USGBC TSAC PVC Draft Report dated December 17, 2004 (released 12/22/04)
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Comments submitted by:

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Comments:

Comment
TSAC was charged with preparing a scientific assessment of the evidence on PVC's environmental and health hazards in order to evaluate a credit for PVC avoidance in the U.S. Green Building Council's LEED standard. For more than a decade I have studied the environmental impacts of vinyl, and I have been a participant in the USGBC evaluation of vinyl since its inception. I am the author of the most comprehensive analysis of the PVC lifecycle of which I am aware (Thornton 2002), and a peer-reviewed book on the subject published by a major academic press (Thornton 2000c). The TSAC report is of extremely poor scientific quality. The report is based on a novel, unvalidated combination of two methodologies that are widely viewed as problematic among environmental scientists – lifecycle assessment (LCA) and risk assessment (RA). These questionable methodologies are then applied in a shoddy and incomplete manner. This document would be unsuitable for publication in a quality peer-reviewed journal or for acceptance as a graduate student thesis; it certainly does not provide an adequate basis for a policy decision by a major public organization. The problems with the report fall into two major categories. First, environmental and health hazards of great consequence were omitted. TSAC's method treats as non-existent hazards for which data are inadequate to derive a quantitative estimate of risk and those

that are deliberately excluded. Surprisingly, TSAC has chosen to exclude many of the major hazards associated with the PVC lifecycle, and it has completely ignored the most important one – the global distribution and accumulation of persistent toxic substances produced in the manufacture, disposal, and accidental combustion of vinyl.

Second, TSAC"s report was surprisingly unbalanced. A second flaw with RA and LCA is their intense dependence on contestable choices and assumptions made by the assessor, and the ease with which the results can therefore be manipulated. Indeed, it has been shown that the subjective choice of different assumptions can result in a 100 million-fold difference in the results of a toxicological risk assessment (Cothern et al. 1986). Unfortunately, TSAC's assessment appears to suffer from a systematic bias that results in a radical underestimation of the hazards associated with PVC.

Due to these problems, which are discussed in more detail below, the TSAC report cannot be accepted as an accurate assessment of PVC's environmental costs compared to alternatives.

1. Failure to conform to scientific standards of reporting and transparency. Any scientific paper or report must provide adequate detail for the methods to be fully understood and replicated. The TSAC report provides some general information on the equations used and the types of hazards considered in the RA and LCA, and it then skips straight to the results. Specific information on the emissions and toxicology input values used for each material -- and where this information came from -- is not provided in most cases. Thus there is no way for the critical reader to know precisely what risks were assessed or whether the emissions and exposure estimates used are credible.

   TSAC did supply upon request spreadsheets containing data and calculations relevant to the LCA and RA, but these do not provide adequate information to evaluate the risk calculations made. For example, the LCA spreadsheet contains estimates of the emissions factors for the hundreds of specific pollutants considered in the LCA, but it provides absolutely no explanation of the source of these estimates and the assumptions embodied in them. Some of these emissions figures completely lack credibility: for example, the estimate of dioxin emissions for linoleum and for cork are higher than many of the PVC entries, despite the fact that PVC manufacture and disposal is recognized as a significant source of dioxin, but no dioxin has ever been associated with any specific aspects of the linoleum or cork lifecycles. Similarly, the human health normalization worksheet includes factors to weight risks by the price of the product – hence a more expensive material like cast iron and wood have their TSAC risk estimates amplified compared to those of vinyl by factors of 5 and 3 respectively, without any discussion or justification. These are examples of a general failure in the TSAC report to explicitly describe assumptions and data sources, an essential aspect of good scientific practice.

2. Failure to include all relevant hazards. The report notes correctly that "A life cycle assessment endeavors <u>to quantify and characterize all of the resources and pollution flows (inputs and outputs associated with a particular material) over its entire lifecycle.</u>" [emphasis added] But the TSAC report did not even come close to doing this for PVC. In fact, many of the most significant causes of environmental damage and health risks associated with vinyl appear to have been completely excluded from the report and/or the summary risk estimates on which its conclusions were based. (Hundreds of citations supporting the PVC-

related environmental and health hazards discussed here were provided in my submissions prepared for the USGBC (Thornton 2000a, Thornton 2000b) and other submitted materials (Thornton 2000c, Thornton 2002). Because they were previously submitted, the individual citations are not reproduced in this comment.)

A hallmark of scientific reasoning is the careful limiting of inferences to those that are supported by the data. That the TSAC report presents itself as an adequate characterization of the risks of PVC and draws broad conclusions about the environmental performance of PVC vis-à-vis specified alternatives, despite the extraordinary omissions detailed below, represents an egregious violation of scientific standards.

a. Production of highly toxic wastes in synthesis processes. There is ample and uncontested evidence that very large quantities of hazardous wastes are produced in the synthesis of ethylene dichloride (EDC) and vinyl chloride monomer (VCM), the feedstocks for PVC. These wastes include remarkably high concentrations of extremely persistent, bioaccumulative and toxic substances, including polychlorinated dibenzo-p-dioxins (dioxins, or PCDDs) and dibenzofurans (PCDFs, or furans), polychlorinated biphyenyls (PCBs), hexachlorobutadiene (HCBD), hexachlorobenzene (HCB), and hexachloroethane (HCE). These substances resist environmental breakdown, accumulate in food webs, and can cause severe health effects at very low doses. Because of these characteristics, they are now globally distributed and have accumulated to levels in upper trophic species, including humans, that may pose both present and potential health hazards. Substances of this type are therefore rightly regarded one of the most important global environmental health hazards of our time. The TSAC report makes no mention of the production, release or disposal of the wastes and by-products associated with this stage of the PVC lifecycle.

b. Water and sediment contamination near EDC/VCM facilities. There is ample evidence of severe surface water and sediment contamination near facilities making the feedstocks for PVC in a number of nations, including the U.S. In particular, extremely high levels of persistent, bioaccumulative toxic substances such as PCDD/Fs, HCB, and HCBD in aquatic ecosystems have been linked to EDC/VCM manufacturing facilities have been documented. The TSAC report makes no mention of this source of contamination during the PVC lifecycle, or of the associated exposures and health risks.

c. Worker and residential exposure to synthesis by-products. The report presents an extensive discussion of the occupational health risks of VCM. But no mention is made of the health risks that PCDD/Fs, PCBs, HCB, HCBD, and HCE pose to workers and plant neighbors, despite the extraordinary occupational toxicity of these chemicals.

d. Exposure to contaminated groundwater. There are several documented examples of severe groundwater contamination caused by EDC/VCM production facilities in the United States, which required wholesale relocation of residential communities to prevent unacceptable exposures and health risks. The TSAC report does not mention this source of contamination or exposure associated with the PVC lifecycle.

e. Disposal of PVC products. Incineration of spent PVC products is perhaps the most environmentally damaging aspect of the PVC lifecycle. There is no debate that burning PVC produces PCDD/Fs. Further, PVC is the major source of dioxins in many or most of the major identified sources of dioxin air emissions, such as trash incinerators, hospital waste incinerators, uncontrolled waste burning, and some types of secondary metals smelters. In addition to these substances, organochlorine combustors produce and emit a diverse array of other hazardous products of incomplete combustion, including numerous highly toxic, persistent and bioacummulative substances. Shockingly, the words incinerator and incineration never appear in the TSAC report. Nor is there any mention of land disposal of PVC, which results in both leaching of contaminants to groundwataer and further PCDD/F production in accidental landfill fires. Shockingly, the TSAC report appears to have completely ignored the entire disposal phase of the vinyl lifecycle.

f. Failure to recycle PVC products. Post-consumer PVC is essentially unrecyclable in the present system, and even the best-case scenarios indicate that only a tiny fraction of all PVC will be recycled in the coming decades. The environmental costs of reliance on an unrecyclable material are never discussed in the TSAC report.

g. Heavy metal stabilizers. Because PVC is unstable in many environments, many long-life uses require the addition of toxic metal stabilizers, including lead, cadmium, and organotin compounds, all of which are now globally distributed toxic pollutants. Lead and cadmium are particular problems for human health. TSAC considered occupational exposure to cadmium and barium heat stabilizers, but there is no evidence that the environmental release and accumulation of these substances from manufacture and disposal of PVC products was considered.

h. Global pollution associated with fires. The report correctly notes evidence that very large quantities of dioxins have been found to be produced during accidental fires in structures containing PVC. The report then classifies these hazards, however, as “nonquantifiable,” and excludes them from both the risk assessment and life-cycle assessment on which its conclusions were based.

The report dismisses evidence of very high levels of dioxins found near major PVC fires, by noting that after a rain the levels decrease. The committee surely must know that dioxins are not destroyed by rain but are merely adsorbed onto soils and, to a significant extent, carried by runoff into waterways and then distributed over much longer distances. The contribution of many small to medium-sized fires to the global dioxin burden is a major source of concern about PVC. That the TSAC report views dispersal of dioxins into the global environment as comforting because it reduces local concentrations is bizarre at best and suggests a complete failure to understand the environmental issues at stake in this project.

i. Global pollution associated with backyard burning. The report acknowledges evidence that burning PVC materials in open fires or burn barrels produces extremely large quantities of dioxins. To the committee’s credit, the report notes that “reducing PVC content in household waste would reduce dioxin and furan emissions.” However, these emissions are also treated as a “nonquantifiable” hazard that is not included in the LCA or RA and therefore plays no role in the quantitative

comparison on which the committee based its conclusion. The report also erroneously states that "it is unclear how significant the effect would be;" statistical analysis of the data in the study cited indicate that chlorine content of the waste – PVC in particular -- is by far the largest single contributor to variation among in the amount of dioxin produced in burn barrel experiments. (Neurath 2004)

It is important to note that all of these omitted hazards are unique to PVC. As a result, TSAC's failure to include them in the quantitative assessment on which its conclusions were based produces a strong pro-PVC bias. It is remarkable that, despite this bias, the LCA/RA still concluded that in all use categories examined, PVC is more hazardous than the best alternative. This result suggests to this reviewer that a comprehensive and unbiased analysis of the hazards of PVC would have found that vinyl is by far the most hazardous of all the materials examined.

The authors of the TSAC report were surely aware of all these issues excluded from the report. For this scientific commentator, who has submitted copiously referenced documentation of these hazards to the USGBC and TSAC over the last four years, the complete lack of discussion of major elements of the PVC lifecycle is particularly irksome.

3. Biased treatment of evidence. A hallmark of good scientific practice is unbiased and consistent consideration of data relevant to an inference. The TSAC report repeatedly dismisses evidence of hazards associated with PVC using rationales that are not consistently applied throughout the analysis. The result is to give the strong impression of a pro-PVC bias. For example:

    a. The TSAC report dismisses several peer-reviewed epidemiological studies that report an association with exposure to phthalates and/or PVC with risk of asthma and/or related symptoms, based on the objection that these studies were not adequately controlled for all possible confounding factors. In the same report, however, TSAC argues against the possibility that community exposures to vinyl chloride may increase cancer risk by reporting its own extremely crude, unpublished comparison of cancer rates in Louisiana parishes with EDC/VCM facilities compared to parishes without such facilities. TSAC presents these statistics with no discussion of the appropriate reference population, no acknowledgement of the fact that the "exposed" parishes include thousands of subjects who live at great distances from EDC/VCM facilities, and absolutely no effort to control for the myriad confounding factors that also affect cancer incidence and mortality. Despite its stated concerns about uncontrolled studies, TSAC was also willing to base its assessments of vinyl chloride health impacts on unverified estimates of emissions and air toxics concentrations provided by the Vinyl Institute and its paid consultant the SAGE group.

    b. The report states, "The majority of the scientific community does not consider DEHP to be a human carcinogen," without offering a citation. This statement is inaccurate and highly selective. The U.S. National Toxicology Program lists DEHP as "reasonably anticipated to be a human carcinogen," and the U.S. EPA considers DEHP "a probable human carcinogen." The International Agency for Research on Cancer has stated that DEHP is unclassifiable as to its human carcinogenicity (not non-carcinogenic, as TSAC states). These classifications by no means suggest a general consensus that DEHP is

noncarcinogenic. Moreover, serious scientific concerns have been raised about the argument that the TSAC report cites -- that rodent studies are of no relevance to humans due to differences in peroxisome proliferation pathways -- but TSAC fails to acknowledge these concerns. (Melnick 2001, 2002, 2003, Melnick et al. 2003)

c. The report dismisses four studies published in highly respected peer-reviewed international scientific journals, all of which found increased risks of several types of cancer associated with VCM exposures lower than those that produce measurable increases in angiosarcoma. To justify this dismissal, the report says that these are "foreign studies," and "these tumors have not been reported in American workers, however." There is no plausible biological difference between American workers on one hand and European or Taiwanese workers on the other that should make these findings inapplicable to a consideration of PVC's health risks. Further, TSAC is entirely willing to base its discussion of DEHP's carcinogenicity on the "foreign" classification by IARC, while ignoring the classifications to the contrary by the major U.S. agencies. TSAC's absurd argument that foreign epidemiological studies are irrelevant reveals a grasping for excuses to dismiss evidence supporting concern about vinyl's lifecycle.

4. The report's convoluted methodology was unnecessary. The primary reason that TSAC report excluded many essential aspects of the PVC lifecycle, such as vinyl's contribution to the global chemical burden, because the methodology it chose has no formal way to take account of these hazards. Rather than choosing a tool to fit the problem at hand, TSAC appears to have created a novel, unverified tool, and then dismissed all evidence that does not fit the tool. This unscientific approach led, as a matter of course, to a pro-PVC bias because the most severe PVC-related hazards were excluded.

   A more rational approach would have been to evaluate the chemical and biological characteristics of PVC and its associated wastes and by-products, in comparison to the available alternatives. PVC is unique in producing large quantities of persistent, bioaccumulative, low-dose toxic substances throughout its lifecycle. There is no debate that such substances are incompatible with ecological processes and pose hazards to human health. PVC is also unique in requiring large quantities of persistent toxic additives, such as metals and phthalate plasticizers, to create useful formulations. Moreover, PVC is unique in being essentially unrecyclable and extremely hazardous to dispose of. These problems cannot be repaired with better technology; they arise directly from the intrinsic chemical qualities of PVC itself.

   As TSAC's analysis points out, no material is without environmental costs, because all products use materials and energy. Must this realization lead to total paralysis, as TSAC's approach implies? Why must a material be the worst of all options in all impact categories in all applications? The two relevant questions to material choice in a green building context should be: can a given material be viewed as a sustainable material, and are safer alternatives available? PVC is the paragon of an unsustainable material, with its production of large quantities of ecologically incompatible by-products throughout its lifecycle, and the infeasibility of recycling making a resource-efficiency and by-product-efficiency impossible. As for alternatives, even using its biased methodology that radically underestimates the hazards of PVC, TSAC found that in all sectors there is at least one less damaging alternatives. These findings indicate that it is both feasible and essential for the building industry to move away from the use of vinyl as rapidly as possible.

In summary, the TSAC report does not provide an adequate scientific basis for the recommendation it puts forth. If the USGBC decides that PVC is as green as any other material, many scientists and members of the green building community -- myself included -- will conclude regretfully that USGBC's standards are worthless. Further, if such a decision is made based on the TSAC report, the credibility of the organization as a well-informed, forward-thinking force in the movement for sustainability will be damaged. Green building governments and practitioners have correctly judged vinyl to be an unsustainable material, and they will continue to move away from vinyl because of the clear and unique hazards it poses. For USGBC to make a decision based on such a shoddy document as the TSAC report would be a shame indeed.

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