxicology and Environmental Chemistry.* 50:1-37, 1995
43. Cohen M, Commoner D, Eisl H, Bartlett P, Dickar A, Hill C, Quigley J, Rosenthal J. **Quantitative Estimation of the Entry of Dioxins, Furans, and Hexachlorobenzene into the Great Lakes from Airborne and Waterborne Sources.** NY: Center for the Biology of Natural Systems, Queens College, City University of New York, 1995
44. A Schechter, O Papke, M Ball, A Lis and P Brandt-Rauf. **Dioxin Concentrations in the Blood of Workers at Municipal Waste Incinerators.** Department of Preventive Medicine, State University of New York, Binghamton 13903, USA. *Occupational and Environmental Medicine,* Vol 52, 385-387
45. Ackerman F, Massey R. **The Economics of Phasing Out PVC.** Global Development and Environment Institute, Tufts University. Dec. 2003
46. **Tellus Institute Packaging Study** (Boston: Tellus Institute, 1992). For a brief overview of this comprehensive study, see Frank Ackerman **Why Do We Recycle? Markets, Values and Public Policy** (Washington DC: Island Press, 1997), Ch.5
47. SRI Consulting. **Chemical Economic Handbook.** As reported in: Ackerman, Frank and Massey, Rachel. **The Economics of Phasing Out PVC.** Global Development and Environment Institute, Tufts University. 2003
48. *ibid.*
49. *ibid.*
50. Kirschner EM. **Dow Chemical: Leading a Quite Revolution.** *Chemical Week,* Sept. 28, 1993:36
51. Elias, Paul. **Scientists Measure Pollution in Humans.** *Associated Press* Dec. 27, 2003
52. Wanjek, Christopher. *The Washington Post* (Feb. 3, 2004) **Get a Load of the Mono-2-Ethylhexyl-Phthalate In That Guy.**
53. **Key Findings – Survey Research on Persistent Toxic Chemicals.** Fairbanks, Maslin, Maullin & Associates. April, 7 2000
54. *The Indian Express* (July 16, 2003) **Government Finally Acts on Anderson’s Extradition.;**  
*The Hindu* (March 15th 2003) **Centre Blamed for Delay in Anderson’s Extradition.;**  
*Frontline Magazine.* **Request for Anderson’s Extradition.** Aug. 02-15, 2003 Vol.20-Issue 16
55. Singh H. *The Indian Express,* Bombay (Oct. 20, 2002) **MP Wants Dow to Cleanup Carbide Mess, State to Approach Center for Supreme Court Action**
56. **Dow Chemical India Holdings Pvt Ltd.** (Registration #11-113550). Registered in Mumbai, Maharashtra.; **Dow Chemical Intl Pvt. Ltd.** Registration # 11-1135512 Registered in Mumbai, Maharashtra.; **Dow Polymers Pvt. Ltd.** Registration # 04-27447 Registered in Ahmedabad, Gujarat; **DE Nocil Crop Protection Ltd.** Registration # 11-83566 Registered in Mumbai, Maharashtra; **Dow Chemical International Ltd, USA.** Registration # 833. Registered in New Delhi. **Dow Corning**

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**India P Ltd; Dow Corning Singapore Pte Ltd, Singapore.** Registration # 1299 Registered in New Delhi; **Dow Elanco B.V., Netherlands.** Registration # 1236 Registered in New Delhi; **Anabond Essex India Pvt. Ltd.** Registered in Chennai, Tamilnadu.;

**NEW DELHI:** Registrar of Companies, 2nd Floor, B Block, Paryavaran Bhavan CGO Complex, Lodi Road, New Delhi 110 003

**MUMBAI:** Registrar of Companies, Maharashtra, Everest 100, Marine Drive, Mumbai 400 002 Tel: +91 22 22812639 fax: +91 22 22811977

57. Indian Business Insight (Jan. 2004) **Sustained Growth: Indian Economy to post 7.2% growth in 2003-2004.**

58. Indian Business Insight. **The Chemical Industry: An Indian Perspective.** Nov., 2003; vol.38; iss.11pg44,46

59. *ibid.*

60. Shah, Suresh. The Economic Times (Dec.31, 2003) **Farm Sector Too Reaps Rewards of Reforms.**

61. The Hindu. (March 22, 2004) **Bhopal Tragedy: Payment Sought from Compensation Fund Balance.**

62. Indian Express, **MP [Madhya Pradesh] Wants Dow to Clean Up Mess,** October 20, 2002.

63. Social Investment Forum

64. **Statement of The Dow Chemical Company Regarding the Bhopal Tragedy.**

<http://www.dow.com/environment/debate/d15.html>

65. Lueck TJ: **1982 Report Cited Safety Problems at Plant in India.** *New York Times*, Dec. 11, 1984: See also Ashford NA: **Chemical Catastrophes: Steps for Prevention.** *New York Times*, Dec.9, 1984 Business Section p.2 & Mukerjee, Madhusree, **Persistently Toxic;** *Scientific American*, June 1995, Vol.272 Issue 6, p16,2p,1c

66. For a description of Cyanide see: Center for Disease Control, Agency for Toxic Substances and Disease Registry; ToxFAQs™ for Cyanide (Cianuro) September 1997; CAS# 74-90-8, 143-33-9, 151-50-8, 592-01-8, 544-92-3, 506-61-6, 460-19-5, 506-77-4

67. Mukerjee, Madhusree, **Persistently Toxic;** *Scientific American*, June 1995, Vol.272 Issue 6, p16,2p,1c

68. Lueck TJ: **1982 Report Cited Safety Problems at Plant in India.** *New York Times*, Dec. 11, 1984: See also Ashford NA: **Chemical Catastrophes: Steps for Prevention.** *New York Times*, Dec.9, 1984 Business Section p.2

69. *ibid.*

70. The Wall Street Journal reported that several weeks before the Bhopal disaster Union Carbide changed procedures at its Institute West. VA plant, on which the Bhopal plant design was based, to prevent a similar incident. Rep. Henry Waxman (D. CA.) disclosed that a Union Carbide safety team in September had warned of a potential "runaway reaction" of methyl isocyanate at Institute and the EPA had reported that there were 28 small leaks of the chemical in 1980 at the facility.– Winslow,

---

Ron. The Wall Street Journal (Jan. 28th 1985) **Union Carbide Moved to Bar Accident at U.S. Plant Before Bhopal Tragedy.**

71. The New York Times conducted an extensive investigation involving more than 100 interviews in India and the U.S. about the gas leak. Its findings indicated that the plant design was from Union Carbide in the U.S. and that many of the safety features of the plant were inoperable at the time of the accident, in some cases to save on costs. -- New York Times (Jan. 27th, 1985) **Design Flaws Contribute to Gas Leaks.**

72. Morehouse, Ward and Subramaniam, M. Arun, **The Bhopal Tragedy: What really happened and what it means for American workers and communities at risk; a report for the Citizens Commission on Bhopal.** 1986, The Council on International and Public Affairs, New York; (See Also).

Everest, Larry, **Behind the Poison Cloud: Union Carbide's Bhopal Massacre;** 1985, Banner Press, Chicago

73. Foreign Exchange Regulation Act, 1973. Details from interview with US based attorney who has brought the New York litigation against Union Carbide regarding Bhopal in **'Proof from Carbide Itself'** : Interview with Himanshu Rajan Sharma, U.S.-based Attorney. *Frontline Magazine*, Vol. 19 – Issue 26, December 21, 2002 – Jan 3, 2003 (Published in India – The Hindu Group)

74. *ibid.*

75. *ibid.*

76. The Hindu. (March 22, 2004) **Bhopal Tragedy: Payment Sought from Compensation Fund Balance.**

77. Bhopal People's Health and Documentation clinic for the Sambhavana Trust. The Bhopal Gas Tragedy: 1984. New Dehli, India: Bhopal People's Health and Documentation Clinic for the Sambhavana Trust, 1998 November.;

Lapierre D, Moro J. **It was Five Past Midnight in Bhopal.** New Delhi, India: Full Circle Publishing, 2001

78. Varma D, et. al. **Methyl Isocyanate Exposure and Growth Patterns of Adolescents in Bhopal.** Research Letter; Journal of the American Medical Association, Oct. 8, 2003 Vol. 290, NO.14

79. For an overview of scientific literature on the health effects of the Bhopal survivors see: Dhara RV, Dhara R. **The Union Carbide Disaster in Bhopal: A Review of Health Effects.** Achieves of Environmental Health Sept./Oct. [Vol.57 (No.5)]

80. Indian Council of Medical Research (ICMR) **Annual Report, Bhopal Gas Disaster Research Center.** Bhopal, India: ICMR, 1991.

81. Varma D, et. al. **Methyl Isocyanate Exposure and Growth Patterns of Adolescents in Bhopal.** Research Letter; Journal of the American Medical Association, Oct. 8, 2003 Vol. 290, NO.14 (note: The effect on boys and not girls is attributed to triethylamine, one of the breakdown products of methyl isocyanate, which has been reported to produce selective growth retardation of male progeny of mice. )

- 
82. Anderson N, Kerr Muir M, Mehra V, Salmon AG. **Exposure and response to methyl isocyanate: results of community - based survey in Bhopal.** British Journal of Industrial Medicine 1988;45:469-475.
83. Anderson N, Muir MK, Mehra V. **Bhopal Eye.** Lancet. 1984;2:1481
84. Anderson N, Ajwani MK, Mahashabde S, Tiwari MK, Kerr Muir M, Mehra V, Ashiru K, Mackenzie CD. **Delayed eye and other consequences from exposure to methyl isocyanate: 93% follow up of exposed and unexposed cohorts in Bhopal.** British Journal of Industrial Medicine. 1990;47:553-558.
85. Karol MH, Taskar S, Gangal S, Rubanoff BF, Kamat SR. **The antibody response to methyl isocyanate: experimental and clinical findings.** Environmental Health Perspectives 1987;72:167-173. National Institutes of Health (U.S.)
86. Boorman GA, Uraih LC, Gupta BN, Bucher JR. **Two hour methyl isocyanate inhalation and 90 day recovery study in B6C3F1 mice.** Environmental Health Perspectives. 1987;72:107-114. National Institutes of Health (U.S.)
87. Indian Council of Medical research. **Health effects of exposure to toxic gas at Bhopal: an update on ICMR sponsored researches.** Dec 1985.
88. Varma DR. **Epidemiological and experimental studies on the effects of methyl isocyanate on the course of pregnancy.** Environmental Health Perspectives. 1987;72:151-55. National Institutes of Health (U.S.)
89. Bhandari NR, Syal AK, Kambo I et. al. **Pregnancy outcome survey in women exposed to toxic gas at Bhopal.** Indian Journal of Medical Research. 92:28-33 (1990)
90. Varma DR, Ferguson J, Alarie Y. **Reproductive toxicity of methyl isocyanate in mice.** Journal of Toxicology and Environmental Health. 1987;21:265-275.;
- Varma DR, Guest I, Smith S, Mulay S. **Dissociation between maternal and fetal toxicity of methyl isocyanate in mice and rats.** Journal of Toxicology and Environmental Health. 1990;30:1-14.;
- Saxena AK, Singh KP, Nagle SL, Gupta BN, Ray PK, Srivastav RK, Tewari SP, Singh R. **Effect of exposure to toxic gas on the population of Bhopal: Part IV-Immunological and Chromosomal Studies.** Indian Journal of Experimental Biology. 1988;26:173-176.
91. Saxena AK, Singh KP, Nagle SL, Gupta BN, Ray PK, Srivastav RK, Tewari SP, Singh R. **Effect of exposure to toxic gas on the population of Bhopal: Part IV-Immunological and Chromosomal Studies.** Indian Journal of Experimental Biology. 1988;26:173-176.
92. Ghosh BB, Sengupta S, Roy A, Maity S, Ghosh S, Talukdar G, Sharma A. **Cytogenetic Studies in Human Populations Exposed to Gas Leak at Bhopal, India.** Environmental Health Perspectives. 1990;86:323-326. National Institutes of Health (U.S.)
93. Saxena AK, Singh KP, Nagle SL, Gupta BN, Ray PK, Srivastav RK, Tewari SP, Singh R. **Effect of exposure to toxic gas on the population of Bhopal: Part IV-Immunological and Chromosomal Studies.** Indian Journal of Experimental Biology. 1988;26:173-176.

- 
94. Srinivasamurthy R, Isaac MK. **Mental health needs of Bhopal disaster victims and training of medical officers in mental health aspects.** Indian Journal of Medical Research 1987;86(Suppl):51-58.
95. Gupta BN, Rastogi SK, Chandra H, Mathur AK, Mahendra PN, Pangtey BS, Kumar P, Seth RK, Dwivedi RS, Ray PK. **Effect of exposure to toxic gas on the population of Bhopal: Part I- Epidemiological, clinical, radiological & behavioural studies.** Indian Journal of Experimental Biology. 1988;26:149-160.
96. Indian Council of Medical Research. Bhopal Gas Disaster Research Centre. **Annual report.** Bhopal, India. 1991.
97. Anderson D, Goyle S, Philips BJ, Tee A, Beech L, Butler WH. **Effect of methyl isocyanate on rat muscle cells in culture.** British Journal of Industrial Medicine. 1988;45(4):269-74.
- 98 <http://www.dow.com/environment/debate/d15.html>
- 99 Paragraph 214 of Supreme Court judgment of October 3, 1991 in (1991) 4 SCC 584 Union Carbide Corporation and Ors Versus Union of India and Ors: "The Court sets aside the quashing of criminal proceedings against UCC and others, and reinstates the proceedings."
100. Bano et. al v. Union Carbide Corp. & Warren Anderson. United States District Court Southern District of New York, Civil Action No.99 Civ.11329(JFK)
101. Brown, Derek, Guardian Weekend Pages. (Sept. 21, 2002) **The Dead Zone.** Pg. 44
102. Labunska, I., Stephenson, A., Brigden, K., Stringer, R., Santillo, D. & Johnston, P.A. 1999. **The Bhopal Legacy. Toxic contaminants at the former Union Carbide factory site, Bhopal, India: 15 years after the Bhopal accident.** Technical Note 04/99, Greenpeace Research Laboratories, Department of Biological Sciences, University of Exeter, Exeter UK, November.
103. Ibid.
104. Indian Express, **MP [Madhya Pradesh] Wants Dow to Clean Up Mess,** October 20, 2002.
105. **Indian Council for Enviro-Legal Action v. Union of India** [(1996) 3 SCC 212 : JT (1996) 2 SC 196 at p. 246, para 65.
106. **Vellore Citizens Welfare Forum vs. Union of India,** WP 914/1991 (1996.08.28)
107. Office of Frank Pallone, 6th Dist. Of NJ; **Press Release: Pallone, 17 Colleagues Call on Dow Chemical to Provide Reparations to the Victims of Bhopal Disaster in Letter to Company's CEO: Jersey Congressman Announces Plans To File Amicus Brief In Support of Bhopal Survivors;** July 21, 2003
108. United States Court of Appeals for the Second Circuit, Docket no. 03-7416 Decision March 17th, 2004. Bano et al. v. Union Carbide and Warren Anderson.
109. Ibid.
110. International Campaign for Justice in Bhopal, Activists mount global challenge to Dow, Press Release, January, 16, 2004
111. Social Investment Forum

- 
112. 2003 Dow 10K filing to the SEC
113. *ibid.*; See also the 1988 MDNR Bioaccumulation Study.
114. Johnson, Jeff. **Dow Sued Over Dioxin in Soil** ; Chemical & Engineering News, June 9, 2003 Vol.81, Number 23
115. Grim, Andy . **State to Test Dioxin Claims**; The Saginaw News, Jan. 9, 2004
116. 2nd Record of Decision (ROD) Covering Operable Units 3 through 5 for Lower Fox River and Green Bay site, Wisconsin Department of Natural Resources. \*Note: The remediation on the Fox River is broken up into 5 "Operable Units" (OU) along the length of the cleanup site. Costs for remedial action at OU's 3 & 4 are estimated at \$284 million and costs at OU 5 at \$39.6 million. Costs for OU 1 & 2 have not been estimated at the time of publication.
117. Michigan Dept. of Environmental Quality, Tittabawassee and Saginaw Rivers, and Saginaw Bay Sediment and Floodplain Soil Data in ppt TEQ.
118. **Tittabawassee River Aquatic Ecological Risk Assessment: Polychlorinated Dibenzo-p-Dioxins/Polychlorinated Dibenzofurans**. Galbraith Environmental Sciences LLC., (on behalf of ) Michigan Department of Environmental Quality, Remediation & Redevelopment Division, Saginaw Bay District Office. See References at back for a literature survey on Peer-reviewed scientific studies.
119. Michigan Department of Environmental Quality Press Release; **DEQ Preliminary Soil Sample Results from Residential Properties Located Within the Tittabawassee River Floodplain Continue to Identify Dioxin Contamination**; February 23, 2004
120. Letter from Dr. James R. Clary to Senator Tom Daschle (September 9, 1988). Dr. Clary is a former government scientist with the Chemical Weapons Branch, BW/CW Division, Air Force Armament Development Laboratory, Eglin AFB, Florida.; Referenced in "**Report to Secretary of the Department of Veterans Affairs on the Association Between Adverse Health Effects and Exposure to Agent Orange.**" As Reported by Special Assistant Admiral E.R. Zumwalt, Jr. May 5 1990
121. Akhtar, Fatema Z.; Garabrant, David H.; Ketchum, Norma S.; Michalek, Joel E. **Cancer in US Air Force Veterans of the Vietnam War**. Journal of Occupational and Environmental Medicine: Volume 46(2) February 2004 pp 123-136; see also Endnote 125.
122. Office of Veterans Affairs. See Appendix E: Agent Orange Exposure Related Diseases for a full list. See also endnote 125. below.
123. Schuck, Peter H. **Agent Orange on Trial: Mass Toxic Disasters in the Courts**. Belknap Press/Harvard University Press, Cambridge, Mass. & London England. 1986
124. *ibid.* Pg. 166
125. Wolfe et. al., **Diabetes versus Dioxin Body Burden in Veterans of Operation Ranch Hand**; Finnish Institute of Occupational Health Organohalogen Compounds 1992;10:279-282. \*There are numerous studies on the connections between Veteran exposure and health effects which can be located at the Air Force Research Laboratory website or through the Office of Veterans Affairs (<http://www.brooks.af.mil/AFRL/HED/hedb/afhs/articles.html>)
- See the following studies:

---

Wolfe WH, Michalek JE, Miner JC, Rahe AJ, Silva J, Thomas WF, Grubbs WD, Lustik MB, Karrison TG, Roegner RH, and Williams DE. **Health Status of Air Force Veterans Occupationally Exposed to Herbicides in Vietnam. 1. Physical Health.** Journal of the American Medical Association 1990;264(14):1824-1831.;

Michalek JE, Wolfe WH, and Miner JC. **Health Status of Air Force Veterans Occupationally Exposed to Herbicides in Vietnam. 2. Mortality.** Journal of the American Medical Association 1990;264(14):1832-1836.;

Wolfe WH, Michalek JE, and Miner JC. **Immunological Parameters in Current and Former U.S. Air Force Personnel.** Vaccine 1992;11:545-547. ;

Wolfe WH, Michalek JE, Miner JC, Needham LL, and Patterson Jr. DG. **Diabetes versus Dioxin Body Burden in Veterans of Operation Ranch Hand.** Organohalogen Compounds 1992;10:279-282. Finnish Institute of Occupational Health. Helsinki. Topeliuksenkatu 41 a A, FIN-00250 Helsinki, FINLAND ;

Henriksen GL, Ketchum NS, Michalek JE, and Swaby JA. **Serum Dioxin and Diabetes Mellitus in Veterans of Operation Ranch Hand.** Epidemiology 1997;8(3):252-258.;

Burton JE, Michalek JE, and Rahe AJ. **Serum Dioxin, Chloracne and Acne in Veterans of Operation Ranch Hand.** Archives of Environmental Health 1998;53(3):199-204.;

Michalek JE, Ketchum NS, and Check IJ. **Serum Dioxin and Immunologic Response in Veterans of Operation Ranch Hand.** American Journal of Epidemiology 1999;149:1038-1046.;

Ketchum NS, Michalek JE, and Burton JE. **Serum Dioxin and Cancer in Veterans of Operation Ranch Hand.** American Journal of Epidemiology 1999;149:630-639.;

Michalek JE, Akhtar FZ, and Kiel JL. **Serum Dioxin, Insulin, Fasting Glucose and Sex Hormone Binding Globulin in Veterans of Operation Ranch Hand.** Journal of Clinical Endocrinology and Metabolism 1999;84:1540-1543.;

Longnecker MP and Michalek JE . **Serum Dioxin Level in Relation to Diabetes Mellitus among Air Force Veterans with Background Levels of Exposure.** Epidemiology 2000;11:44-48.;

Michalek JE, Ketchum NS, and Longnecker M. **Serum Dioxin and Hepatic Abnormalities in Veterans of Operation Ranch Hand.** Annals of Epidemiology 2001;11:304-311.;

Barrett D, Morris R, Akhtar FZ, and Michalek JE. **Serum Dioxin and Cognitive Functioning in Veterans of Operation Ranch Hand.** Neurotoxicology 2001;22:491-502. ;

Michalek JE, Akhtar FZ, Arezzo JC, Garabrant D, and Albers JW. **Serum Dioxin and Peripheral Neuropathy in Veterans of Operation Ranch Hand.** Neurotoxicology 2001;22:479-490.;

Steenland K, Calvert G, Ketchum N, and Michalek JE. **Dioxin and diabetes mellitus: an analysis of the combined NIOSH and Ranch Hand data.** Occupational and Environmental Medicine 2001;58:641-648. ;

Michalek JE, Akhtar FZ, Longnecker MP, and Burton JE. **Relation of Serum 2,3,7,8 Tetra-chlorodibenzo-p-dioxin (TCDD) Level to Hematological Examination Results in Veterans of Operation Ranch Hand.** Archives of Environmental Health 2001;56:396-405. ;

---

Barrett D, Morris R, Jackson Jr W, and Michalek JE. **Serum Dioxin and Psychological Functioning in Veterans of Operation Ranch Hand**. Military Medicine 2003;168:153-159.;

Pavuk M, Schechter A, Akhtar FZ, and Michalek JE. **Serum 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) Levels and Thyroid Function in Air Force Veterans of the Vietnam War**. Annals of Epidemiology Vol. 13, Issue 5 , May 2003, Pgs. 335-343;

Michalek JE, Tripathi RC, and Ketchum N. **Diabetes and 2,3,7,8-Tetrachlorodibenzo-p-dioxin Elimination in Veterans of Operation Ranch Hand**. Journal of Toxicology and Environmental Health 2003;66:211-221. ;

Michalek JE, Ketchum NS, and Akhtar FZ. **Post-Service Mortality of Air Force Veterans Occupationally Exposed to Herbicides in Vietnam: 15 Year-Follow-up** American Journal of Epidemiology 1998;148:786-792.;

Wolfe WH, Michalek JE, Miner JC, Rahe A, Needham LL, and Patterson Jr. DG. **Reproductive Outcomes versus Paternal Dioxin Body Burden in Veterans of Operation Ranch Hand** Organohalogen Compounds 1992;10:283-286. Finnish Institute of Occupational Health. Helsinki.;

Wolfe WH, Michalek JE, Miner JC, Rahe AJ, Moore CA, Needham LL, and Patterson Jr. DG. **Paternal Serum Dioxin and Reproductive Outcomes among Veterans of Operation Ranch Hand** Epidemiology 1995;6(1):17-22.;

Henriksen GL, Michalek JE, Swaby JA, and Rahe AJ. **Serum Dioxin, Testosterone, and Gonadotropins in Veterans of Operation Ranch Hand** Epidemiology 1996;7(4):352-357.;

Michalek JE, Rahe AJ, and Boyle C. **Paternal Dioxin, Preterm Birth, Intrauterine Growth Retardation, and Infant Death** Epidemiology 1998;9(2):161-167.;

Michalek JE, Rahe AJ, and Boyle CA. **Paternal Dioxin and the Sex of Children Fathered by Veterans of Operation Ranch Hand**. Epidemiology 1998;9(4):474-475.;

Pirkle JL, Wolfe WH, Patterson Jr. DG, Needham LL, Michalek JE, Miner JC, and Peterson MR. **Estimates of the Half-life of 2,3,7,8 tetrachlorodibenzo-p-dioxin in Vietnam Veterans of Operation Ranch Hand**. Journal of Toxicology and Environmental Health 1989;27:165-171.;

Michalek JE, Tripathi RC, Caudill SP, and Pirkle JL. **Investigation of TCDD Half-life Heterogeneity in Veterans of Operation Ranch Hand**. Journal of Toxicology and Environmental Health 1992;35:29-38.;

Wolfe WH, Michalek JE, Miner JC, Pirkle JL, Caudill SP, Needham LL, and Patterson Jr. DG. **Dioxin Half-life in Veterans of Operation Ranch Hand**. Organohalogen Compounds 1992;10:239-242. Finnish Institute of Occupational Health. Helsinki.;

Caudill SP, Pirkle JL, and Michalek JE. **The Effects of Measurement Error on Estimating Biological Half-life** Journal of Exposure Analysis and Environmental Epidemiology 1992;2:463-476.;

Wolfe WH, Michalek JE, Miner JC, Pirkle JL, Caudill SP, Patterson Jr DG, and Needham LL. **Determinants of TCDD Half-life in Veterans of Operation Ranch Hand**. Journal of Toxicology and Environmental Health 1994;41:481-488.;

---

Michalek JE, Pirkle JL, Caudill SP, Tripathi RC, Patterson Jr. DG, and Needham LL. **Pharmacokinetics of TCDD in Veterans of Operation Ranch Hand: 10 Year Follow-up.** *Journal of Toxicology and Environmental Health* 1996;47:209-220.;

Michalek JE, Tripathi RC, Kulkarni PM, Gupta PL, and Selvavel K. **Correction for Bias Introduced by Truncation in Pharmacokinetic Studies of Environmental Contaminants.** *Environmetrics* 1998;9:165-174.;

Michalek JE and Tripathi RC. **Pharmacokinetics of TCDD in Veterans of Operation Ranch Hand: 15-year follow-up.** *Journal of Toxicology and Environmental Health* 1999;57:369-378.;

Michalek JE, Pirkle JL, Needham LL, Patterson Jr DG, Caudill S, Tripathi RC, and Mocarelli P. **Pharmacokinetics of 2,3,7,8 tetrachlorodibenzo-p-dioxin in Seveso Adults and Veterans of Operation Ranch Hand.** *Journal of Exposure Analysis and Environmental Epidemiology* 2002;12:44-53. ;

Wolfe WH, Michalek JE, Miner JC, Patterson Jr. DG, Needham LL, and Pirkle JL. **Serum Dioxin Levels in Air Force Health Study Participants Preliminary Report.** *Morbidity Mortality Weekly Report* 1988;37:309-311.;

Michalek JE, Wolfe WH, Miner JC, Papa TM, and Pirkle JL. **Indices of TCDD Exposure and TCDD Body Burden in Veterans of Operation Ranch Hand.** *Journal of Exposure Analysis and Environmental Epidemiology* 1995;5(2):209-223.;

Michalek JE, Tripathi RC, Kulkarni RM, and Pirkle JL. **The Reliability of the Serum Dioxin Measurement in Veterans of Operation Ranch Hand.** *Journal of Exposure Analysis and Environmental Epidemiology* 1996;6(3):327-338.;

Michalek JE, Rahe AJ, Kulkarni PM, and Tripathi RC. **Levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin in 1,302 Unexposed Air Force Vietnam-era Veterans.** *Journal of Exposure Analysis and Environmental Epidemiology* 1998;8(1):59-64.;

Jackson Jr W and Michalek JE. **Temporal changes in TCDD levels in 1,419 Air Force Vietnam-era veterans not occupationally exposed to herbicides.** *Journal of Exposure Analysis and Environmental Epidemiology* 2001;11:50-55.;

Guo X, Longnecker MP, and Michalek JE. **Relation of Serum tetrachlorodibenzo-p-dioxin (TCDD) levels to diet among veterans in the Air Force Health Study with background-level exposure.** *Journal of Toxicology and Environmental Health* 2001;63:159-172.

126. Stephenson et al. v. Dow Chemical Co. et. al. Nos. 00-7455 and 00-9120, 2003 WL 22227965 (2nd Cir.,9/29/2003)

127. Schuck, Peter. **Agent Orange On Trial: Mass Toxic Disasters in the Courts.** Belknap Press/Harvard University Press, Cambridge Ma., London, 1986

128. Knafel G, and Schartz L. **A Fresh Look at the Ranch Hand Data: Composite Birth Defects and Developmental Disabilities Yale University School of Nursing;** Presented at *Dioxin 2003*, Boston, August 25, 2003 in the Real Human Effects of Dioxins & Related Compounds Session, The Westin-Copley Hotel and Conference Center Essex North West Room 13:50-16:50h;

---

George J. Knafel, Linda S. Schwartz, Catherine L. Gilliss. **Assessment of Evidence for an Impact of Dioxin Exposure on Birth Defect Occurrence in Offspring of Ranch Hand Study Participants.** Yale University School of Nursing

129. The Dallas Morning News, (January 1, 1985) **Agent Orange Claims Due Wednesday**

130. Pacific Daily News, (June 17, 2003) **Sick Vets Report on Agent Orange**

131. U.S. Agency for Toxic Substances and Disease Registry, Centers for Disease Control, **Public Health Assessment, Anderson Air Force Base Yigo, Guam Appendix A: Evaluation of Potential IRP Sites At Anderson AFB.** EPA FACILITY ID: GU6571999519. January 4, 2002

132. Chemical and Engineering News (July 14,2003) **Dioxin in Vietnam Remain High: Analyses Show Much More TCDD Sprayed Than Earlier Estimates**

133. Stellman J, Stellman D, Christian R, Weber T, and Tomasallo C, **The Extent and Patterns of Usage of Agent Orange and Other Herbicides in Vietnam.** Nature 422, 681 - 687 (17 April 2003)

134. **Conference to 'put a human face' on the Vietnam War;** Yale Bulletin and Calendar August 30, 2002 | Volume 31, Number 1

135. Schechter, Arnold. Pavuk, Marian. Constable, John D.. Dai, Le Cao. Papke, Olaf. **A Follow-Up: High Level of Dioxin Contamination in Vietnamese From Agent Orange, Three Decades After the End of Spraying.** (Letter) Journal of Occupational & Environmental Medicine. 44(3):218-220, March 2002. ;

Schechter, Arnold MD, MPH. Quynh, Hoang Trong MD, PhD. Pavuk, Marian MD, PhD. Papke, Olaf MS. Malisch, Rainer PhD. Constable, John D. MD. **Food as a Source of Dioxin Exposure in the Residents of Bien Hoa City, Vietnam.** Journal of Occupational & Environmental Medicine. 45(8):781-788, August 2003. ,

Schechter, Arnold MD, MPH. Cao Dai, Le MD. Papke, Olaf MS. Prange, Joelle MS. Constable, John D. MD. Matsuda, Muneaki PhD. Duc Thao, Vu PhD. Piskac, Amanda L. MPH. **Recent Dioxin Contamination From Agent Orange in Residents of a Southern Vietnam City.** Journal of Occupational & Environmental Medicine. 43(5):435-443, May 2001.

136. Chemical and Engineering News (July 14,2003) **Dioxin in Vietnam Remain High: Analyses Show Much More TCDD Sprayed Than Earlier Estimates**

137. See endnote 135.

**138.** Asia Times, (July 10,2003) **A Little Bit Of Help**, For Some; See also: **Development of Impact Mitigation Strategies related to the Use of Agent Orange Herbicide in the Alou Valley, Vietnam Vol. 1 and Vol. 2** April 2000 & **Preliminary Assessment of Environmental Impacts Related to Spraying of Agent Orange Herbicide During the Vietnam War Vol. 1 and Vol. 2** October 1998 Prepared for the National Committee For Investigation of the Consequences of the Chemicals Used During the Viet Nam War (10-80 Committee) Tôn Thất Tùng Street, Dong Da, Ha Noi, Viet Nam By Hatfield Consultants Ltd. 201 - 1571 Bellevue Avenue, West Vancouver, B.C. Canada V7V 1A6

139. **Agent Orange Victims Support Fund Benefits over 220,400 People** (Aug. 1, 2003) The Vietnamese News Agency

- 
140. **Vietnamese Agent Orange Victims File lawsuit Against U.S. Companies** (Feb. 4, 2004) Agence France-Presse (AFP)
141. The Korea Times, (July 27, 2003) **Agent Orange Victims Demand US Compensation.**
142. Tony Glover. **"Class Action Turns Up Heat on Chipmakers."** The Business 18 Aug. 2002.
143. Heidi Schmidt. **"Small, Foreign and Female."** Wired Magazine Sept.-Oct. 1993.
144. Henschler, D Vamvakas S, Lammert M, Dekant W, Kraus B, Thomas B, Ulm K. **Increased Incidence of Renal Cell Tumors in a Cohort of Cardboard Workers exposed to Trichloroethylene.** *Archives of Toxicology* 70:131-133, 1995.
145. Schenker, M. B., E. B. Gold, J. J. Beaumont, B. Eskenazi, S. K. Hammond, B. L. Lasley, S. A. McCurdy, S. J. Samuels, C. L. Saiki and S. H. Swan. **Association of spontaneous abortion and other reproductive effects with work in the semiconductor industry.** *American Journal Industrial Medicine.* 28(6):639-659. 1995
146. McCurdy, S. A., D. Pocekay, S. K. Hammond, S. R. Woskie, S. J. Samuels and M. B. Schenker. **A Cross-sectional Survey of Respiratory and General Health Outcomes Among Semiconductor Industry Workers.** *American Journal Industrial Medicine.* 28(6):847-860. 1995;
- Pocekay, D., S. A. McCurdy, S. J. Samuels, S. K. Hammond and M. B. Schenker. **A Cross-sectional Study of Musculoskeletal Symptoms and Risk Factors in Semiconductor Workers.** *American Journal Industrial Medicine* 28(6):861-871. 1995;
- Samuels, S. J., S. A. McCurdy, D. Pocekay, S. K. Hammond, L. Missell and M. B. Schenker. **Fertility History of Currently Employed Male Semiconductor Workers.** *American Journal Industrial Medicine.* 28(6):873-882. 1995;
147. Santa Clara Center for Occupational Safety and Health 2003
148. Monsanto Company **2002 Annual Report**, pg. 36-7.
149. Wall Street Journal (Nov. 3, 2000) **Maize-recall costs could reach into the hundreds of millions**
150. USDA (March 29, 2002) **Japan Grain and Feed Annual Report**
151. Reuters (Feb. 7, 2003) **US farmers reach \$110 million StarLink settlement**
152. USDA (Dec. 6, 2002) USDA announces actions regarding Plant Protection Act violations involving Prodigene Inc., press release.
153. Gills J. (Nov. 18, 2002) **Gene-altered Grain Mishaps Spark Fears of Contamination**, Toronto Star – Ontario Edition
154. Washington Post (Nov. 14, 2002) **Biotech Firm Mishandled Corn in Iowa**
155. Kilman S. (Nov. 5, 2002) **Food, Biotech Industries Feud Over Plans for Bio-Pharming**, The Wall Street Journal
156. "Current gene-containment strategies cannot work reliably in the field. Can we reasonably expect farmers to [clean] their agricultural equipment meticulously enough to remove all GM seed?"; *Nature Biotechnology* (June 2002) Going with the flow, Editorial, Vol. 20, No. 6, p. 527.

- 
157. "(...)it is possible that crops transformed to produce pharmaceutical or other industrial compounds might mate with plantations grown for human consumption, with the unanticipated result of novel chemicals in the human food supply."; Committee on Environmental Impacts Associated with Commercialization of Transgenic Plants of the National Academy of Sciences (2002) Environmental Effects of Transgenic Plants: The Scope and Adequacy of Regulation, National Academy Press, p. 68.
158. The Dow Chemical Company. **2003 Form 10K** filing to the Securities and Exchange Commission, pg.8
159. For complete coverage of scientific conclusions regarding global warming see the Intergovernmental Panel on Climate Change: [www.ipcc.ch](http://www.ipcc.ch) – **Climate Change 2001, The Scientific Basis: Summary for Policymakers– A Report of Working Group I of the Intergovernmental Panel on Climate Change**
160. **World Climate News. No.23**, June 2003, World Meteorological Organization
161. The Dow Chemical Company; **2002 Annual Report**, pg 24.
162. EPA proposed TCE exposure limits.
163. Office of New York State Attorney General Elliot Spitzer, Press Release April 2, 2003, **State to Sue Dow Chemical Subsidiary Over Misleading Ads: Dow Chemical Co. Subsidiary Said to Renege on Earlier Agreement.**
164. Pérez-Peña, Richard. (March 22, 2004) Babies are Larger After Ban on 2 Pesticides, Study Finds. New York Times.
165. **Analysis Of Pesticide Residues in Soft Drinks**, Centre for Science and Environment, Delhi, August 2003.
166. **Dole, Dow and Shell Win Dismissal of Suit.** LA Times, Oct. 25, 2003
167. Herrick T. (Feb. 26, 2004) Chemical Stock Run-Up Belies Woes, The Wall Street Journal.
168. Sutherland, Donald; (Oct. 14, 2003) **EPA Reveals US Publicly Traded corporations Hide Environmental Debt in SEC Filings to Shareholders.**
169. Securities and Exchange Commission; **Regulation S-K Item 101, 103, 303.**
170. Securities and Exchange Commission; August 12, 1999; **17 CFR Part 211 Staff Accounting Bulletin No. 99** [Release No. SAB 99]
171. Sutherland, Donald; (Oct. 14, 2003) **EPA Reveals US Publicly Traded corporations Hide Environmental Debt in SEC Filings to Shareholders.**
172. Sarbines Oxley Act 2002 - Section 906.
173. Securities and Exchange Commission; **Section 307- Sarbanes Oxley Act** (Adopted Jan., 23 2003)
174. Rogers, Greg. **Financial Reporting of Environmental Liabilities: Closing the Gap in GAAP.** Directors & Officers Liability Series.
175. Sarah D. Stanwick, Ph.D., Understanding SOP 96-1: **Reporting Environmental Cleanup Liabilities**; The Journal of Corporate Accounting and Finance, Autumn 1997

---

176. *ibid.*

177. Innovest had several discussions with officers at Dow Chemical Corporation during the authoring of this report. Self insurance was mentioned as a standard business practice for many operations.

178. Bhalla, Nita. Reuters (Tues., Dec.9, 2003) **Whales reveal man's damaging impact on oceans.**