UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

# Comments of Safer Chemicals Healthy Families, Environmental Health Strategy Center, Earthjustice and Natural Resources Defense Council on EPA's Draft Risk Evaluation for Trichloroethylene under Section 6(b) of TSCA

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Docket ID EPA-HQ-OPPT-2019–0500

Safer Chemicals Healthy Families (SCHF), Environmental Health Strategy Center, Earthjustice and Natural Resources Defense Council (NRDC) submit these comments on the Environmental Protection Agency (EPA) draft risk evaluation for trichloroethylene (TCE) under section 6(b) of the Toxic Substances Control Act (TSCA).[1] Our organizations are committed to assuring the safety of chemicals used in our homes, workplaces and the many products to which our families and children are exposed each day. We took a leadership role during the TSCA legislative process, advocating the most protective and effective legislation possible to reduce the risks of toxic chemicals in use today.

## Executive Summary

TCE is a high exposure/high hazard chemical with several known health effects that have long been of deep concern to state and federal agencies, members of the military, labor unions, and the general public. The draft evaluation determines that virtually every existing condition of use of TCE presents unreasonable risks to workers and users of consumer products. While these findings are alarming, they fail to reflect the full seriousness of TCE's risks to health and the true extent of the population at risk. Because of its serious understatement of exposure and risk, the EPA evaluation is insufficiently protective and, if used as the basis for risk management, will leave large segments of the US population exposed to unsafe levels of TCE.

It is critical for EPA to fully account for all TCE pathways of exposure and conditions of use, accurately and fully identify all health endpoints contributing to TCE's risks, and ensure that its risk evaluation and risk management actions protect vulnerable populations, as required by TSCA and EPA's own regulations. This comprehensive approach is also necessary to ensure full protection of public health since states will be pre-empted by TSCA from adopting additional risk management measures to address TCE once EPA's actions are complete.

We focus in these comments on several aspects of the draft evaluation that greatly understate TCE's risks. Our concerns are summarized below.

[1] 85 Federal Register 11079 (February 26, 2020); Draft Toxic Substances Control Act (TSCA) Risk Evaluation for Trichloroethylene (TCE Risk Evaluation), https://www.epa.gov/sites/production/files/2020-02/documents/1_draft_risk_evaluation_for_trichloroethylene_tce_public.pdf

- **Failure to Base Unreasonable Risk Determinations on Evidence of Fetal Heart Defects (pp. 7-23 )**

In past assessments and rulemakings under TSCA, EPA has consistently concluded that the weight of the scientific evidence supports the link between TCE and fetal heart malformations and that, as the most sensitive endpoint, these effects should drive risk determinations for acute and chronic TCE exposure. As originally drafted by EPA career scientists, the draft risk evaluation reaffirmed this approach, using the study by Johnson et al for dose-response analysis and determination of Margins of Exposure (MOEs) for TCE-exposed workers and consumers, consistent with the peer-reviewed 2011 IRIS assessment and the 2014 TSCA Work Plan assessment. However, a recent investigative report has now revealed that, after the draft was submitted for interagency review, the White House directed EPA not to use fetal heart defects to determine unreasonable risk.[2] As a result, the draft evaluation was revised to state that "there are uncertainties which decrease EPA's confidence in this endpoint" and therefore EPA will now use "immunosuppression and autoimmunity as the key endpoints for determining whether or not a condition of use presents unreasonable risks."

Using the results of Johnson et al, EPA's dose response analysis of acute exposure scenarios shows that the 99th percentile estimate of the human equivalent concentration ($HEC_{99}$) for immune system effects is 470 times higher than the $HEC_{99}$ for heart malformations. Thus, for consumers and workers, the Margins of Exposure (MOEs) are over two orders of magnitude lower for heart defects than immune effects. This means that exposure limits based only on immune effects would expose women of childbearing age to levels of TCE that would leave their offspring at serious risk of heart malformations.

There is no credible scientific justification for ignoring evidence of fetal heart defects in evaluating TCE's risks to health:

- EPA has repeatedly found that the "weight of evidence" (WOE) demonstrates that TCE causes fetal heart malformations, the available data are sufficient for dose-response assessment, and these data provide a sound basis for determining risks to consumers and workers. While the Agency now asserts (at the direction of the White House) that unspecified "uncertainties" weaken its "confidence" in the heart defect evidence, the entirety of the risk evaluation shows the exact opposite -- that this evidence is strong and reliable.
- EPA's WOE analysis demonstrates that the evidence for TCE-related cardiac effects extends well beyond the Johnson et al study and includes epidemiological studies, mechanistic data and animal tests on TCE metabolites. Failing to include this endpoint in EPA's determination of unreasonable risk would ignore a documented and serious health concern that should play a major role in setting limits on TCE exposure and use.

[2] Elizabeth Shogren, *EPA scientists found a toxic chemical damages fetal hearts. The Trump White House rewrote their assessment,* Reveal/Center for Investigative Reporting, February 28, 2010 (Reveal Report) https://www.revealnews.org/article/epa-scientists-found-a-toxic-chemical-damages-fetal-hearts-the-trump-white-house-rewrote-their-assessment/. It would be instructive to compare the draft evaluation submitted for interagency review with the current public comment version.

- Although the Johnson et al study has been repeatedly attacked by industry, the draft evaluation classifies it as "medium quality" using the TSCA systematic review criteria and thus suitable for use in TSCA risk determinations. Although the study was unorthodox in some respects, the authors have responded in detail to the industry concerns and EPA's continued reliance on the study is based on a careful review of this additional information. The study is essential for dose-response assessment without which calculation of MOEs for this endpoint would be impossible.

- The only change in circumstance since EPA's earlier TCE assessments is a recent study by the Halogenated Solvents Industry Alliance (HSIA) that purports to find that TCE does not cause heart malformations. However, the draft evaluation concludes that this study's "methodology was likely of reduced sensitivity" and did "not sufficiently examine the complete range of potential cardiac defects." Moreover, for the narrow category of cardiac defects it addressed, the HSIA study in fact found a dose-related increase in heart malformations remarkably similar to the findings of Johnson el al and thus provides confirmation of these findings and their value for dose-response analysis.

- The TCE draft selects immune effects as a "representative endpoint" that should drive determinations of unreasonable risks to the exclusion of other more sensitive endpoints. Under this unprecedented approach, sensitive endpoints supported by the weight of the evidence could be ignored on the ground that the data for less sensitive endpoints warrant greater "confidence." This violates the long-standing public health policy that risk managers should protect against the most sensitive health endpoints adequately demonstrated by the available science. Until now, EPA and the National Academy of Sciences have consistently endorsed this approach as a central principle of risk assessment. It therefore represents the best available science that TSCA section 26(h) requires EPA to employ in its risk evaluations.

- While TCE's immune effects are serious and should be included in the TCE evaluation, the implication that the data supporting them are significantly more "certain" than the evidence of heart defects is an after-the-fact invention of the White House with no support elsewhere in the draft evaluation. It is clear from the evaluation that EPA career scientists had "high confidence" in *all* the endpoints selected as Points of Departure (PODs) and drew no distinction between immune effects and fetal heart defects based on relative degrees of "certainty."

### ➢ Failure to Address the Contribution of Air, Water and Soil Contamination to the Risks Faced By The General Populations And Vulnerable Subpopulations (pp. 23-35)

Like previous evaluations, the draft ignores the human health implications of TCE releases to the environment. In fact, TCE air emissions and contaminated groundwater, drinking water and soil are pervasive across the US and contribute significantly to overall TCE exposure. Each of these pathways is alone responsible for cancer and non-cancer risks to large segments of the population that exceed EPA benchmarks. Moreover, some subpopulations are exposed by multiple pathways simultaneously – i.e. individuals who breathe TCE in indoor and outdoor air, consume contaminated drinking water and live

near TCE-contaminated Superfund sites. Because TCE exposure levels are higher for these subpopulations than for the general population, they face elevated risks of TCE-related health effects that the draft evaluation ignores. Indeed, even for the limited populations (workers and users of consumer products) that the draft evaluation addresses, EPA significantly understates risks by ignoring exposure to TCE in air, water and soil.

A comprehensive risk evaluation taking into account all conditions of use as required under TSCA and EPA's regulations would identify and quantify these subpopulations, estimate total exposure from all known and reasonably foreseen conditions of use and characterize the increased risk resulting from concurrent exposure pathways. However, because of its impermissibly narrow scope, the draft TCE evaluation fails to provide this analysis and therefore presents a limited and incomplete picture of TCE's risks to the public. EPA must revise the draft TCE evaluation so it accounts for *all* known and reasonably foreseen conditions of use – that is, all sources of exposure and risk -- and provides a comprehensive accounting of TCE's dangers to public health.

- **Correct Determination That TCE is a Non-Threshold Carcinogen but Understatement of Cancer Risk (pp. 35-41)**

TCE is universally recognized to be a known human carcinogen based on evidence of multiple tumor types in animal and human epidemiological studies. Like IRIS, the draft evaluation has correctly determined that TCE is a genotoxic carcinogen and that hypothesized modes of action (MOAs) that assume a threshold are unsupported. We agree with EPA that linear extrapolation is the correct approach to estimate cancer risk.

However, we are concerned that EPA's risk evaluation fails to account for acute cancer risks to workers and consumers. In addition, EPA must apply to workers the same benchmarks for determining unreasonable cancer risks that it uses for other populations. For all exposed populations, the goal should be to protect against cancer risks exceeding $1 \times 10^{-6}$.

- **Failure to Model Realistic Dermal Exposure Scenarios and Combine Dermal and Inhalation Exposures (pp. 41-46)**

EPA developed exposure and risk estimates for dermal as well as inhalation routes of exposure. While this was the correct approach, EPA's estimates of dermal exposure rest on questionable assumptions and likely understate the magnitude of TCE exposure by this route. EPA should model a broader range of dermal contact scenarios based on its own analysis of variations in dermal exposure conditions and base risk estimates on multiple dermal exposure events per day. It should also estimate increases in exposure and risk where occlusion results in higher skin absorption of TCE during glove use.

EPA chose not to derive composite risk estimates even though it recognizes that inhalation and dermal exposures occur simultaneously. EPA's rationale for failing to combine these exposure routes is puzzling and counter-intuitive and its concern about overestimating exposure is simply not credible. The greater concern is that exposure will be understated, as EPA has itself recognized in previous risk evaluations. To

employ the "best available science," as TSCA requires, the final evaluation must aggregate dermal and inhalation exposure and present a more realistic estimate of risk for the two exposures combined.

EPA has also arbitrarily failed to include dermal exposure in risk determinations for several consumer products. The Agency's claim that it can dismiss dermal exposure because it is *de minimis* is not consistent with realistic use scenarios for these products and in conflict with how EPA has quantified dermal exposure by workers. Moreover, nothing in TSCA permits EPA to ignore exposures that it considers *de minimis*; indeed, any incremental additional risk can tip the scales from acceptable to unreasonable risk.

- **Omission of any Risk Determination for Chronic Consumer Exposure to TCE (pp. 46-48)**

EPA makes no risk determinations for chronic exposures to TCE by consumers and thus fails to address whether consumers are at risk for cancer, developmental toxicity, kidney effects and immunotoxicity. However, many of the TCE-containing consumer products identified by EPA are expected to be used regularly by hobbyists, artists who work at home or home renovators. Others are likely applied frequently during normal household cleaning and maintenance or used regularly by consumers who maintain and repair their own or friends' vehicles. Indeed, EPA itself notes that high end-frequency of use of these products could be 50 times a year. Moreover, as EPA acknowledges, consumers are likely exposed to multiple TCE-containing products, magnifying total exposure.

Contrary to EPA, it is typical for chemical use scenarios to involve repeated but not continuous exposure, and risk assessors have had no trouble using repeated dose toxicity studies to estimate the long-term health risks of these scenarios. EPA could easily determine overall exposure levels from recurring consumer use of multiple TCE-containing consumer products and then estimate risks of cancer, developmental and reproductive toxicity, kidney effects and immunotoxicity to consumers. Its failure to consider this condition of use in violation of TSCA and EPA's own regulations is a glaring hole in the draft evaluation.

- **Failure to Aggregate Exposures to TCE Across Multiple Routes and Pathways (pp. 48-49)**

TSCA requires EPA to considering aggregating exposures to chemicals under their conditions of use. EPA's regulations define "aggregate exposure" as "the combined exposures to an individual from a single chemical substance across multiple routes and across multiple pathways." The draft TCE evaluation unjustifiably refuses to use aggregate exposure analysis.

As discussed above, EPA has failed to address exposure to TCE "across multiple routes" because it has not combined dermal and inhalation exposure even though workers and consumers experience both routes of exposure simultaneously. It has also failed to address "combined exposures . . . across multiple pathways" by not accounting for the contribution of TCE levels in ambient air, indoor air, drinking water and waste sites near communities. Finally, given the large number of industry and consumer uses of TCE, workers may be exposed to TCE in their homes – for example, when they use one

or more other TCE-containing household products or do weekend work or have a side business using the same products as during their weekday work.

In all these cases, risks to workers and consumers would be a function of the aggregate contribution of each activity and pathway to total exposure. However, the draft evaluation looks at each exposure pathway in isolation from others, thus understating total risk.

- **Unwarranted Reliance on Personal Protective Equipment (PPE) in Determining TCE Risks to Workers (pp. 49-55)**

As in previous risk evaluations, EPA's risk determinations for workers exposed to TCE calculate MOEs assuming both the use of respirators and gloves and the absence of protective equipment. Even for scenarios where workers consistently and reliably use PPE, EPA concludes that MOEs are below "benchmarks" for all conditions of use. However, while unacceptably low even with PPE use, EPA's MOEs are significantly lower for "no PPE" scenarios.

As the SAAC has repeatedly underscored and EPA's draft evaluations recognize, an expectation of universal PPE use is in fact contrary to the realities of workplace practice and sound principles of worker protection. Because TSCA requires EPA to consider "reasonably foreseen" conditions of use and universal PPE use is not reasonably foreseeable, the "no PPE" scenario is the only defensible baseline for determining current risk levels for exposed workers and then defining the additional worker protections necessary to eliminate unreasonable risk. To comply with TSCA, the final TCE evaluation must base determinations of unreasonable risk solely on the "no PPE" scenario.

- **Flawed TSCA "Systematic Review" Method (pp. 55-59)**

The TSCA method departs radically from accepted scientific principles for systematic review adopted by the Institute of Medicine (IOM), the National Toxicology Program (NTP) and EPA's Integrated Risk Information System (IRIS) and endorsed by the NAS and other peer review bodies. The SACC has "noted problems with both the systematic review design and consistent implementation of its protocols" and called upon EPA to consider significant changes in approach. Thus far, the serious concerns raised by the SACC have not been addressed by EPA: at a minimum, EPA's final risk evaluations must respond fully to the SACC's comments.

As the National Academy of Sciences (NAS) belatedly reviews the TSCA "Systematic Review" method, EPA should cease using it in final risk evaluations but instead apply one of the recognized systematic review methodologies.

- **Failure to Make a Single Determination of "Unreasonable Risk" for TCE as Required by TSCA (pp. 59-60)**

TSCA mandates that EPA issue a single risk determination for TCE, and EPA's contrary approach of evaluating each condition of use in isolation is an unlawful attempt to minimize the assessment of the total risk posed by TCE and avoid regulation. EPA must examine the combined combination of all conditions of use to total risk and exposure and cannot determine unreasonable risk for each condition of use in isolation

## I. EPA's Unreasonable Risk Determination for TCE Should be Based on Cardiac Malformations as the Most Sensitive Endpoint Supported by the Weight of the Evidence

EPA's 2011 IRIS[3] and 2014 Workplan[4] assessments concluded that the weight of the scientific evidence supports the link between TCE and fetal heart malformations and that, as the most sensitive endpoint, these effects should drive risk determinations for acute and chronic TCE exposure. These conclusions formed the basis for EPA's proposals in late 2016 and early 2017 to ban vapor and aerosol degreasing and spot removal uses of TCE under section 6 of TSCA.[5]

EPA again relied on the evidence of fetal heart defects in the draft TSCA risk evaluation it submitted to the White House for interagency review in December 2019. According to a recent report by the Center for Investigative Reporting, this draft stated as follows:[6]

> "EPA identifies developmental cardiac malformations as the driver end point for the conditions of use that EPA has preliminarily determined present unreasonable risk. This is the effect that is most sensitive, and it is expected that addressing risks for this effect would address identified risks."

However, the draft that EPA released for public comment and peer review on February 21 omits this statement and no longer bases EPA's determination of unreasonable risk on fetal heart defects. Instead, it claims that "there are uncertainties which decrease EPA's confidence in this endpoint" and therefore EPA will now use "immunosuppression and autoimmunity as the key endpoints for determining whether or not a condition of use presents unreasonable risks."[7] As the Center for Investigative Reporting found and EPA has now admitted,[8] this reversal of EPA's longstanding position occurred at the express direction of the White House Executive Office of the President, which instructed EPA career scientists to

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[3] EPA, Toxicological review of trichloroethylene (CASRN 79-01-6) in support of summary information on the Integrated Risk Information System (IRIS) (IRIS Report]. (EPA/635/R- 09/011F), September 2011 https://cfpub.epa.gov/ncea/iris/iris_documents/documents/toxreviews/0199tr/0199tr.pdf

[4] EPA, TSCA Work Plan Chemical Risk Assessment Trichloroethylene: Degreasing, Spot Cleaning and Arts & Crafts Uses, June 2014 (Work Plan Assessment), https://www.epa.gov/sites/production/files/2015-09/documents/tce_opptworkplanchemra_final_062414.pdf

[5] 81 Fed. Reg. 91592 (Dec. 16, 2016) (proposed TSCA ban on TCE aerosol degreasing and spot removal uses); 82 FR 7432 (Jan. 19, 2017) (proposed TSCA ban on TCE use for vapor degreasing).

[6] Reveal Report, note 2.

[7] TCE Draft Evaluation at 377.

[8] INSIDE EPA, *EPA Defends Its Process For Crafting Public Draft TCE Risk Evaluation,* March 2, 2020, https://insideepa.com/daily-news/epa-defends-its-process-crafting-public-draft-tce-risk-evaluation

rewrite the draft to cast doubt on the evidence of cardiac defects and to shift the basis of its risk determinations to less sensitive endpoints.

The revised draft developed at White House direction asserts that despite these changes, its unreasonable risk determinations remain the same for most TCE conditions of use, implying that the exclusion of fetal heart defects from these determinations is inconsequential from a public health perspective:[9]

> "For the majority of the occupational and consumer conditions of use, unreasonable risk determinations were consistent whether based on congenital heart defects (an endpoint for which EPA has lower confidence) or immunosuppression and autoimmunity endpoints."

This is highly misleading. While the evaluation concludes that immune-related effects do present unreasonable risks for nearly all conditions of use, these effects occur at significantly higher dose levels than heart malformations. Thus, a significant and unreasonable risk will still exist if EPA bases exposure limits on the less sensitive immune endpoints. For example, EPA's dose response analysis of acute exposure scenarios shows that the $HEC_{99}$ for immune system effects is 470 times higher than the $HEC_{99}$ for heart malformations.[10] Thus, for consumers and workers, the Margins of Exposure (MOEs) are over two orders of magnitude lower for heart defects than immune effects. This means that exposure limits based on the immune effects would be unprotective for women of childbearing age and their offspring, for whom heart defects can cause serious health impairments and death in utero, during childhood and later in life.

As shown below, there is no credible justification for ignoring fetal heart defects and the serious dangers they pose to pregnant women exposed to extremely low levels of TCE:

- EPA has repeatedly found – and the draft evaluation reaffirms -- that the "weight of evidence" (WOE) demonstrates that TCE causes fetal heart malformations, the available data are sufficient for dose-response assessment and there is a sound basis for using MOEs for these effects for determinations of unreasonable risk. While the Agency now asserts (at the direction of the White House) that unspecified "uncertainties" weaken its "confidence" in the heart defect evidence, the entirety of the risk evaluation shows the exact opposite -- that this evidence is strong and reliable.

- EPA's WOE analysis demonstrates that the evidence for TCE-related cardiac effects extends well beyond the Johnson et al study and includes epidemiological studies, mechanistic data and animal tests on TCE metabolites. Failing to include this endpoint in EPA's determination of unreasonable risk would ignore a documented and serious health concern that should play a major role in setting limits on TCE exposure and use.

- The Johnson et al study has been repeatedly attacked by industry, but the draft evaluation classifies it as "medium quality" using the TSCA systematic review criteria and thus suitable for use in TSCA risk determinations. Although the study was unorthodox in some respects, the

[9] TCE Risk Evaluation at 377.
[10] Id, at 252.

authors have responded in detail to the industry concerns and EPA's continued reliance on the study is based on a careful review of this additional information. The study is essential for dose-response assessment without which calculation of MOEs for this endpoint would be impossible.

- The only change in circumstance since EPA's earlier TCE assessments is a recent study by the Halogenated Solvents Industry Alliance (HSIA), representing TCE manufacturers, that purports to find that TCE does not cause heart malformations.[11] However, the draft evaluation contains a lengthy critique of the HSIA study which concludes that its "methodology was likely of reduced sensitivity" and did "not sufficiently examine the complete range of potential cardiac defects."[12] For this reason and because of other flaws, EPA found that the HSIA study did not "sway the weight of evidence for the endpoint." Thus, while White House reviewers may have viewed the HSIA study as a new source of "uncertainty," the EPA scientific review concluded that it did not materially alter previous EPA assessments of the strength of the data. In fact, for the narrow category of cardiac defects it addressed, the HSIA study found a dose-related increase in heart malformations remarkably similar to the increase reported in the (Johnson et al 2003) study that HSIA has sought to discredit, thus providing confirmation of Johnson findings and their value for dose-response analysis.

- To justify disregarding fetal heart defects, the TCE draft selects immune effects as a "representative endpoint" that should drive determinations of unreasonable risks to the exclusion of other more sensitive endpoints. This approach would allow the Agency to disregard the endpoints of greatest concern based on subjective and scientifically dubious judgements of the relative "certainty" of different bodies of evidence. Sensitive endpoints supported by the weight of the evidence could thus be ignored on the ground that the data for other endpoints warrant greater "confidence." This violates the long-standing public health policy that risk managers should protect against the most sensitive health effects adequately demonstrated by the available science. Until now, EPA has consistently followed this principle. Nothing in TSCA provides any basis for a different approach. Indeed, the law requires EPA to assure that its risk evaluations address all unreasonable risks to "potentially exposed or susceptible subpopulations." Fetuses exposed to TCE at levels that can cause life-threatening heart defects in utero or after birth fall squarely within the vulnerable populations that EPA must protect under TSCA.

- While TCE's immune effects are serious and should be included in the TCE evaluation, the implication that the data supporting them are significantly more "certain" than the evidence of heart defects is an after-the-fact invention of the White House with no support elsewhere in the draft evaluation. The evaluation repeatedly states that EPA has "high confidence" in *all* the

[11] Halogenated Solvents Industry Alliance, An Oral (Drinking Water) Study of the Effects of Trichloroethylene (TCE) on Fetal Heart Development in Sprague Dawley Rats, Charles River Laboratories Ashland, February 25, 2019 (HSIA Study), file:///C:/Users/Owner/Downloads/EPA-HQ-OPPT-2016-0737-0120%20(1).pdf

[12] TCE Risk Evaluation at 222-23.

endpoints selected as Points of Departure (PODs). While the draft evaluation (presumably at White House direction) cites factors that purportedly warrant greater reliance on the immune endpoints, this comparison is unpersuasive when the strengths and limitations of the two bodies of evidence are objectively evaluated. Thus, there is simply no basis to claim that the immune effects data provide sufficient "certainty" for a determination of unreasonable risk, but the heart defect data do not.

### A. EPA Has Repeatedly Determined that the Weight of Evidence Demonstrates the Link Between TCE and Fetal Heart Defects

**IRIS Assessment.** The 2011 IRIS assessment of TCE relied on the fetal cardiac effects demonstrated in Johnson et al (2003) to derive an RFC and RFD for TCE, finding "that the most sensitive developmental effect by far was heart malformations in the rat reported by Johnson et al. (2003), . . . [and that] although this study has important limitations, the overall weight of evidence supports an effect of TCE on cardiac development."[13]

The Johnson data were derived from a 6-year academic research program and consolidated data from several cohorts. Control data were combined from 6 independent cohort experiments.[14] The study administered 0 ppb, 2.5 ppb, 250 ppb, 1.5 ppm, and 1100 ppm of TCE to pregnant Sprague-Dawley rats via drinking water for the entire duration of pregnancy. On the last day of pregnancy, dams were euthanized, and the heart and great vessels of fetuses were examined for abnormalities. The study reported statistically significant increases in the incidence of a broad array of severe cardiac defects at multiple dose levels

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The cardiac malformations reported by Johnson et al were also observed in studies of other species. Evaluating the animal data as a whole, IRIS concluded that:[15]

> "The animal data provide strong, but not unequivocal, evidence of the potential for TCE-induced cardiac malformations following oral exposures during gestation. Strengths of the evidence are the duplication of the adverse response in several studies from the same laboratory group, detection of treatment-related cardiac defects in both mammalian and avian species (i.e., rat and chicken), general cross-study consistency in the positive association of increased cardiac malformations with test species (i.e., rat), route of administration (i.e., oral), and the methodologies used in cardiac morphological evaluation (i.e., fresh dissection of fetal hearts). Furthermore, when differences in response are observed across studies, they can generally be attributed to obvious methodological differences, and a number of in vivo and in

[13] IRIS Assessment at 5-45.
[14] Johnson PD, Goldberg SJ, Mays MZ, Dawson BV. Threshold of trichloroethylene contamination in maternal drinking waters affecting fetal heart development in the rat. Environ Health Perspect. 2003 Mar;111(3):289-92. Erratum in: Environ Health Perspect. 2014 Apr;122(4):A94.
[15] IRIS Assessment at 4-565

vitro studies demonstrate a consistent and biologically plausible mode of action for one type of malformation observed."

IRIS also found that epidemiology studies provided evidence of TCE-related cardiac effects in humans:

"[T]wo well-conducted studies by ATSDR (2008b, 2006a) clearly demonstrated an elevation in cardiac defects. It could be surmised that the identified cardiac defects were detected because they were severe, and that additional cases with less severe cardiac anomalies may have gone undetected."[16]

Finally, IRIS cited mechanistic data from in vitro studies as further confirmation of human and animal data:[17]

"Thus, in summary, a number of studies have been conducted in an attempt to characterize the mode of action for TCE-induced cardiac defects. A major research focus has been on disruptions in cardiac valve formation, using avian in ovo and in vitro studies. These studies demonstrated treatment-related alterations in endothelial cushion development that could plausibly be associated with defects involving septal and valvular morphogenesis in rodents and chickens."

Summarizing its weight of evidence assessment, IRIS indicated that, "based on weakly suggestive, but overall consistent, epidemiologic data, in combination with evidence from experimental animal and mechanistic studies, it can be concluded that TCE exposure poses a potential hazard for congenital malformations, including cardiac defects, in offspring."[18]

The TCE IRIS assessment underwent several levels of peer review, including agency review, science consultation on the draft assessment with other federal agencies and the Executive Office of the President, public comment, external peer review by the EPA's Science Advisory Board (SAB) in 2002, scientific consultation by the U.S. National Academy of Sciences (NAS) in 2006,[19] external peer review of the revised draft assessment by the EPA's SAB in January 2011,[20] and final internal agency review and EPA-led science discussion on the final draft.

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[16] Id.
[17] Id. at 4-564
[18] Id. at 6-11
[19] NAS report, "Assessing the human health risks of trichloroethylene: Key scientific issues (2006)": http://www.nap.edu/catalog.php?record_id=11707.
[20] EPA's SAB peer review report for the 2009 EPA's Draft Assessment entitled "Toxicological Review of Trichloroethylene": http://yosemite.epa.gov/sab/sabproduct.nsf/c91996cd39a82f648525742400690127/B73D5D39A8F184BD85257817004A1988/$File/EPA-SAB-11-002-unsigned.pdf.

**2014 TSCA Workplan Assessment**. EPA's 2014 Workplan risk assessment likewise determined risks of acute TCE exposure based "on the most health protective endpoint (i.e., fetal cardiac malformations; Johnson et al., 2003) representing the most sensitive human population (i.e., adult women of child-bearing age and fetus > 16 yrs)."[21] These risks were of particular concern for acute exposure "based on U.S. EPA's policy that a single exposure of a chemical within a critical window of fetal development may produce adverse developmental effects." The assessment found that "TCE-induced fetal cardiac malformations are biologically plausible based on the weight of evidence analysis presented in the TCE IRIS assessment, which considered human and animal findings as well as mechanistic data."[22] Updating the IRIS review of the weight of evidence in light of additional information about the Johnson studies, EPA found that a "recent erratum (Johnson, 2014) and subsequent evaluation of the developmental toxicity data reaffirmed that the Johnson et al. studies are adequate to use in hazard identification and dose-response assessment" and that despite their limitations, "there is insufficient reason to dismiss their findings, especially when the findings are analyzed in combination with the remaining body of human, animal and mechanistic evidence."[23]

**2016 WOE Assessment.** In 2016, several EPA scientists published an updated weight of evidence (WOE) review of the available scientific literature on TCE-related developmental cardiac defects, reporting on the quality, strengths, and limitations of the available studies (Makris et al 2016).[24] Their updated review and assessment confirmed earlier EPA determinations that the weight of the evidence demonstrated the relationship between fetal heart defects and TCE exposure and that the Johnson studies, augmented by detailed additional information about study design and conduct, were sufficient for dose-response analysis and determinations of risk.

The authors conducted an in-depth examination of the Johnson study, which concluded that:

> "On the whole, the Johnson et al. study is considered suitable for use in deriving a POD for the following reasons. The study has an appropriate design. It was conducted by a relevant route of exposure (drinking water), covered the entire period of gestation which subsumes the developmental window for the initiation of cardiac defects, and tested multiple exposure levels."

Responding to criticisms of the Johnson and Dawson studies, the authors found that a "number of potential concerns associated with these studies were dispelled, e.g., that inadequate or inappropriate cardiac evaluation methods were used, control animals were not on study concurrently with treated

[21] Work Plan Assessment at 104.
[22] Id at 21.
[23] Id at 98.
[24] Makris SL, Scott CS, Fox J, Knudsen TB, Hotchkiss AK, Arzuaga X, Euling SY, Powers CM, Jinot J, Hogan KA, Abbott BD, Hunter ES 3rd, Narotsky MG. A systematic evaluation of the potential effects of trichloroethylene exposure on cardiac development. Reprod Toxicol. 2016 Oct;65:321-358. doi:10.1016/j.reprotox.2016.08.014. Review. PubMed PMID: 27575429.

animals, fetuses were not randomly assigned to evaluations, cardiac examinations were conducted with knowledge of treatment group, and statistical analysis of cardiac malformation data was inappropriate."

Based on a detailed methodological comparison of Johnson/Dawson and negative animal studies, Makris et al reached "the conclusion that differences in study methods (e.g., route of exposure, vehicle, animal source or strain, or other factors) may have contributed to differences in the detection of cardiac malformations."

Makris et al added that "further support [for relying on the Johnson study} was derived from the finding of a robust, statistically significant dose-response relationship." As they explained:

> "Confidence that data from Johnson et al. [51] represent a real response is supported by the increasing trend in response (Fig. 6),and the observations of higher percentages of cardiac malformations elicited by higher doses (500 mg/kg-day and higher) in studies of rats exposed to TCE metabolites, TCA and DCA [27,79,78]. The highest dose in the Johnson et al. [51] study lies at the lower end of doses that elicited substantial responses in these other studies. *Thus, a hypothesis that the Johnson data represent a false positive or an anomalous dose-response pattern seems implausible, based on trend tests and comparison with studies that used higher doses*" (emphasis added).

Makris et al also found that concerns about variability among litters were resolved in the method for data analysis:

> "The possibility of increased variability among litters due to temporal drift and perhaps other factors across time (overdispersion), was dealt with by using a standard method for clustered data. The dose-response trend was found to be highly significant after adjusting for overdispersion. Because the maximal observed response was 10%, models with plateaus of less than 100% were investigated and were found to not substantially change the general conclusions and results. Confidence in the dose-response relationship is supported by the increasing trend in response and by metabolite studies that demonstrate findings at higher dose levels."

Overall, like the IRIS and Work Plan assessments, the Makris et al review determined that, "[d]espite the recognized uncertainties and limitations in the TCE database, the evidence supports a conclusion that TCE has the potential to cause cardiac defects in humans when exposure occurs at sufficient doses during a sensitive period of fetal development. This conclusion is warranted by the data that demonstrate or suggest a potential hazard to cardiac development, including epidemiological studies, developmental toxicology studies in rodents with TCE and its metabolites (DCA and TCA), avian in ovo studies, in vitro assays, and mechanistic data that form the basis of a preliminary conceptual model of an AOP for valvulo-septal defects resulting from TCE exposures. "[25]

[25] An industry sponsored WOE review, Wikoff et al 2018, reached a different conclusion using a Risk Of Bias assessment for internal study validity but, as noted in the draft evaluation, this review focused only on animal and epidemiological data. TCE Risk Evaluation at 222.

### B. Despite White House Intervention, the Draft Evaluation Reaffirms the Weight of Evidence for TCE-Related Cardiac Defects

Even with the changes demanded by the White House, the draft TCE evaluation presents a strong case for the sufficiency of the evidence of TCE-related cardiac effects.

Both the body of the risk evaluation and Appendix G provide a detailed analysis of the weight of evidence for congenital heart defects. Based on scoring of all relevant studies and integration of data across lines of evidence, EPA summarized the database as follows:[26]

> "In summary, the database contains a large and diverse set of studies pertinent to assessing congenital heart defects from TCE exposure (overall relevance was rated as ++). Well-designed, conducted and reported studies were located for all categories, although the epidemiology studies were limited to ecological or case-control study designs with high potential for misclassification of exposure and many of the in vivo animal studies contained at least one major limitation (overall reliability rating of +/++). The integrated strength area score was (+), indicating a suggestive positive association of TCE with congenital cardiac defects. The epidemiology studies as a group provide suggestive evidence for an effect of TCE on cardiac defects in humans (summary score of +). Oral in vivo studies provided ambiguous to weakly positive (0/+) results for TCE itself, but positive results for its TCA and DCA metabolites (+), while inhalation studies contributed negative evidence (-). Mechanistic studies provided solid, consistent supporting information for effects of TCE and metabolites on cardiac development and precursor effects (summary score of ++)."

EPA then concluded that:[27]

> "Overall, the database is both reliable and relevant and provides positive overall evidence that TCE may produce cardiac defects in humans (based on positive evidence from epidemiology studies, mixed evidence from animal toxicity studies, and stronger positive evidence from mechanistic studies)."

As EPA indicated, "[t[he fetal cardiac defects reported in (Dawson et al., 1993) and (Johnson et al., 2003) were identified as the most sensitive endpoint within the developmental toxicity domain and across all of the health effects domains evaluated in the TCE IRIS assessment."[28] EPA noted that these studies were rated "medium" for data quality in its TSCA systematic review, which incorporated all available information on the two studies, including subsequent errata and communications to EPA. As EPA explained, "[w]hile the original publications had extensive data and methodology reporting issues, many of the data quality concerns from the original study were mitigated by the information provided in these updates. "[29]

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[26] Id at 620.
[27] Id at 621.
[28] Id. at 232.
[29] Id., at 232-3. According to the draft, these "updates provided the following information which was lacking in the initial publications:

Of the two studies, EPA "decided to utilize (Johnson et al., 2003) for dose-response analysis, which has increased statistical sensitivity from the additional two dose levels and allowed a nested design for BMD modeling analysis in order to account for litter effects."[30] Johnson was suitable for dose response assessment, according to EPA, because it "reported a statistically and biologically significant increase in the formation of heart defects at the 0.048 mg/kg-bw/day and higher dose levels (concentrations of 0, 0.00045, 0.048, kg-bw/day) measured on both an individual fetus basis and a litter basis."[31]

Using additional information reported by the study authors, EPA revaluated the BMR used in the 2014 risk assessment using biological and statistical factors, concluding that "the biological severity of the effect, potentially lethal heart defects, strongly supported a BMR of 1%." Compared to the 2014 assessment, EPA concluded that "the p- value of = 0.661 from the updated BMDS nested model run (Appendix N) is significantly improved, demonstrating strong model fit and confirming the 2011 conclusion that the modeling results for cardiac malformation data are appropriate for reference value derivation."[32]

### C. The HSIA Study Does Not Rebut the Johnson Study and In Fact Provides Additional Evidence of the Link between TCE Exposure and Fetal Heart Defects

Since EPA's 2011, 2014 and 2016 WOE reviews of the evidence for fetal heart defects, the only new information to become available is the 2019 HSIA-sponsored drinking water study of TCE's effects on fetal heart development in Sprague Dawley rats.[33] The stated purpose of this study was to replicate the fetal malformations observed in the Johnson and Dawson studies. The study authors reported that the study was negative. However, Appendix G of EPA's draft evaluation includes a detailed review of the HSIA study which concludes that, because of its severe limitations, the study did not negate the earlier findings of TCE-induced heart defects and thus did not warrant any change in the Agency's previous WOE determinations for this endpoint.

As EPA notes, the "Johnson study clearly shows greater incidences of cardiac defects at 0.25 ppm, 1.5 ppm, and 1100 ppm compared to the same or similar doses" in the HSIA study. However, "VSDs, and

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1) Individual fetal cardiac malformation data for each litter
2) Individual maternal terminal body weight data
3) Detailed description of fetal evaluation procedures including:
    - methods used to blind fetal examiners to treatment group
    - protocol for unanimous confirmation of any observed cardiac defects by the three principle investigators
4) Additional information on animal husbandry and randomized group assignment of dams to study group
5) Transparency regarding experimental variables across the dates of the experiments."

[30] Id. at 233.
[31] Id. at 237.
[32] Id. at 236-237.
[33] See note 11 supra.

specifically only membranous VSDs, were the only type of heart malformation identified" in the HSIA study, whereas "the Johnson study identified a broad variety of defects in exposed fetuses."[34] The explanation of this discrepancy, according to EPA, is that the HSIA study [was] insufficiently sensitive to non-VSD defects."[35] After conducting a detailed analysis of studies on other chemicals finding atrial and valve fetal heart defects (including RA, the positive control in the HSIA study), EPA found that:[36]

> "In the Johnson study, the materials and methods section described examination of the internal structure of the heart for all fetuses. The dissection methodology allows detailed examination of the atrial septum. In contrast, the [HSIA] study states that the fetal evaluation methods were conducted according to Stuckhardt and Poppe (1984), which does not include examination of atrial septal defects. *Therefore, the methodology used by the [HSIA] study was likely to miss this important category of cardiac malformations*."

EPA thus concluded that the HSIA study "insufficiently replicates the methodology of (Johnson et al., 2003), and the results do not entirely contradict the conclusions of that study."[37]

Even in its identification and analysis of VSDs, EPA found that the HSIA study was highly flawed. According to EPA, the HSIA study discounted the <1mm VSDs induced by TCE because "… similar to humans, small spontaneous interventricular septal defects in rats close postnatally and hence should not be considered adverse."[38] On this premise, the study authors claimed that "the interventricular septal defects observed in the TCE-treated groups were considered to be spontaneous background occurrences and unrelated to TCE exposure." However, EPA did not accept this characterization, emphasizing that "one cannot rule out the possibility that any VSD may be a potential adverse effect of chemical exposure." It added that "even if a membranous VSD is able to spontaneously close, there are likely functional impacts of that closer, resulting in an adverse health effect."[39]

EPA also found that HSIA's efforts to dismiss the increase in VSDs in treated animals as "spontaneous" and "unrelated to TCE exposure" was "confounding and internally inconsistent . . . because the vast majority (92%) of VSDs observed in the RA-treated positive control group were also <1mm." As EPA explained, '[i]f VSDs <1mm are truly non-adverse, then this positive control data provides additional indication that the study is insufficiently sensitive for detecting adverse cardiac defects."[40]

Equally important, the ventricular septal defects (VSDs) observed in treated animals showed a startling trend of increasing VSD with increasing dose and the VSD incidences at different dose levels were very close to those in the Johnson study. As EPA compared VSDs in the two studies:[41]

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[34] TCE Risk Evaluation at 601.
[35] Id. at 604.
[36] Id. at 607-608 (emphasis added).
[37] Id. at 222.
[38] Id. at 609.
[39] Id. at 610.
[40] Id.
[41] Id. at 222.

> "In fact, the [HSIA] study (2019) observed a similar percentage of VSDs as (Johnson et al., 2003). Considering total VSDs, 3.5% of fetuses showed a VSD in [HSIA] vs 3.8% in Johnson at the highest dose, with 1.5% in [HSIA] vs 2.2% in Johnson at 1.5ppm. When considering only membranous VSDs (the only type observed in the [HSIA] study), observed incidences were actually higher in [HSIA] at the highest dose (3.5% vs 2.86%)."

HSIA's convoluted efforts to establish that the dose-related VSD increases in its study were not statistically significant when compared to controls should receive little weight in assessing the study results. The unit of analysis in their statistical analysis is the litter, but with only 20 litters, the analysis is likely to be statistically underpowered. Typically, one would conduct statistical analyses using both the litter and the individual fetus, but this does not appear to have been done. In addition, the use of two-sided tests is inappropriate; such tests presume the treatment is like a pharmaceutical drug that could be either harmful or beneficial. Instead, HSIA and EPA should have used a one-sided test since the only possible test hypotheses are either no effect or adverse effects, not benefit (no one has seriously proposed that TCE causes any benefits for fetal development). Had HSIA used the more appropriate one-sided statistical test, it would have doubled the statistical power, and likely would have resulted in a study outcome showing statistically significant harmful effects of the treatment. Thus, analyzing the VSDs on an individual animal basis through the Cochran Armitage trend test, the one-sided p-value is 0.0196, which is highly significant. EPA should provide this analysis in Appendix G.

An additional important problem is the HSIA's use of historical control data for some endpoints but not others, with no real rationale provided. The seemingly arbitrary oscillation between using within-study and historical controls casts doubt on the rigor and consistency of the statistical analysis, making it appear instead to be manipulated and biased to dismiss evidence of harm.

Finally, as the EPA guidelines for carcinogenicity risk assessment advise,[42] observation of a dose-response trend may be sufficient to identify compound-related adverse effects in the absence of statistical significance, particularly when the adverse endpoint is permanent, serious, and possibly life-threatening. An important new paper published this month in Nature, one of the world's most prestigious and highly ranked scientific journals, signed by over 800 supporters, argues that over-reliance on statistical significance to deny or disregard an adverse effect is a misuse of statistics and puts the public health at risk:

> "Let's be clear about what must stop: we should never conclude there is 'no difference' or 'no association' just because a P value is larger than a threshold such as 0.05 or, equivalently, because a confidence interval includes zero. Neither should we conclude that two studies conflict because one had a statistically significant result and the other did not. These errors waste research efforts and misinform policy decisions" (Nature 2019).

[42] EPA, *Guidelines for Carcinogen Risk Assessment,* March 2005, https://www.epa.gov/sites/production/files/2013-09/documents/cancer_guidelines_final_3-25-05.pdf.

This recommendation is of particular relevance to the dose-related VSD increases seen in the HSIA study, which represent a permanent and potentially fatal effect that mirrored similar dose-related cardiac defects seen in the Johnson study.

In short, even with its flaws, the HSIA study provides evidence of a link between TCE exposure and fetal heart defects, adding to the overall weight of evidence for this endpoint.

### D. The White House-Imposed Rationale for Disregarding the Heart Defects Is Contrary to Sound Science and Accepted Policies and Principles of Risk Assessment

At the direction of the White House, the revised risk evaluation claims that "[w]hile congenital heart defects were the most sensitive endpoint for TCE, for the purpose of the draft risk determination, there are uncertainties which decrease EPA's confidence in this endpoint."[43] Nowhere, however, does EPA identify these "uncertainties" or describe why they "decrease confidence" in the heart defect endpoint.

EPA instead relies on general "scientific principles" required under TSCA that supposedly cast doubt on the finding of cardiac defects:

> "Section 26 of TSCA requires that EPA make decisions consistent with the "best available science." Section 26 also requires other scientific considerations including consideration of the "extent of independent verification" and "weight of the scientific evidence." As described in EPA's framework rule for risk evaluation [82 FR 33726] weight of the scientific evidence includes consideration of the "strengths, limitations and relevance of the information."

In fact, these are the very "principles" that EPA scientists used in evaluating the database on congenital heart effects. The Agency conducted an analysis of the "weight of the scientific evidence" (more detailed than for any other non-cancer endpoint) and examined the "strengths, limitations and relevance" of each study and the overall evidence. The EPA analysis demonstrated that the finding of TCE-related cardiac effects was not limited to animal studies but "independently verified" in epidemiology and mechanistic studies and that "the database is both reliable and relevant and provides positive overall evidence that TCE may produce cardiac defects in humans." The analysis thus conformed to the definition of "weight of the evidence" in EPA risk evaluation regulations, which calls for the Agency to "comprehensively, objectively, transparently, and consistently, identify and evaluate each stream of evidence, including strengths, limitations, and relevance of each study and to integrate evidence as necessary and appropriate based upon strengths, limitations, and relevance." 40 CFR §702.33

Nowhere did the EPA WOE analysis express a lack of "confidence" in the heart defect data. In fact, in multiple assessments, it found that the data as a whole provide a strong basis for determining unreasonable risk.

[43] TCE Risk Evaluation, at 377.

EPA's analysis also incorporated the "best available science" as defined in its regulations. Id. The WOE assessment for TCE relied on data "that is reliable and unbiased" and derived from "studies conducted in accordance with sound and objective science practices." For example, the key study, Johnson et al, that EPA used for dose-response analysis was screened for data quality using EPA's TSCA systematic review protocol and scored as "medium" and therefore acceptable for inclusion in the risk evaluation. It also was ranked ++ for strength in EPA's more detailed weight of evidence analysis, in contrast to the HSIA study, which was ranked as 0/- for this metric.

EPA scientists have now reached the same conclusions in four separate WOE assessments over the last nine years and these conclusions have been reviewed both by the EPA Science Advisory Board and the National Academy of Sciences. For the White House to disavow a decade of scientific work on the basis of nebulous "uncertainties" is the exact opposite of the "best available science" that EPA is obligated to use under TSCA.

To justify disregarding the cardiac malformations, the White House directed EPA to apply the novel approach of selecting a single "representative endpoint" to determine unreasonable risk and then ignoring more sensitive endpoints that present greater risks. Applying this concept, EPA chose immunotoxicity over heart defects as its "representative endpoint" for TCE.[44] This approach is without precedent in previous EPA risk evaluations under TSCA or other laws and is contrary to sound public health protection policy. As many examples demonstrate, risk assessors and risk managers have always based determinations of risk and related exposure limits on the most sensitive endpoint for which there is sufficient scientific evidence.[45] This ensures that at risk populations receive adequate protection from adverse effects. Otherwise, exposure limits will be too high to prevent harm and unreasonable risks will remain unaddressed.

These are particularly important considerations for congenital heart defects. As EPA underscored in its 2016 proposal to ban TCE use in aerosol degreasing, "TCE may cause fetal cardiac malformations that begin in utero. In addition, fetal death, possibly resulting from cardiac malformation, can be caused by exposure to TCE. Cardiac malformations can be irreversible and impact a person's health for a lifetime."[46] EPA elaborated that:[47]

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[44] TCE risk evaluation, at 257

[45] For example, the EPA risk assessment guidelines for developmental toxicity state that "[t]he most sensitive developmental effect (i.e., the critical effect) from the most appropriate and/or sensitive mammalian species is used for determining the NOAEL, LOAEL, or the benchmark dose**."** EPA, *Guidelines for Developmental Toxicity Risk Assessment*, December 1991, at 42, https://www.epa.gov/sites/production/files/2014-11/documents/dev_tox.pdf. *See also EPA Risk Assessment Task Force, Staff Paper on Risk Assessment Principles and Practices (pp. 57-58); EPA, A Review of the Reference Dose and Reference Concentration Processes (p. 4-22); Policy on Evaluating Risk to Children (p. 1).* The National Academy of Sciences (NAS) has also reiterated the need to protect the most sensitive subpopulations and to protect against the most sensitive endpoints in *NAS, Science and Decisions: Advancing Risk Assessment (p. 120) and NAS, Science and Judgment (pp. 142, 145)*

[46] 81 Fed. Reg. 91612

[47] 81 Fed. Reg. 91613

> "Cardiac defects, which can result from very low level exposure to TCE, affect the structural development of a baby's heart and how it works. The defects impact how blood flows through the heart and out to the rest of the body. The impact can be mild (such as a small hole in the heart) or severe (such as missing or poorly formed septal wall and valves of the heart). While diagnosis for some cardiac defects can occur during pregnancy, for other cardiac defects, detection may not occur until after birth or later in life, during childhood or adulthood. These cardiac defects can be occult or life- threatening with the most severe cases causing early mortality and morbidity."

The occurrence of cardiac defects in the population of newborns is significant. According to the 2016 proposal:[48]

> "Nearly 1% or about 40,000 births per year in the United States are affected by cardiac defects (Ref. 46). About 25% of those infants with a cardiac defect have a critical defect. Infants with critical cardiac defects generally need surgery or other procedures in their first year of life. Some estimates put the total number of individuals (infants, children, adolescents, and adults) living with cardiac defects at 2 million."

EPA is simply wrong that its "representative endpoint" of immune effects "would address other identified risks."[49] The Agency's dose response analysis for the four acute endpoints it assessed is as follows:[50]

[48] Id.
[49] TCE Risk Evaluation at 377.
[50] Id at 252.

2030 **Table 3-7: Dose-response analysis of selected studies considered for acute exposure scenarios**

| Target Organ/ System | Species | Duration | POD Type [1] (applied dose) | Effect | Dose Metric | $HEC_{50}$ (ppm) | $HEC_{99}$ (ppm) | $HED_{50}$ (mg/kg) | $HED_{99}$ (mg/kg) | Uncertainty Factors (UFs) [2] | Reference | Data Quality [3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Develop-mental Effects | Rat (female) | Gestational days 6 to 15 | $BMDL_{01}$= 32.2 mg/kg-bw/day | Increased resorptions | TotMetab BW34 | 57 | 23 | 29 | 28 | $UF_S$=1; $UF_A$= 3; $UF_H$=3; $UF_L$=1; Total UF=10 | (Narotsky et al., 1995) | High (1.3) |
| | Rat (female) | 22 days throughout gestation (gestational days 0 to 22) | $BMDL_{01}$ = 0.0207 mg/kg-bw/day | Congenital heart defects | TotOx Metab BW34 | 0.012 | 0.0037 | 0.0058 | 0.0052 | $UF_S$=1; $UF_A$= 3; $UF_H$=3; $UF_L$=1; Total UF=10 | (Johnson et al., 2003) | Medium (1.9) |
| | Rat (male pups) | Postnatal days 10 to 16 | LOAEL = 50 mg/kg-bw/day | Decreased rearing activity | TotMetab BW34 | 8 | 3 | 4.2 | 4.1 | $UF_S$=1; $UF_A$= 3; $UF_H$=3; $UF_L$=10; Total UF=100 | (Fredriksson et al., 1993) | Medium (1.7) |
| Immune System | Rat (female) | 3hr/day, single dose; followed by respiratory infection | $BMDL_{01}$ = 13.9 ppm | Immuno-suppression | N/A[4] | N/A[4] | 1.74[4] | N/A[4] | 2.74[4,5] | $UF_S$=1; $UF_A$= 3; $UF_H$=10; $UF_L$=1; *Total UF=30* | (Selgrade and Gilmour, 2010) | High (1.6) |

[1] POD type can be NOAEL, LOAEL, or BMDL. EPA adjusted all values to continuous exposure.
[2] $UF_S$=subchronic to chronic UF; $UF_A$=interspecies UF; $UF_H$=intraspecies UF; $UF_L$=LOAEL to NOAEL UF.
[3] See [*Data Quality Evaluation of Human Health Hazard Studies. Docket: EPA-HQ-OPPT-2019-0500]* for full evaluation by metric.
[4] Data from Selgrade and Gilmour, 2010) was not subject to PBPK modeling due to uncertainty concerning the most appropriate dose metric. The BMDL value adjusted for a 24hr exposure will be used as the POD for occupational risk estimates, while the 3hr value will be used for consumer risk estimates. This value is presented in the $HEC_{99}$ column but does not represent any particular percentile since it was not PBPK-modeled.
[5] A dermal HED was obtained through route-to-route extrapolation using breathing rate and body weight data on male CD-1 mice (insufficient female data was reasonably available) from (U.S. EPA, 1988) and allometric scaling based on (U.S. EPA, 2011d) using a dosimetric adjustment factor of 0.14 for mice.

Thus, the acute $HEC_{99}$ for immune system effects is *470 times higher* than the acute $HEC_{99}$ for heart malformations. This significant disparity translates into large differences in the acute MOEs for the two endpoints. For example, EPA calculated acute inhalation MOEs (high-end exposure/no PPE) for workers in batch open top vapor degreasing operations of .000014 for heart defects but 0.67 for immune effects.[51] Both MOEs are far below the benchmark MOEs for these endpoints but the MOE for heart defects is over two orders of magnitude below the MOE for immune effects.[52]

Accordingly, the large number of pregnant women exposed to TCE would be unprotected from fetal heart defects in their offspring by an exposure limit based only on immunotoxicity. This outcome would be directly contrary to EPA's obligation in section 6(b)(4)(A) of TSCA to determine whether TCE "presents an unreasonable risk to a potentially exposed or susceptible subpopulation."[53] Section 3(12) of TSCA states explicitly that such populations include "infants, children [and] pregnant women" yet EPA's approach would deny them the special protection that TSCA requires.

### E. The White House-Dictated Comparison of the Relative Strength of the Evidence for Heart Defects and Immune Effects Is Misleading and Contrary to the Evaluation as a Whole

[51] Id. at 545.
[52] For chronic risks, the differences in the MOEs for the two endpoints are less dramatic but the MOE for heart defects is still generally an order of magnitude lower than the MOE for immune effects. Thus, the $HEC_{99}$ for chronic autoimmunity was 0.033 ppm as compared to 0.0037 ppm for heart malformations. Id. at 253.
[53] Once EPA identifies an unreasonable risk to a potentially exposed or susceptible subpopulation, EPA must take regulatory action under section 6(a) of TSCA "necessary so that the chemical no longer presents such risk."

While TCE's immune effects are serious and should be included in the TCE evaluation, the claim (apparently added to the evaluation at White House direction) that the data supporting them are significantly more "certain" than the evidence of heart defects is incorrect and based on a selective and misleading comparison of the WOE for the two endpoints.

According to EPA, "the POD for mortality due to immunosuppression from (Selgrade and Gilmour, 2010) is considered to be the most robust and best representative POD for acute non- cancer scenarios."[54] EPA claims that:

> "Considerations for selection of this study and the High confidence rating include the following:
> 1) The study scored a High in data quality evaluation
> 2) The study used a broad dose range, with several concentrations above and below the LOAEL
> 3) The response data followed a consistent dose-response curve
> 4) The data is based on an acute exposure study so there is no uncertainty resulting from extrapolating from a repeated-dose study
> 5) The study demonstrated multiple assays supporting the apical outcome
> 6) The endpoint is severe"

However, several of these factors also apply to the heart defect database. Heart malformations are an extremely "severe" effect; the Johnson study used a "broad dose range"; the "dose response curve" in Johnson was clear and consistent; and while Johnson was a repeated dose study, EPA's longstanding policy is that a single exposure to a chemical within a critical window of fetal development can cause adverse effects.[55] Finally, the slightly different quality scores of the two studies – "medium" for Johnson and "high" for Selgrade and Gilmour (2010) – are unimportant compared to their strength in demonstrating adverse effects and the overall WOE supporting their findings.

Moreover, uncertainty factors (UF) for immune effects in the IRIS assessment and draft risk evaluation were actually *higher* than for the fetal heart malformations. In the TSCA evaluation, the UF for fetal heart defects based on Johnson et al was 10. However, for acute immunosuppression effects based on Selgrade, the UF was 30 "because the data was not subject to PBPK modeling and therefore a HEC99/HED99 value was not applied which would have accounted for human toxicokinetic variability."[56]

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[54] TCE Risk Evaluation, at 257.

[55] Thus, the EPA risk assessment guidelines for developmental toxicity state (at 38) that. "for developmental toxic effects, a primary assumption is that a single exposure at a critical time in development may produce an adverse developmental effect, i.e., repeated exposure is not a necessary prerequisite for developmental toxicity to be manifested. In most cases, however, the data available for developmental toxicity risk assessment are from studies using exposures over several days of development, and the NOAEL, LOAEL, and/or benchmark dose is most often based on a daily dose, e.g., mg/kg-day. Usually, the daily dose is not adjusted for duration of exposure because appropriate pharmacokinetic data are not available."

[56] Id. at 239. EPA also assigned a UF or 30 to the Keil et al study it relied on to determine the POD for chronic autoimmune effects (id at 245), lower than the IRIS UF of 100 but higher than the UF of 10 for the Johnson study. In light of these higher UFs, EPA's claim that it has greater confidence in in Keil et al because of reduced uncertainty (id. at 257) is not credible.

IRIS also pointed to "notable uncertainty in the [BMR] modeling" for immune effects. [57] EPA expressed similar concerns about the Selgrade study in its draft evaluation, observing that a "reliable BMDL could not be obtained from the percentage infected data because BMDs and BMDLs from all models were well below the lowest data point and cannot be considered reliable."[58]

The draft evaluation underscores that the EPA scientists had *high confidence* in *all* the endpoints selected as PODs for calculating MOEs: [59]

> *"There is high confidence in the database for human health hazard*. All studies considered for dose-response analysis scored either Medium or High in data quality evaluation and were determined to be highly relevant to the pertinent health outcome. EPA selected the best representative study for each identified endpoint from among a broad selection of studies, taking into account factors such as data quality evaluation score, species, exposure duration, dose range, cumulative uncertainty factor, and relevance."

These descriptions of the human health database are directly at odds with eleventh hour White House efforts to pick one "representative endpoint" and exclude others that are more sensitive. Since EPA scientists rejected any differentiation between the endpoints it chose as PODs and had "high confidence" in all of them, it is indefensible for the White House to now force EPA to conclude that the immune effects data provide sufficient "certainty" for a determination of unreasonable risk but the heart defect data do not.

**In sum, to employ the best available sciences, as TSCA requires, EPA should revise the draft risk evaluation to use the heart defect data for addressing TCE's acute and chronic risks to human health and, as the most sensitive endpoint, the key driver for determining whether TCE presents an unreasonable risk of injury under TSCA.**

## II. The Draft Evaluation Ignores Significant Environmental Releases of TCE That Present Serious Health Risks

Like previous evaluations, the EPA draft lacks any assessment of risks to the general population from TCE's presence in air, water and soil. Few chemicals are as ubiquitous in the environment as TCE and, because of its many adverse health effects, its widespread distribution presents a significant threat to communities across the US. EPA's failure to account for the conditions of use that result in environmental pathways of exposure is a major shortcoming of its draft evaluation and results in a dramatic underestimate of the exposed population and the level of risk it faces in violation of TSCA and EPA's regulations.

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[57] IRIS Assessment at 5-22

[58] TCE Risk Evaluation at 238.

[59] Id at 254 (emphasis added). EPA also emphasized that "[t]here is high overall confidence in the database, weight of evidence, and dose-response for chronic non- cancer endpoints" and that "there is strong WOE in support of all health effects." Id. at 257.

As in other evaluations, EPA declined to address environmental releases of TCE because it contends that "those exposure pathways are covered under the jurisdiction of other environmental statutes, administered by EPA, which adequately assess and effectively manage exposures, i.e., CAA, SDWA, CWA, and RCRA."[60] This exclusion defeats the central TSCA goal of providing a comprehensive picture of a chemical's risks to humans and the environment. Congress directed EPA to conduct risk evaluations that take into account all conditions of use (a mandate that EPA adopted in its regulations), reflecting congressional intent that EPA examine the combined impact of all sources and pathways of exposure on affected populations, and provided no exemption for environmental releases that might be subject to other environmental laws. Moreover, as widespread TCE contamination illustrates, other laws are not adequately addressing the contribution of air, soil and drinking water to total risk. If these pathways are ignored under TSCA, the result will likely be an incomplete understanding of TCE's risks and inadequate protection of health and the environment in violation of TSCA.

### A. TSCA Requires Risk Evaluations to Address All Pathways of Exposure

Risk evaluations under section 6(b)(4)(A) must determine "whether a chemical substance presents an unreasonable risk of injury to health or the environment" This requirement cannot be met without examining all sources of exposure that contribute to health and environmental risk. Section 6(b)(4)(A) provides that a risk evaluation must determine the substance's risks under "the conditions of use." This broad term spans the entire life cycle of a chemical and is defined under section 3(4) to mean "the circumstances . . . under which a chemical substance is intended, known or reasonably foreseen to be manufactured, processed, distributed in commerce, used or disposed of." Moreover, TSCA section 6(a) requires EPA to take into account "any combination of such activities." These "circumstances" clearly include environmental releases that result in pathways of human exposure, whether or not they might be controlled under other environmental laws.

If Congress had intended a blanket exemption for environmental releases from risk evaluations under section 6(b), it surely would have said so explicitly. But not only is there no such exemption in the law, but its legislative history and structure demonstrate that Congress intended TSCA to provide a comprehensive framework for identifying and managing chemical risks, including those that derive from environmental exposure pathways that are subject to other environmental laws.

When it enacted TSCA in 1976, Congress recognized that then-existing environmental laws were "clearly inadequate" to address the "serious risks of harm" to public health from toxic chemicals. H.R. Rep. No. 94-1341, at 7 (1976); see S. Rep. No. 94-698, at 3 ("[W]e have become literally surrounded by a manmade chemical environment. … [T]oo frequently, we have discovered that certain of these chemicals present lethal health and environmental dangers."). While other federal environmental laws focused on specific media, such as air or water, none gave EPA authority to "look comprehensively" at the hazards of a chemical "in total." S. Rep. No. 94-698, at 2. Congress designed TSCA to fill these

[60] TCE Risk Evaluation at 34.

"regulatory gaps," S. Rep. No. 94-698, at 1, through a comprehensive approach to chemical risk management that considered "the full extent of human or environmental exposure," H.R. Rep. No. 94-1341, at 6.

In amending TSCA in 2016, Congress sought to promote "effective implementation" of the 1976 law's objectives. See S. Rep. No. 114-67, 114th Cong., 1st Sess. (2015) at 2. Thus, it affirmed that the intent of the original law—to give EPA "authority to look at the hazards [of chemicals] in total," S. Rep. No. 94-698, at 2—remained "intact." S. Rep. No. 114-67, at 7. Indeed, in a statement accompanying the law's passage, its Senate Democratic sponsors underscored that, with the expanded authorities conferred by Congress, TSCA should not be "construed as a 'gap filler' statutory authority of last resort" but "as the primary statute for the regulation of toxic substances."[61] Excluding from risk evaluations all pathways of chemical exposure through air, water and soil would be directly contrary to these Congressional expectations.

EPA's position that other environmental laws should displace TSCA risk evaluations for *all* chemicals arbitrarily assumes that these laws provide equivalent protection of public health and the environment and that there is no added benefit in addressing environmental pathways of exposure under TSCA. But in reality, these other laws vary greatly in the degree of protection they afford against chemical risks and the extent of their application to unsafe chemicals. In many cases, other laws do not regulate the entire universe of polluting sources. They may also impose controls based not on of risk but on other considerations like cost or available technology. Moreover, the Clean Air Act (CAA), Safe Drinking Water Act (SDWA), Clean Water Act (CWA) and Resource Conservation and Recovery Act (RCRA) are specific to individual media; they do not contemplate or authorize an examination of exposure and risk across media, a responsibility that Congress only conferred on EPA under TSCA. In addition, other EPA authorities are struggling with their workloads and resources and may simply lack the bandwidth to tackle serious chemical risks that do not represent immediate priorities. These limitations are precisely why Congress gave EPA comprehensive authority over chemical risks under TSCA in 1976 and strengthened that authority in 2016.

In the 1976 law, Congress recognized the need to coordinate use of TSCA with implementation of other environmental laws. However, it chose to do so *not* by excluding environmental releases from the purview of TSCA – the approach EPA is arbitrarily pursuing now. Instead, it established a framework for determining, on a case-by-case basis, whether the risks of particular chemicals are best addressed under these laws or under TSCA. Thus, section 9(b)(1) of TSCA provides that EPA may use TSCA regulatory authorities if it "determines, in [its] discretion, that it is in the public interest to protect against [a particular] risk by action taken under this Act" but should use other environmental laws if it determines that "a risk to health or the environment . . . could be reduced to a sufficient extent by actions taken under" these laws.

In 2016, Congress underscored the chemical-specific focus of this analysis by revising section 9(b)(2) so that, in deciding whether to regulate under TSCA or another law, EPA must "consider . . . all relevant aspects of the risk" in question and make a "comparison of the estimated costs and efficiencies" of

[61] Congressional Record – Senate 3517 (June 7, 2016).

addressing the risk under TSCA and other laws. Commenting on this language, the law's Senate Democratic sponsors explained that it allowed EPA to regulate under other laws in lieu of TSCA only where the "Administrator has already determined that a risk to health or the environment associated with a chemical substance or mixture could be eliminated or reduced to a sufficient extent by additional actions taken under other EPA authorities."[62]

This approach presupposes that EPA has already used the TSCA risk evaluation process to identify the risks of a chemical and the exposure pathways contributing to those risks and thus has an informed basis to determine whether they "could be eliminated or reduced to a sufficient extent" under another law. However, If EPA has not examined the specific pathways of environmental exposure and their contribution to total risk under TSCA, then it cannot conduct the analysis that section 9(b) requires because it will be unable to evaluate the relative strengths of using TSCA or another law to eliminate the risk. By presuming that other laws are *always* superior to TSCA in identifying and reducing the risks of chemicals in environmental media, EPA's blanket exclusion of environmental releases thus turns section 9(b) on its head.

### B. SAAC Reports Strongly Recommend that EPA Address Environmental Pathways of Exposure

The SACC has repeatedly raised concerns about EPA's failure to consider environmental pathways of human exposure. In its review of the 1,4-dioxane draft risk evaluation, for example, the SACC said:[63]

> "Exposure scenarios that include consumers are important given the known presence of 1,4-Dioxane in plastics, other commercially available products, surface water, drinking water, groundwater, and in sediments. The Committee also had concerns that the omission of these multiple routes of exposure puts workers who inhale or ingest 1,4-Dioxane outside the workplace at even greater risk."

The SACC added that:[64]

> "The Committee discussed that if each program office of the EPA says others are assessing the risks and thus not including them in their assessment, the U.S. public will be left with no overall IRIS assessment of risks. If risks have been assessed by other program offices of EPA then the Agency should present them as part of the underlying data to support this TSCA Evaluation—if not, the Agency must gather the data for an assessment or include an assessment based on the assumption of near-worst-case exposures."

The SACC underscored that "[g]eneral human population and biota exposure must be assessed for inhalation, ingestion, and dermal routes [and that] [d]ifferent sub-populations may have different

[62] Congressional Record – Senate 3517 (June 7, 2016).
[63] 1,4-Dioxane and HBCD SACC Report, at 18.
[64] Id.

extents of exposure, but each route must be assessed."[65] EPA's narrower approach, it said, "strayed from basic risk assessment principles by omitting well known exposure routes such as water consumption by all occupationally and non-occupationally-exposed humans as well as similar exposures to other biological receptors."[66]

The SACC review of the 1-BP draft risk evaluation similarly took EPA to task for failing to consider air emissions and other environmental releases: [67]

> "The lack of consideration for general population exposures excludes a vast extent of the US population (workers, consumers, school children, and other populations) who are exposed to 1-BP, perhaps on a daily basis. The lack of consideration of the general population exposure is concerning given the strong evidence of widespread exposure to a chemical that may be 1-BP based (from biomonitoring data)."

The SACC report for the methylene chloride evaluation raised similar concerns:[68]

> "Several Committee members expressed concern that large quantities of methylene chloride are volatilized to ambient air from diverse and disperse uses and that there is no COU that provides a basis for setting any limit on these emissions. While EPA asserts that the Clean Air Act (CAA) can be used to control these emissions, Committee members thought the CAA would address only a fraction of total emissions, i.e. only from Major Sources as defined by the 1990 CAA Amendments."

The Report added that:[69]

> "Concern was expressed that many of the methylene chloride releases to the environment are unaccounted for, and the Committee recommended EPA consider using a mass-balance approach to match amount manufactured/imported with amounts used in products, recycled or disposed, and released to the environment. . . . Discharges to air, ground water, soils and sediments are not considered."

The SACC expressed concern that "readers of this Evaluation receive a partial picture of risks, finding for example, that recycling and proper disposal present the only environmental hazards under TSCA" and that "this incomplete picture of risks may be used to promote improper releases and disposal of methylene chloride."[70] The SACC's concerns are based on its expert assessment of the "best available science," which EPA is required to employ in its risk evaluations.

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[65] Id.
[66] Id.
[67] SACC 1-BP Report at 17.
[68] SACC Methylene Chloride Report at 75.
[69] Id at 15.
[70] Id.

For TCE, like several other chemicals EPA is evaluating, the exclusion of environmental release pathways is not merely a theoretical concern. There is considerable evidence of TCE's ubiquitous presence in air, soil and drinking water at levels that likely harm human health and contribute to ozone depletion and climate change.

### C. Air Emissions of TCE Are Substantial and Are Harmful to Human Health

Like other halogenated solvents, TCE is highly volatile at ambient temperatures and, according to ATSDR, most of the TCE "used in the United States is released into the atmosphere by evaporation."[71] Toxic Release Inventory (TRI) reporting indicates that 1,886,809 pounds (855.8 metric tons) of TCE were released to the atmosphere from 154 domestic manufacturing and processing facilities in 2017.[72] Moreover, this significantly understates total TCE emissions as TRI requirements apply to a narrow subset of facilities that release chemicals to the environment. The 2011 EPA National Emission Inventory (NEI) estimated US TCE emissions of 3,250 tons – or 7,150,000 pounds.[73]

TCE has been detected in the air throughout the United States. Atmospheric levels are highest in areas concentrated with industry and population, and lower in remote and rural regions.[74] According to IRIS, "[t]he most recent data (2006) come from 258 monitors located in 37 states. The means for these monitors range from 0.03 to 7.73 µg/m$^3$ and have an overall average of 0.23 µg/m$^3$."[75] As IRIS has summarized the data:

**Table 2-6. TCE ambient air monitoring data (µg/m$^3$)**

| Yr | Number of monitors | Number of states | Mean | Standard deviation | Median | Range |
|---|---|---|---|---|---|---|
| 1999 | 162 | 20 | 0.30 | 0.53 | 0.16 | 0.01–4.38 |
| 2000 | 187 | 28 | 0.34 | 0.75 | 0.16 | 0.01–7.39 |
| 2001 | 204 | 31 | 0.25 | 0.92 | 0.13 | 0.01–12.90 |
| 2002 | 259 | 41 | 0.37 | 1.26 | 0.13 | 0.01–18.44 |
| 2003 | 248 | 41 | 0.35 | 0.64 | 0.16 | 0.02–6.92 |
| 2004 | 256 | 37 | 0.32 | 0.75 | 0.13 | 0.00–5.78 |
| 2005 | 313 | 38 | 0.43 | 1.05 | 0.14 | 0.00–6.64 |
| 2006 | 258 | 37 | 0.23 | 0.55 | 0.13 | 0.03–7.73 |

[71] ATSDR, *Toxicological Profile for Trichloroethylene* June 2019 (ToxProfile) at 305, file:///C:/Users/Owner/Downloads/ATSDR%20TCE.pdf.
[72] Id at 307.
[73] EPA, Technology transfer network. Clearinghouse for lower in remote and rural regions. Inventories & emissions factors. National Emissions Inventory (NEI) air pollutant emissions trends data. U.S. Environmental Protection Agency. http://www3.epa.gov/ttnchie1/trends/. December 7, 2015.
[74] IRIS Assessment at 2-6/2-7.
[75] Id at 2.8.

**Source: EPA's Air Quality System database at the AirData Web site: http://www.epa.gov/air/data/index.html.**

**Table 2-7. Mean TCE air levels across monitors by land setting and use (1985–1998)**

| | Rural | Suburban | Urban | Agricultural | Commercial | Forest | Indus-trial | Mobile | Residential |
|---|---|---|---|---|---|---|---|---|---|
| Mean concentration ($\mu g/m^3$) | 0.42 | 1.26 | 1.61 | 1.08 | 1.84 | 0.1 | 1.54 | 1.5 | 0.89 |
| *N* | 93 | 500 | 558 | 31 | 430 | 17 | 186 | 39 | 450 |

Source: EPA's Air Quality System database at the AirData Web site: http://www.epa.gov/air/data/index.html.

These ambient levels are of health concern based on EPA's assessment of TCE's health effects. For example, IRIS has determined the following cancer risk levels (70 year lifetime exposure) for different TCE ambient air concentrations:[76]

| | |
|---|---|
| E-4 (1 in 10,000) | 20 $\mu g/m^3$ |
| E-5 (1 in 100,000) | 2 $\mu g/m^3$ |
| E-6 (1 in 1,000,000) | 0.2 $\mu g/m^3$ |

Thus, mean TCE levels in ambient air for all locations except forests would present lifetime cancer risks above 1 in 1 million, EPA's benchmark for determining unreasonable cancer risks for non-worker population. Risks for higher levels within the range measured would exceed 1 in 100,000.

Similarly, mean ambient air levels in most locations (which range between 0.89 and 1.6.ug/$m^3$) would be very close to the IRIS non-cancer RfC of 0.0004 ppm (0.4 ppb or 2 $\mu g/m^3$), which IRIS describes as having "robust support [from] . . . estimates for multiple effects from multiple studies."[77] For individuals exposed to ambient TCE levels near the higher end of the reported range, the RfC would be exceeded.

**Thus, large segments of the US population are likely exposed to TCE levels in air that present unreasonable risks of cancer and non-cancer effects. It violates TSCA for EPA to ignore this risk in its draft TSCA risk evaluation.**

### D. Indoor Air Levels of TCE are Significantly Greater than Ambient Levels and Pose Greater Risks

[76] IRIS Chemical Assessment Summary for TCE (IRIS Summary) at 44, https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0199_summary.pdf#nameddest=rfd.

[77] IRIS Assessment at 5-97. The IRIS RfC is similarly to the risk determination methodology EPA's draft evaluation uses for fetal heart defects. The chronic $HED_{99}$ for these effects is 0.0037 ppm which, when reduced to reflect EPA's UF of 10, would result in a concentration very close to the RfD. TCE Risk Evaluation at 280

According to IRIS, "TCE can be released to indoor air from use of consumer products that contain it (i.e., adhesives and tapes), vapor intrusion (migration of volatile chemicals from the subsurface into overlying buildings) and volatilization from the water supply."[78] Consistently, measured indoor levels have been shown to be higher than outdoor levels. IRIS summarizes a number of key studies as follows:[79]

- The 1987 EPA Total Exposure Assessment Methodology study (Wallace, 1987) showed that the ratio of indoor to outdoor TCE concentrations for residences in Greensboro, NC, was about 5:1.
- In two homes using well water with TCE levels averaging 22–128 µg/L, the TCE levels in bathroom air ranged from <500–40,000 µg/m$^3$ when the shower ran <30 minutes (Andelman, 1985).
- Shah and Singh (1988) report an average indoor level of 7.2 µg/m$^3$ based on over 2,000 measurements made in residences and workplaces during 1981−1984 from various locations across the United States.
- Hers et al. (2001) provides a summary of indoor air TCE measurements at locations in United States, Canada, and Europe with a range of <1–165 µg/m$^3$.
- Sapkota et al. (2005) measured TCE levels inside and outside of the Baltimore Harbor Tunnel toll booths during the summer of 2001. Mean TCE levels were 3.11 µg/m$^3$ indoors and 0.08 µg/m$^3$ outdoors based on measurements on 7 days. The authors speculated that indoor sources, possibly dry cleaning residues on uniforms, were the primary source of the indoor TCE.
- Sexton et al. (2005) measured TCE levels inside and outside residences in Minneapolis/St. Paul metropolitan area. Two day samples were collected over three seasons in 1999. Mean TCE levels were 0.5 µg/m$^3$ indoors (*n* = 292), 0.2 µg/m$^3$ outdoors (*n* = 132) and 1.0 µg/m$^3$ based on personal sampling (*n* = 288).
- Zhu et al. (2005) measured TCE levels inside and outside of residences in Ottawa, Canada. Seventy-five homes were randomly selected and measurements were made during the winter of 2002/2003. TCE was above detection limits in the indoor air of 33% of the residences and in the outdoor air of 19% of the residences. The mean levels were 0.06 µg/m$^3$ indoors and 0.08 µg/m$^3$ outdoors. Given the high frequency of nondetects, a more meaningful comparison can be made on basis of the 75$^{th}$ percentiles:0.08 µg/m$^3$ indoors and 0.01 µg/m$^3$ outdoors.

These reported levels would in most cases exceed a 1 in 1 million cancer risk and, at the higher end of the reported range, would exceed the IRIS RfC as well.

The contribution to TCE indoor levels of volatilization of contaminated drinking water is well-documented. According to ATSDR, "In two homes (using well water containing the relatively high level of 40,000 ppb trichloroethylene), a running shower was found to elevate trichloroethylene levels in bathroom air from <0.5 to 81 mg/m3 (93–15,072 ppb) in <30 minutes (Andelman 1985a)."[80] ATSDR also reports that "[t]he transfer of trichloroethylene from shower water to air in one study had a mean

[78] IRIS Assessment at 2-10.
[79] Id.
[80] ToxProfile at 335.

efficiency of 61%, which was independent of water temperature (McKone and Knezovich 1991) [and] the study authors concluded that showering for 10 minutes in water contaminated with trichloroethylene could result in a daily exposure by inhalation comparable to that expected by drinking contaminated tap water."[81]

**Although the draft risk evaluation examines exposure levels for specific TCE-containing consumer products, it does not look more broadly at indoor TCE air concentrations to which consumers are exposed, and as a result, overlooks the combined contributions to exposure of product use and other indoor exposure pathways like volatilization of TCE from contaminated water and intrusion of TCE vapors from contaminated soil and groundwater. Thus, it underestimates TCE risks in the indoor environment. Equally important, EPA's risk evaluation assumes that consumers only have acute exposure to TCE. However, the evidence of ongoing TCE concentrations in indoor air indicates that chronic exposure is also occurring and therefore consumers are at risk for cancer and other chronic health effects that EPA fails to address. TSCA requires EPA to consider this risk.**

### E. TCE Is Pervasive in Surface Water, Groundwater and Drinking Water at Levels of Health Concern

IRIS describes the presence of TCE in surface water as follows:[82]

> "According to IARC (1995a), the reported median concentrations of TCE in 1983−1984 were 0.5 µg/L in industrial effluents and 0.1 µg/L in ambient water. Results from an analysis of the EPA STORET Data Base (1980−1982) showed that TCE was detected in 28% of 9,295 surface water reporting stations nationwide (ATSDR, 1997c). A more recent search of the STORET database for TCE measurements nationwide during 2008 in streams, rivers and lakes indicated three detects (0.03–0.04 µg/L) out of 150 samples (STORET Database,http://www.epa.gov/storet/dbtop.html)."

According to ATSDR, "[a] summary of U.S. groundwater analyses from both federal and state studies reported that trichloroethylene was the most frequently detected organic solvent and the one present in the highest concentration."[83] As ATSDR notes, TCE "was detected in 388 of 669 groundwater samples collected in New Jersey from 1977 to 1979, with a maximum concentration of 635 ppb . . .Maximum concentrations ranging from 900 to 27,300 ppb trichloroethylene were found in contaminated wells from four states (Pennsylvania, New York, Massachusetts, and New Jersey)." [84]

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[81] Id. at 342.
[82] IRIS Assessment at 2-12.
[83] ToxProfile at 330. The draft risk evaluation describes surface water monitoring data for 2013-2017 from STORET at 93-94. The average detection frequency for this period was 3.04% and the average TCE concentration was 0.33 ug/L.
[84] Id.

In light of the widespread presence of TCE in groundwater, it is not surprising that TCE is a common contaminant in drinking water. According to IRIS, "[i]t has been estimated that between 9 and 34% of the drinking water supply sources tested in the United States may have some TCE contamination."[85] As ATSDR describes, drinking water monitoring conducted by or for EPA has consistently detected TCE in public water systems (PWSs) across the US:[86]

> "The EPA (2011d) released the results of its second 6-year review of 69 regulated contaminants in public water systems (PWS) located across the United States. . . . During 2005, trichloroethylene was detected in 2,292 out of 46,937 samples (4.9%) collected from groundwater supplied PWS and 1,874 out of 12,705 samples (14.8%) collected from surface water supplied PWS. The median, 95th percentile, and maximum concentrations of the positive samples were 1.1, 13.0, and 159 ppb, respectively, in groundwater supplied PWS and 1.6, 28.0, and 50.0 ppb, respectively, in the surface water supplied PWS. . . . The EPA Groundwater Supply Survey of finished water from 945 drinking water systems nationwide using groundwater sources found trichloroethylene in 91 water systems (detection limit 0.2 ppb); the median level of the positive samples was approximately 1 µg/L (ppb), with a single maximum level of 130 µg/L (ppb) (Westrick et al. 1984)."

ATSDR reports similar findings in other studies:[87]

> "Williams et al. (2002) reported annual levels of trichloroethylene measured in 3,447–4,226 California drinking water sources between 1995 and 2001. Trichloroethylene was detected in 9.6–11.7% of the sources over the time period with an average detected concentration ranging from 14.2 to 20.7 µg/L (ppb). . . . Drinking water supplies at Camp Lejeune have been shown to be heavily contaminated with trichloroethylene and other chlorinated solvents due to handling and disposal practices of an off-site dry cleaning facility (ATSDR 2017b). Water samples obtained from the Hadnot Point Water Treatment plant at Camp Lejeune had levels of trichloroethylene of up to 1,400 µg/L in 1982 (ATSDR 2017b)."

In 1987, EPA set a National Primary Drinking Water Regulation (NPDWR) for TCE which establishes a maximum contaminant level goal (MCLG) of zero and an enforceable maximum contaminant level (MCL) of 5 ug/L (5 ppb).[88] Based on the monitoring data presented above, exceedances of the MCL (in some cases by an order of magnitude or more) have been recorded in several PWSs. Moreover, the current MCL is not health protective in light of current science. The IRIS assessment for TCE determines that drinking water exposures over a lifetime to 0.5 ug/L – a tenth of the MCL – pose a cancer risk of 1 in a million.[89] Similarly, the IRIS non-cancer RfD is 0.0005 mg/kg/day (0.5 ug/L or 0.5 ppb).[90]

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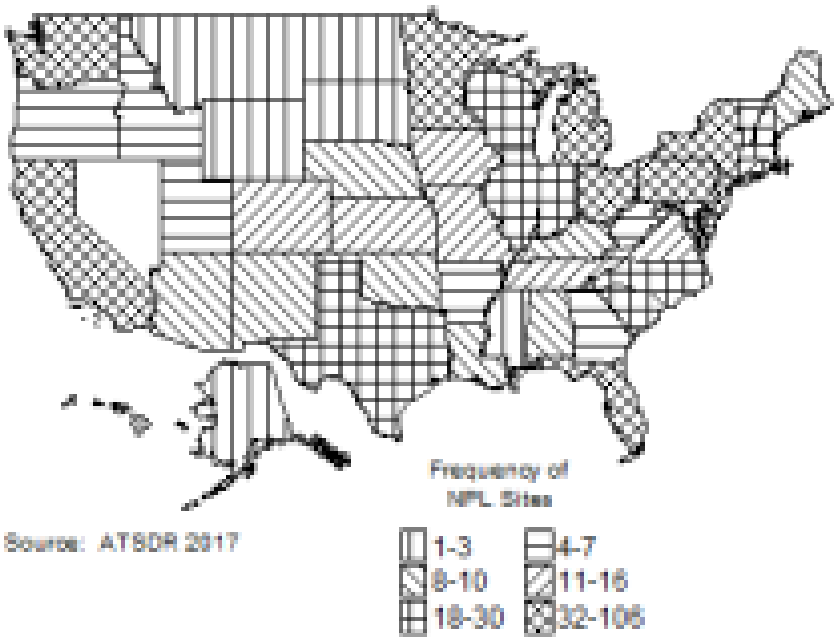
[85] IRIS Assessment at 2-12.
[86] ToxProfile at 328.
[87] Id.
[88] 52 Federal Register 25690 (July 8, 1987).
[89] IRIS Summary at 39
[90] IRIS Assessment at 5-101.

Based on EPA-mandated drinking water monitoring, the Environmental Working Group (EWG) has determined that 149 PWSs in 30 states have detected TCE levels in drinking water above health guidelines and that these utilities serve 2.6 million people.[91] **Cancer and non-cancer risks to this subpopulation exceed EPA benchmarks for unreasonable risk, even without considering the volatilization of household water during showering and other daily activities and resulting in TCE inhalation exposure. TSCA requires consideration of this risk.**

### F. TCE Is Frequently Found at Contaminated Sites, Resulting in Contamination of Groundwater and Release of TCE Vapors into Ambient Air and Buildings

TCE is a significant concern at contaminated sites within the purview of the EPA Superfund program. ATSDR reports that TCE "has been identified in at least 1,051 of the 1,854 hazardous waste sites that have been proposed for inclusion on the EPA National Priorities List (NPL)."[92] ATSDR depicts the geographic distribution of these sites as follows:

**Frequency of NPL Sites with Trichloroethylene Contamination**




Across the nation, only a small minority of contaminated sites are listed or proposed for listing on the NPL. Given the ubiquity of TCE in soil and groundwater, there are assuredly far more sites with TCE contamination than are identified in the table above. At these sites, volatilization of TCE from

[91] https://www.ewg.org/tapwater/contaminant.php?contamcode=2984. EWG used a health guideline of of 0.4 ppb for TCE, which the state of Minnesota has set as a health risk limit.
[92] ToxProfile at 305.

contaminated soils is relatively rapid and may lead to elevated ambient air levels in nearby communities. ATSDR notes that "[r]elease of trichloroethylene also occurs at treatment and disposal sites," including "through volatilization and air-stripping procedures" at water treatment facilities and "gaseous emissions from landfills."[93] TCE's mobility in soil is well-documented, [94] and it readily leaches to the subsurface and to groundwater. The presence of TCE in leachate from active and inactive landfills is considered an important pathway for groundwater contamination and is linked to TCE-contaminated groundwater at many NPL sites.[95]

TCE vapor intrusion is a serious indoor air concern in buildings overlaying contaminated soil and groundwater. As described by the State of Minnesota:[96]

> "TCE can evaporate from the polluted soil and groundwater and rise toward the ground surface. If these TCE vapors come to a basement as they travel to the surface, they may enter through cracks in the foundation, around pipes, or through a sump or drain system. In this way, the vapors enter buildings and contaminate indoor air. This process, when pollution moves from air spaces in soil to indoor air, is called vapor intrusion."

ATSDR describes vapor intrusion as a "notable exposure route" and cites several studies which attributed elevated TCE indoor air levels to vapor intrusion from TCE-contaminated cleanup sites or groundwater.[97] EPA has repeatedly acknowledged the risks associated TCE vapor intrusion[98] and has published guidance governing the calculation of vapor intrusion risks.[99] There is no basis for EPA to exclude vapor intrusion and other disposal-related TCE emissions from the draft risk evaluation.

### G. By Failing to Account for Environmental Pathways, EPA Disregards Large at Risk Subpopulations and Greatly Understates Risks to Workers and Users of Consumer Products

This brief survey of TCE releases to air, water and soil demonstrates the important contribution of TCE air emissions and contaminated groundwater, drinking water and soil to overall TCE exposure. Each of these pathways is alone responsible for cancer and non-cancer risks to large segments of the population that exceed EPA benchmarks. Moreover, some subpopulations are exposed by multiple pathways simultaneously – i.e. individuals who breath TCE in indoor and outdoor air, consume contaminated drinking water and live near TCE-contaminated NPL sites. Because TCE exposure levels are higher for these subpopulations than the general population, they face elevated risks of TCE-related health effects

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[93] Id. at 314.
[94] Id. at 317
[95] Id. at 330.
[96] https://www.health.state.mn.us/communities/environment/hazardous/topics/tce.html.
[97] ToxProfile. at 327, 341.
[98] IRIS Review at 2-11. ,
[99] *See* EPA, *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air* (June 2015) ("EPA Vapor Intrusion Guidance"), https://www.epa.gov/sites/production/files/2015-09/documents/oswer-vapor-intrusion-technical-guide-final.pdf

like cancer, fetal heart malformations and immunotoxicity. A comprehensive risk evaluation as required by TSCA would identify and quantify these subpopulations, estimate total exposure from all sources and characterize the increased risk resulting from concurrent exposure pathways. However, because of its narrow scope, the draft TCE evaluation fails to provide this analysis and therefore presents a limited and incomplete picture of TCE's risks to the public.

The draft evaluation even understates risks to the population groups – workers and users of consumer products – that it does address. These groups also are exposed to TCE in air, water and soil in addition to the pathways that EPA addresses. For example, workers in vapor degreasing operations may live in industrialized areas with high ambient air levels and one or more Superfund sites and consume TCE-contaminated drinking water. In the aggregate, TCE exposure by these workers would be significantly greater than exposure in the workplace alone and health risks (which are already alarmingly high for worker activities) would be correspondingly higher. This would likewise be true of users of consumer products who have concurrent exposure to TCE air emissions, contaminated drinking water and elevated indoor air levels due to vapor intrusion. EPA's MOEs for consumer product use (while themselves significantly below benchmark MOEs) would be reduced further if other contributors to consumer exposure are taken into account. Moreover, since exposure to TCE in ambient air and contaminated drinking water is continuous, EPA could not limit its evaluation to acute risks to consumers, as it does in its draft evaluation. Instead, it would need to address long-term exposure scenarios and determine risks for chronic endpoints like cancer, liver and kidney toxicity, and developmental and immunotoxicity related to repeated dose exposure.

EPA's claim that other programs are effectively protecting against TCE environmental releases and obviate the need to evaluate them under TSCA is a red herring. In fact, the EPA media-specific programs responsible for air, water and waste are not examining TCE's cross-media risks and could not do so since they lack authority over multiple environmental pathways. Moreover, distracted by other priorities, these programs are in many cases not even effectively addressing TCE risks within their areas of responsibility. For example, the TCE drinking water MCL is over 30 years old but there are no plans to update it to reflect the many TCE health concerns that that have come to light in the intervening years.

TSCA is the only law administered by EPA that provides a mandate and comprehensive authority to examine chemical risks from all conditions of use, and thus across all pathways of exposure. It is clear that Congress viewed this unique strength of TSCA as an essential tool in protecting against the cross-media effects of chemicals like TCE on human health and the environment. EPA should revise the draft TCE evaluation so it accounts for all conditions of use, including TCFE's presence in environmental media, and thus provides a complete understanding of how TCE endangers human health and the environment.

## III. EPA Correctly Recognizes that TCE is a Non-Threshold Carcinogen but Understates and Discounts Its Cancer Risks

### A. EPA Has Correctly Determined that Evidence of a Mode of Action for TCE Carcinogenicity is Inadequate and Linear Extrapolation is Required to Estimate Cancer Risk

As the draft evaluation finds, TCE is linked to non-Hodgkin's lymphoma, kidney, and liver cancer.[100] Based on extensive evidence of carcinogenicity in animals and humans, EPA's IRIS program has classified TCE as "carcinogenic to humans by all routes of exposure."[101] Other authoritative bodies have reached the same conclusion. The International Agency for Research on Cancer (IARC) has stated that TCE is "*carcinogenic to humans (Group 1)*," based on sufficient evidence in both humans and experimental animals.[102] The National Toxicology Program's (NTP) *Report on Carcinogens* has similarly determined that TCE is "*known to be a human carcinogen* based on sufficient evidence of carcinogenicity from humans."[103]

The draft evaluation builds on these previous determinations. Concluding that TCE is genotoxic, the draft uses linear extrapolation to determine TCE's cancer risks, consistent with the earlier evaluations. At the SACC meeting, however, some industry presenters urged EPA to base cancer risk estimates on a non-linear Mode of Action (MOA). We strongly recommend against this approach.

EPA's 2005 Guidelines for Carcinogen Risk Assessment[104] emphasize the high level of evidence necessary to depart from the presumption of linearity for carcinogens:

> "Elucidation of a mode of action for a particular cancer response in animals or humans is a data-rich determination. *Significant information should be developed to ensure that a scientifically justifiable mode of action underlies the process leading to cancer at a given site. In the absence of sufficiently, scientifically justifiable mode of action information, EPA generally takes public health protective, default positions* regarding the interpretation of toxicologic and epidemiologic data animal tumor findings are judged to be relevant to humans, and cancer risks are assumed to conform with low dose linearity" (emphasis added) (1-10 through 1-11).

The Guidelines add that:

> "When the weight of evidence evaluation of all available data are insufficient to establish the mode of action for a tumor site and when scientifically plausible based on the available data, linear extrapolation is used as a default approach, because linear extrapolation generally is considered to be a health-protective approach. Nonlinear *approaches generally should not be used in cases where the mode of action has not been ascertained.* (emphasis added) (3-21). A nonlinear approach should be selected when there are sufficient data to ascertain the mode of

[100] Draft TCE Evaluation, at 218-219 and 225-226
[101] IRIS Assessment, at xlii.
[102] IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. "Trichloroethylene, Tetrachloroethylene, and Some Other Chlorinated Agents." *IARC monographs on the evaluation of carcinogenic risks to humans* 106 (2014).
[103] Natl'l Toxicology Program, *Report on Carcinogens Monograph for Trichloroethylene*, https://ntp.niehs.nih.gov/ntp/roc/monographs/finaltce_508.pdf
[104] EPA Cancer Guidelines, at 84-85.

> action and conclude that it is not linear at low doses and the agent does not demonstrate mutagenic or other activity consistent with linearity at low doses." (3-22).

EPA has correctly applied these principles in the draft evaluation to conclude that TCE should be considered a non-threshold, linear carcinogen.

The 2011 IRIS Assessment concluded that "Overall, evidence from a number of different analyses and a number of different laboratories using a fairly complete array of endpoints suggests that TCE, following metabolism, has the potential to be genotoxic."[105] Like the IRIS assessment, the draft evaluation concludes that "there is sufficient evidence that TCE-induced kidney cancer operates primarily through a mutagenic mode of action[106] and further explains that:[107]

> "The predominant mode of action (MOA) for kidney carcinogenicity involves a genotoxic mechanism through formation of reactive GSH metabolites (e.g., DCVC, DCVG). This MOA is well-supported, as toxicokinetic data indicates that these metabolites are present in both human blood and urine, and these metabolites have been shown to be genotoxic both in vitro and in animal studies demonstrating kidney specific genotoxicity (U.S. EPA, 2011e)."

IRIS derived unit risks for carcinogenicity using a linear model, noting that there is "sufficient weight of evidence to conclude that TCE operates through a mutagenic mode of action for kidney tumors" and "high confidence in these unit risks for cancer, as they are based on good quality human data, as well as being similar to unit risk estimates based on multiple rodent bioassays."[108] According to the draft evaluation, EPA's "2019 meta-analysis of all relevant studies examining kidney cancer, liver cancer, or NHL (Appendix H) came to the same conclusion as the previous EPA meta-analysis in the 2011 IRIS" and therefore "EPA utilized the same inhalation unit risk and oral slope."[109] As EPA elaborated, a "linear non-threshold assumption was applied to the TCE cancer dose-response analysis because there is sufficient evidence that TCE-induced kidney cancer operates primarily through a mutagenic mode of action while it cannot be ruled out for the other two cancer types.[110]

EPA also examined non-linear modes of action but concluded that:[111]

> "Although the actual exposure-response relationship at low exposure levels is unknown, the conclusion that a mutagenic mode of action is operative for TCE-induced kidney tumors supports the linear low-dose extrapolation that was used (U.S. EPA, 2005). The weight of evidence also supports involvment of processes of cytotoxicity and regenerative proliferation in the carcinogenicity of TCE, although not with the extent of support as for a mutagenic mode

[105] IRIS Assessment at 4-80
[106] Draft TCE Evaluation at 30
[107] Id at
[108] IRIS assessment at xliii
[109] Draft TCE Evaluation at 233.
[110] Id.
[111] Id at 256

of action. In particular, data linking TCE-induced proliferation to increased mutation or clonal expansion are lacking, as are data informing the quantitative contribution of cytotoxicity. Because any possible involvement of a cytotoxicity mode of action would be additional to mutagenicity, the dose-response relationship would nonetheless be expected to be linear at low doses. Therefore, the additional involvement of a cytotoxicity mode of action does not provide evidence against the use of linear extrapolation from the POD."

**These conclusions are consistent with EPA's cancer risk assessment guidelines and demonstrate why evidence for a non-linear MOA is inadequate. The final evaluation should retain the unit risks in the proposal.**

### B. EPA's Risk Evaluation Should Account for Acute Cancer Risks to Workers and Consumers

It is widely recognized that genotoxic carcinogens like TCE can induce cancer following a limited acute exposure event and that methods to estimate such risks are available. As stated in a 2011 National Research Council (NRC) report:[112]

> "Guidance on the development of short-term exposure levels, published by the NRC, identified cancer as one of the potential adverse health effects that might be associated with short-term inhalation exposures to certain chemical substances (NRC 1993a). That guidance document discusses and recommends specific risk- assessment methods for known genotoxic carcinogens and for carcinogens whose mechanisms are not well understood. As a first approximation, the default approach involves linear low-dose extrapolation from an upper confidence limit on theoretical excess risk. Further, the NRC guidance states that the determination of short-term exposure levels will require the translation of risks estimated from continuous long-term exposures to risks associated with short-term exposures. Conceptually, the approach recommended for genotoxic carcinogens adopted the method developed by Crump and Howe (1984) for applying the linearized multistage model to assessing carcinogenic risks based on exposures of short duration."

Thus, there exists a recognized methodology for extrapolating from findings of carcinogenicity in long-term studies to exposures of short duration. Moreover, EPA acknowledges the possibility of calculating acute cancer risks in the draft risk evaluation.[113] However, EPA declines to calculate such risk due to "uncertainties" in the NRC methodology.[114] **Rather than summarily dismissing acute cancer risks because they are harder to estimate, EPA should have quantified these risks using the framework outlined by NRC, which reflects the best available science.**

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[112] NRC, *Standard Operating Procedures for Developing Acute Exposure Guideline Levels for Hazardous Chemicals*, pp. 111-112 (2001), available at https://www.epa.gov/aegl/standing-operating-procedures-developing-acute-exposure-guideline-levels-aegls-hazardous

[113] TCE Risk Evaluation at 251 (discussing NRC methodology).

[114] Id.

### C. EPA Should Use a Benchmark of 1 x $10^{-6}$ to Determine Whether Cancer Risks to Workers and Consumers are Unreasonable under TSCA

As with earlier evaluations, EPA continues to use a cancer risk of 1 x $10^{-4}$ as the benchmark for determining unreasonable risk to workers. Using this benchmark results in a significantly smaller number of worker exposure scenarios that present unreasonable risks than under cancer risk levels of 1 x $10^{-5}$ and 1 X $10^{-6}$. The SACC has previously stated that EPA has not provided "adequate explanation and justification" for this reduced threshold[115] and the TCE draft evaluation also fails to justify EPA's approach.

The draft TCE evaluation describes how EPA has previously approached cancer risks under the laws it administers as follows:[116]

> "Standard cancer benchmarks used by EPA and other regulatory agencies are an increased cancer risk above benchmarks ranging from 1 in 1,000,000 to 1 in 10,000 (i.e., 1x10-6 to 1x10-4) depending on the subpopulation exposed. Generally, EPA considers 1 x 10-6 to 1x 10-4 as the appropriate benchmark for the general population, consumer users, and non-occupational PESS."

Thus, as EPA notes, in applying CAA "residual risk" standards for air toxics, it uses a two-step approach that includes a "presumptive limit on maximum individual lifetime [cancer] risk (MIR) of approximately 1 in 10 thousand" and consideration of whether emissions standards provide an ample margin of safety to protect public health "in consideration of all health information, including the number of persons at risk levels higher than approximately 1 in 1 million, as well as other relevant factors."[117] EPA likewise uses a risk range of 1 x $10^{-4}$ to 1 x $10^{-6}$ to set cleanup goals at CERCLA hazardous waste sites.[118] In fact, EPA has used a 1 x $10^{-6}$ cancer standard to evaluate risk and determine CERCLA remedies at sites where carcinogens are present. [119]

Despite reserving discretion to make case-by-case decisions within this range, however, EPA has identified 1 x $10^{-6}$ as its goal for public health protection. Thus, in its air toxics standard for radionuclides, EPA stressed that it "should reduce risks to less than 1 x 10-6 for as many exposed people as reasonably possible."[120] Similarly, in guidance for setting health-based water quality criteria under the Clean Water Act (CWA), EPA explained that it:[121]

> "intends to use the 10-6 risk level, which the Agency believes reflects an appropriate risk for the general population. EPA's program office guidance and regulatory actions have evolved in

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[115] SACC 1,4-Dioxane and HBCD Report at 23.
[116] TCE Risk Evaluation at 376.
[117] 54 Fed. Reg. 38044, 38045 (September 14, 1989).
[118] EPA, *Rules of Thumb For Superfund Remedy Selection*, August 1997, found at https://semspub.epa.gov/work/HQ/174931.pdf. (CERCLA Guidance).
[119] *See* Record of Decision, Bofors Nobel Superfund Site at 12 (Sept. 1990) (methylene chloride).
[120] 54 Fed. Reg. 51654, 51686 (Dec. 15, 1989).
[121] EPA, *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* p. 2-6 (2000), https://www.epa.gov/sites/production/files/2018-10/documents/methodology-wqc-protection-hh-2000.pdf.

recent years to target a 10-6 risk level as an appropriate risk for the general population. EPA has recently reviewed the policies and regulatory language of other Agency mandates (e.g., the Clean Air Act Amendments of 1990, the Food Quality Protection Act) and believes the target of a 10-6 risk level is consistent with Agency-wide practice."

In the CERCLA program, EPA guidance provides that, while "remedies should reduce the risks from carcinogenic contaminants such that the excess cumulative individual lifetime cancer risk for site-related exposures falls between 10-4 and 10-6," the Agency "has expressed a preference for cleanups achieving the more protective end of the risk range (i.e., 10-6)."[122]

However, EPA's recent draft risk evaluations deviate from this approach for worker exposures, maintaining that risks smaller than $1 \times 10^{-4}$ will be considered "reasonable" under TSCA because, "consistent with case law and 2017 NIOSH guidance," this risk level applies to "industrial and commercial work environments subject to Occupational Safety and Health Act (OSHA) requirements."[123]

OSHA precedent does not control decision-making under TSCA, a separate law with different purposes and wording. The cancer risk threshold applied by NIOSH and OSHA is rooted in the Supreme Court's *Benzene* decision, which interpreted the OSH Act as requiring "a threshold finding that a place of employment is unsafe—in the sense that *significant* risks are present and can be eliminated or lessened by a change in practices." *Indus. Union Dep't, AFL-CIO v. API*, 448 U.S. 607, 642 (1980) (emphasis added). The Court grounded this interpretation in an examination of the language, structure and legislative history of the OSH Act. TSCA, by contrast, is anchored in the concept of "unreasonable risk" (a term that implies a lower risk threshold than the OSH Act concept of "significant risk"). No provision of TSCA provides that workers should receive less protection than other exposed subpopulations or that well-established EPA benchmarks for unacceptable cancer risks would be inapplicable to workers. Indeed, workers are specifically identified as a "potentially exposed or susceptible subpopulation" that EPA is required to protect in section 3(12) of TSCA, indicating that Congress was particularly concerned by the levels of toxic chemicals in the workplace and the special vulnerability of some employee populations to their adverse health effects. Moreover, contrary to EPA's claims, NIOSH does not recommend that workers be left exposed to a 1 in 10,000 risk of cancer. Instead, the NIOSH guidance cited by EPA states "for most carcinogens, there is no known safe level of exposure … [and] NIOSH will continue to recommend that employers reduce worker exposure to occupational carcinogens as much as possible through the hierarchy of controls, most importantly elimination or substitution of other chemicals that are known to be less hazardous …"[124]

In contrast to the OSH Act, TSCA provides protections to workers not just from chemical exposure in the workplace but from air emissions and other environmental releases as well as exposures to consumer products. As discussed above, while draft EPA risk evaluations have assessed worker exposure in isolation from other pathways, this approach understates risks; instead, EPA should

[122] CERCLA Guidance at 9.
[123] TCE Risk Evaluation at 376.
[124] Christine Whittaker et al., NIOSH, Current Intelligence Bull. 68, NIOSH Chemical Carcinogen Policy 20 (July 2017), https://www.cdc.gov/niosh/docs/2017-100/pdf/2017-100.pdf.

combine exposures from all relevant pathways and determine an aggregate risk reflecting the contribution of each source. This is a further reason why setting a higher cancer risk threshold for workers than other populations is unjustified under TSCA.

**EPA must apply to workers the same benchmarks for determining unreasonable cancer risks that it uses for other populations. For all exposed populations, EPA should consider any increased cancer risk exceeding 1 x $10^{-6}$ to be unreasonable and to require action under TSCA.**

## IV. EPA Has Failed to Model Realistic Dermal Exposure Scenarios and to Combine Dermal and Inhalation Exposures to Determine a Composite Estimate of Risk

### A. EPA's Dermal Exposure Scenarios for Workers Understate Dermal Absorption

TCE is a volatile liquid and both inhalation and dermal exposure are expected during manufacturing, processing, use and disposal. Accordingly, EPA developed exposure and risk estimates for dermal as well as inhalation routes of exposure. While this was the correct approach, EPA's estimates of dermal exposure rest on questionable assumptions and likely understate the magnitude of TCE exposure by this route.

EPA used modeling techniques to estimate dermal exposure. Instead of relying on test data to quantify dermal absorption rates, EPA modeled "dermal potential dose rate based on an assumed amount of liquid on skin during one contact event per day and the steady-state fractional absorption for TCE based on a theoretical framework provided by Kasting."[125] It concluded that the "steady state fractional absorption (fabs) for TCE is estimated to be 0.08 in industrial facilities with higher indoor wind flows or 0.13 in commercial facilities with lower indoor wind speeds . . . , meaning approximately 8 or 13 percent of the applied dose is absorbed through the skin following exposure, from industrial and commercial settings, respectively."[126] Because EPA's PBPK model did not account for dermal exposure and minimal dermal toxicity data was available, EPA "relied on traditional route-to-route extrapolation from oral HED values" to determine potential adverse health effects from dermal exposure. [127]

EPA estimated workers' dermal exposure "considering evaporation of liquid from the surface of the hands and use with and without gloves." For the former set of estimates, EPA applied groupings of glove "protection factors" (also used in several earlier risk evaluations) and assigned commercial and industrial TCE uses to four different "bins" corresponding to potential levels of glove use and dermal exposure.[128] Overall, EPA emphasized, "[t]he volatile properties of TCE suggest that the majority of dermally deposited TCE would quickly evaporate except in occluded scenarios. Therefore, inhalation is expected to be the predominant route of human exposure for most conditions of use."[129]

[125] Id at 115.
[126] Id. at 117.
[127] Id., at 92.
[128] Id., at 117-119.
[129] Id at 279-280.

As EPA itself acknowledged, however, several of the steps in this analysis were based on debatable assumptions that resulted in an underestimation of dermal exposure and risk, as discussed below:

**Higher Dermal Penetration Scenarios**. EPA recognized that its assumption of rapid volatilization of TCE after skin contact did not hold true in all worker operations:[130]

> "Dermal exposure may be significant in cases of occluded exposure, repeated contacts, or dermal immersion. For example, work activities with a high degree of splash potential may result in TCE liquids trapped inside the gloves, inhibiting the evaporation of TCE and increasing the exposure duration."

EPA expanded on this point in its draft evaluation for carbon tetrachloride [131]

> "Due to increased area of contact and reduced skin barrier properties, repeated skin contact with chemicals could have even higher than expected exposure if evaporation of the chemical occurs and the concentration of chemical in contact with the skin increases. In the workplace the wearing of gloves could have important consequences for dermal uptake. If the worker is handling a chemical without any gloves, a splash of the liquid or immersion of the hand in the chemical may overwhelm the skin contamination layer so that the liquid chemical essentially comprises the skin contamination layer. If the material is undiluted, then uptake could proceed rapidly as there will be a large concentration difference between the skin contamination layer and the peripheral blood supply."

However, EPA did not develop alternate estimates of dermal exposure using higher levels of absorption that could occur in these scenarios.

EPA's assumption of low dermal absorption based on rapid TCE volatilization is also open to question. EPA admits that its absorption rate modeling was uncertain because "there is a large standard deviation experimental measurement, which is indicative of the difficulty in spreading a small, rapidly evaporating dose of TCE evenly over the skin surface."[132] Moreover, EPA elsewhere cites data showing that TCE dermal absorption is in fact rapid:[133]

> "Rapid absorption through the skin has been shown by both vapor and liquid TCE contact with the skin. In several human volunteer studies, both TCE liquid and vapors were shown to be well absorbed in humans via the dermal route. Dermal absorption was rapid following exposures of between 20 and 30 minutes, with peak TCE levels in expired air occurring within 15 minutes (liquid) and 30minutes (vapor) (U.S. EPA, 2011e). Dermal exposure to TCE disrupts the stratum corneum, impacting the barrier function of skin and promoting its own

[130] Id at 116
[131] Carbon tetrachloride risk evaluation at 92
[132] TCE risk evaluation at 117.
[133] Id. at 203.

> absorption. Therefore, absorption may increase at a greater than linear rate due to increasing epidermal disruption over time (ATSDR, 2019)."

The ATSDR toxicological profile which EPA references in fact reviews a number of rodent studies of TCE dermal absorption, including the following:[134]

> "Rapid dermal absorption of trichloroethylene is evident from a study in which peak blood and exhaled air concentrations occurred within 5 minutes after a human subject immersed one hand in liquid trichloroethylene for 30 minutes (Sato and Nakajima 1978). Similarly, maximum penetration rates for 1 minute exposure of the volar forearm to liquid trichloroethylene occurred within 5 minutes of the start of exposure (modeled based on the time course of trichloroethylene in expired air following dermal versus inhalation exposure) (Kezic et al. 2001). The estimated dermal flux was 430 nmol/cm2/minute."

EPA's failure to consider those studies and their implications for EPA's assumed rates of dermal absorption violates EPA's requirement to base its risk determinations on all "reasonable available information" and the "best available science."

**Multiple Dermal Exposure Events.** in its carbon tetrachloride risk evaluation, EPA admitted that its dermal "model assumes one exposure event per day, which likely underestimates exposure as workers often come into repeat contact with the chemical throughout their workday."[135] However, EPA did not model any repeat contact scenarios for TCE involving higher levels of dermal exposure. In its review of the draft risk evaluation for methylene chloride, the SACC similarly "was concerned with the assumption of only a single dermal exposure per day and thought that this assumption results in an underestimation of potential exposures."[136] Indeed, in its methylene chloride evaluation, EPA acknowledged that, "[f]or workplace exposures inhalation and dermal exposures are assumed to occur simultaneously i.e. both occur at the start of the task and continue through the end of the task, shift, or work day."[137] Similarly, EPA should base dermal exposure scenarios in the final TCE evaluation on an assumption of ongoing exposure by this route throughout the work day, not a single exposure event.

**Failure to Aggregate Dermal and Inhalation Exposure.** EPA chose not to derive composite risk estimates even though it recognizes that inhalation and dermal exposures occur simultaneously. EPA's rationale for failing to combine these exposure routes is that:[138]

> "In this risk evaluation, EPA determined that aggregating dermal and inhalation exposure for risk characterization was not appropriate due to uncertainties in quantifying the relative

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[134] Toxprofile at 198.
[135] Carbon tetrachloride risk evaluation, at 168.
[136] SAAC, *Peer Review for EPA Draft Risk Evaluation for Methylene Chloride*. December 3-4, 2019, at 33, file:///C:/Users/Owner/Downloads/EPA-HQ-OPPT-2019-0437-0080%20(6).pdf
[137] Methylene Chloride Risk Evaluation at 387.
[138] TCE Risk Evaluation at 352-353.

> contribution of dermal vs inhalation exposure, since dermally applied dose could evaporate and then be inhaled. Aggregating exposures from multiple routes could therefore inappropriately overestimate total exposure, as simply adding exposures from different routes without an available PBPK model for those routes would compound uncertainties."

EPA's claim that aggregating dermal and inhalation exposure could "inappropriately overestimate total exposure" is puzzling and counter-intuitive; in its draft evaluation for methylene chloride, EPA in fact said that failure to combine the two routes "may lead to an underestimate of exposure."[139] EPA's apparent concern is that combining exposures from the two routes could result in double-counting dermal exposures because a large portion of these exposures are not absorbed through the skin but volatilized and inhaled. However, elsewhere in its evaluation, EPA has based estimates of dermal risk on the percentage of TCE absorbed through the skin. While we believe EPA may have underestimated the dermal absorption rate as described above, any amount of TCE absorbed through the skin will necessarily not be inhaled and thus not be counted in modeling or measuring inhalation exposure. The more realistic concern is that, by not combining these concurrent sources of exposure, the dermal component of total risk will be ignored.

In its report on the draft evaluation for 1-bromopropane (1-BP), the SACC recommended that EPA estimate "cumulative exposures, which involves both dermal and inhalation contact with 1-BP" because "dermal exposure to 1-BP would most likely correspond with simultaneous inhalation exposure" and "vapor and dermal exposures are not separable."[140] EPA should similarly use combined dermal and inhalation exposures to determine TCE's risks in its final evaluation.

**Glove Protection Assumptions**. For EPA to assume that gloves will provide any level of protection from dermal absorption is highly speculative. In its *Supplemental File: Environmental Releases and Occupational Exposure,* EPA acknowledges that:[141]

> "Data about the frequency of effective glove use – that is, the proper use of effective gloves – is very limited in industrial settings. Initial literature review suggests that there is unlikely to be sufficient data to justify a specific probability distribution for effective glove use for a chemical or industry."

Thus, in other evaluations, EPA admitted that its "glove protection factors are based on . . . 'what-if' assumptions and are highly uncertain" and that it "does not know the actual frequency, type, and effectiveness of glove use in specific workplaces of the occupational exposure scenarios."[142] Even where

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[139] Methylene Chloride Risk Evaluation at 304.
[140] TSCA Science Advisory Committee on Chemicals Meeting Minutes and Final Report No. 2019-03, Peer Review for the United States Environmental Protection Agency (EPA) Draft Risk Evaluation for 1-Bromopropane (1-BP) (SACC Report on 1-BP), December 12, 2019, https://www.regulations.gov/document?D=EPA-HQ-OPPT-2019-0235-0061, at 47, 73.
[141] Supplement at 223.
[142] Carbon Tetrachloride Evaluation at 168.

gloves are used, their effectiveness is not assured. As other draft evaluations recognize, some glove types may lack impermeability for specific chemicals and even protective glove types will fail to fully prevent exposure if not properly maintained and replaced.

Moreover, there are situations where glove use can *increase* skin absorption. As the draft evaluation notes, "[d]ermal exposure may be significant in cases of occluded exposure."[143] The *Supplemental File* elaborates that "[m]any gloves do not resist the penetration of low molecular weight chemicals . . . Wearing gloves which are internally contaminated can lead to increased systemic absorption."[144] EPA in fact modeled the effect of occlusion on dermal exposure:[145]

> "EPA also estimated central tendency and high-end dermal retained doses for occluded scenarios for OESs where occlusion was reasonably expected to occur. Occluded scenarios are generally expected where workers come into contact with bulk liquid TCE during use in open systems (e.g., during solvent changeout in vapor degreasing) and not expected in closed-type systems (e.g., during connection/ disconnection of hoses used in loading of bulk containers in manufacturing). "

As Table 2-15 shows, occlusion greatly increases dermal absorption: with occlusion, exposures are 7.6-12.2 times higher than in the no-glove scenarios.[146] However, EPA does not carry these exposure estimates forward to its determinations of risk in Tables 4-6 through 4-27. Instead, its risk determinations for PPE scenarios are only based on its default glove protection factors and do not reflect the increase in risk from glove occlusion scenarios. This is a serious omission that overlooks a real-world pathway for increased dermal exposure. If EPA assumes any glove use in the final risk evaluation (and, for the reasons stated above, it should not), EPA must also base in its risk determinations on the foreseeable occlusion scenarios that such glove use would create.

**In sum, EPA should (1) model a broader range of dermal contact scenarios based on its own analysis of variations in dermal exposure conditions, (2) base risk estimates on multiple dermal exposure events per day, (3) recognize that gloves can actually increase dermal absorption if occlusion occurs and (4) aggregate dermal and inhalation exposures since these two routes of exposure occur simultaneously and contribute to total risk.**

### B. EPA Has Arbitrarily Failed to Include Dermal Exposure in Risk Determinations for Consumer Products

Remarkably, the draft evaluation claims that dermal exposure during use of TCE-containing consumer products "is unlikely to contribute significantly to overall exposure."[147] The basis for this claim is "the

[143] TCE Risk Evaluation at 116.
[144] Supplement at 139.
[145] TCE Risk Evaluation at 102.
[146] Id at 106.
[147] Id at 137.

expectation that TCE would evaporate from the surface rapidly, with <1% dermal absorption predicted from instantaneous contact." Thus, for most consumer products, EPA makes no assumption of dermal exposure. EPA makes a limited exception for "certain scenarios with higher dermal exposure potential – where liquid TCE is not able to evaporate readily and volatilization is inhibited. An example of this is a user holding a rag soaked with TCE against their palm during a cleaning activity."[148] Thus, "dermal exposures are quantified and presented for consumer use scenarios that may involve dermal contact with impeded evaporation." However, these scenarios are a distinct minority of cases. Most consumer risk determinations contain the following notation: "*Dermal exposures were not quantified for this scenario, as dermal exposure with impeded evaporation is not expected."*

EPA used different dermal absorption models for consumer and workplace exposure scenarios — assuming that absorption is on the order of 8-13% for workers but 0.8% for consumers.[149] The rationale for these differences is not clearly stated although EPA suggests that "the choice of one model over the other is primarily driven by the exposure scenario that needs to be assessed and the information that is reasonably available."[150] The implication seems to be that worker dermal exposure is longer in duration than consumer exposure but this is inconsistent with EPA's premise that both exposures involve one-time events and the reality that many consumer products are liquids likely to contact the skin during normal application. Moreover, just as the assumption of a single exposure event is unrealistic for workers, so it seems likely that a subset of consumers (i.e. do-it-yourselfers) use TCE-containing products multiple times during a day and repeatedly over several days. In any event, data showing very rapid uptake of TCE through the skin (discussed above) suggests that even fleeting dermal contact with TCE by consumers could result in significant absorption.

EPA states that "there is low to medium confidence in consumer dermal exposure modeling due to uncertainties related to absorption (as discussed above) and assumptions regarding impeded evaporation for particular conditions of use."[151] **We agree and believe that EPA should revise this modeling to reflect more realistic consumer use scenarios.**

## V. EPA's Evaluation Should Address Chronic Risks to Consumers from Exposure to TCE

The draft EPA evaluation only addresses acute risks to consumers. No risk determinations are made for chronic health effects, including cancer, developmental toxicity and immunotoxicity, that EPA attributes to TCE. EPA explains its approach as follows:[152]

> "Inhalation and dermal exposures are evaluated for acute exposure scenarios, i.e., those resulting from short-term or daily exposures. Chronic exposure scenarios resulting from long-term use of household consumer products were not evaluated. In general, the frequency of

[148] Id.
[149] Id.
[150] Id. at 359.
[151] Id. at 350.
[152] Id. at 136.

> product use was considered to be too low to create chronic risk concerns. Although high-end frequencies of consumer use are up to 50 times per year, reasonably available toxicological data is based on either single or continuous TCE exposure and it is unknown whether these use patterns are expected to be clustered or intermittent (e.g. one time per week). There is uncertainty regarding the extrapolation from continuous studies in animals to the case of repeated, intermittent human exposures. Therefore, EPA cannot fully rule out that consumers at the high-end frequency of use could possibly be at risk for chronic hazard effects, however it is expected to be unlikely."

This logic is unpersuasive, as EPA itself seems to concede. The risk evaluation identifies 25 separate categories of TCE-containing products.[153] Some of these products (degreasers, adhesives, and sealants) would be expected to be used regularly by hobbyists, artists who work at home or home renovators. Others (carpet cleaners, spot remover, fabric spray and shoe polish) would be applied frequently during normal household cleaning and maintenance. Still others (tire cleaners and sealers and lubricants) would likely be used frequently by consumers who maintain and repair their own or friends' vehicles. Indeed, EPA itself notes that high end-frequency of use of these products could be 50 times a year.

Moreover, EPA acknowledges that "inhalation exposures were evaluated on a product-specific basis and are based on use of a single product type within a day, not multiple products."[154] This in unrealistic: it is likely that many consumers use different TCE-containing products on the same day or over time. To ignore this scenario is to overlook the additional consumer exposure resulting from multiple product use.

EPA's 1-BP draft evaluation acknowledged that it is not realistic to assume that consumers are only exposed once to consumer products containing this substance in view of how these products are used:[155]

> "This assumption may result in underestimating the exposure of certain consumer users, in particular those consumers who may be do-it-yourselfers who may use products more frequently or may use more than one product within a single day. There is a medium uncertainty associated with this assumption because of the possible of underestimating exposure of frequent use or multi-product users."

EPA's assertion that "reasonably available toxicological data is based on either single or continuous TCE exposure . . . [and] [t]here is uncertainty regarding the extrapolation from continuous studies in animals to the case of repeated, intermittent human exposures" is not a justification for only assessing acute risks to consumers. It is typical for chemical use scenarios to involve repeated but not continuous exposure, and risk assessors have had no trouble using repeated dose toxicity studies to estimate the

[153] Id. at 53.
[154] Id at 137.
[155] 1-BP Draft Evaluation at 130.

long-term health risks of these scenarios. EPA could certainly determine overall exposure levels from recurring consumer use of multiple TCE-containing consumer products and then estimate risks of cancer, developmental and reproductive toxicity, kidney effects and immunotoxicity to consumers. Its failure to do so in a glaring hole in the draft evaluation.

EPA also concedes that its risk estimates for consumers may be understated because they do not take into account the continuous presence of TCE in outdoor and indoor air:[156]

> "Background levels of TCE in indoor and outdoor air are not assessed in this assessment; therefore, there is a potential for underestimating consumer inhalation exposures, particularly for populations living near a facility emitting TCE or living in a home with other sources of TCE, such as TCE-containing products stored in the home."

As described above, there is ample evidence of elevated TCE levels in ambient air and within dwellings. These levels augment product-related consumer exposure and increase risks of long-term health effects. There is no legal basis for excluding indoor and outdoor air from TSCA risk evaluations and EPA should address these sources of exposure in its final evaluation for TCE.

## VI. EPA Has Failed to Aggregate Exposures and Risks Across Exposure Pathways and Conditions of Use

Section 6(b)(4)(F)(ii) of TSCA requires EPA risk evaluations to "describe whether aggregate or sentinel exposures to a chemical substance under the conditions of use were considered, and the basis for that consideration." EPA's regulations define "aggregate exposure" as "the combined exposures to an individual from a single chemical substance across multiple routes and across multiple pathways" (40 CFR § 702.33).

As discussed above, EPA has unjustifiably failed to address exposure to TCE "across multiple routes" because it has refused to determine the overall risk from combined dermal contact and inhalation even while recognizing that workers and consumers experience both routes of exposure simultaneously. It has also failed to address "combined exposures . . . across multiple pathways" by not accounting for the contribution of TCE levels in ambient air, indoor air, drinking water and waste sites near communities. This is a violation of TSCA because the law provides no basis for excluding environmental pathways of exposure in determining risks to workers and consumers.

Given the large number of industry and consumer uses of TCE, another foreseen combination of exposures is hat workers will be exposed to TCE in their homes. This can be expected to occur, for example, when they use one or more other TCE-containing household products, such as degreasers, spot removers, fabric sprays, shoe polish, adhesives and sealants. Families of workers may also have "take home" exposures, i.e. contact with the worker's contaminated clothing or skin. Workers may also

[156] Draft TCE Evaluation at 137.

do weekend work or have a side business using the same skills – and the same toxic products – as during their weekday work, thus extending their duration of exposure.

For such individuals, risks would be a function of the aggregate contribution of each activity and pathway to total exposure. However, the draft evaluation looks at each exposure pathway in isolation from others, thus ignoring people with exposure to TCE both in the workplace and at home. EPA defends this failure to "consider aggregate exposure among individuals who may be exposed both in an occupational and consumer context" on the basis that "there is insufficient information reasonably available as to the likelihood of this scenario or the relative distribution of exposures from each pathway."[157] However, EPA could realistically combine its exposure estimates for workplace conditions of use with those it has developed for consumer conditions of use (with adjustments recommended above). These aggregated exposure estimates might not apply to every worker but would be representative of a large subset of workers who use (or are bystanders to the use of) TCE-containing consumer products. By defining a subgroup with high-end exposure and risk, this would enable EPA to meet its obligation under TSCA to determine unreasonable risks to "potentially exposed or susceptible subpopulations."

The SACC report on the 1-BP evaluation indicates that:

> "The Committee found that the draft risk evaluation failed to consider cumulative or aggregate exposures. It was pointed out that a worker who is occupationally exposed may also be exposed through other conditions of use in the home. Yet, these exposures are decoupled in the draft risk evaluation. The Committee was concerned that 1-BP off-gassing from insulation in home and schools is inadequately assessed, thereby underestimating exposures."[158]

**TSCA requires EPA to consider all exposures associated with a chemical's known, intended and reasonably foreseen uses.[159] It also requires EPA to separately evaluate risk to subpopulations that face greater exposures than the general public, including workers who are exposed by multiple routes, both on the job and at home.[160] EPA must include this analysis in its final TCE evaluation.**

## VII. EPA's Unreasonable Risk Determinations for Workers Should Not Assume that They Will be Protected by PPE

As in previous risk evaluations, EPA's risk determinations for workers exposed to TCE calculate MOEs assuming both the use of respirators and gloves and the absence of protective equipment. Even for scenarios where workers consistently and reliably use PPE, EPA concludes that MOEs are below "benchmarks" for all conditions of use and that these conditions present unreasonable risks of injury to

[157] Id. at 353.
[158] SACC Report on 1-BP Evaluation at 16.
[159] 15 U.S.C. §§ 2602(4), 2606(b)(2).
[160] 15 U.S.C. §§ 2602(12), 2606(b)(2).

workers. However, while unacceptably low even with PPE use, EPA's MOEs are significantly lower for "no PPE" scenarios. For example, for batch open top vapor degreasing operations, the "no PPE" acute inhalation MOE for fetal heart defects (high-end exposure) is 1.4E-04 but 7.1E-03 assuming use of respirators with an APF of 50. Similarly, for the "no PPE" scenario, the lifetime cancer risk for this condition of use is 0.20 but 4.0E-03 for the respirator (APF = 50) scenario.[161] Indeed, it was because of such large risks that EPA proposed to ban vapor degreasing using TCE in 2017.

Thus, how much risk workers currently face – and how much risk reduction is necessary to fully protect them under TSCA section 6 – depend on whether PPE are now in widespread use and effectively controlling exposure. However, as the SAAC has repeatedly underscored and EPA's draft evaluations recognize, an expectation of universal PPE use is not supported by evidence and is in fact contrary to the realities of workplace practice and sound principles of worker protection. For this reason, the "no PPE" scenario is the only defensible baseline for determining current risk levels for exposed workers.

### A. The SACC Has Repeatedly Raised Serious Concerns About EPA's Undue Reliance on PPE to Determine the Absence of Unreasonable Risk

In each of its reviews of draft evaluations, the SACC has repeatedly raised concerns about EPA's undue reliance on PPE for determinations of unreasonable risk. In its report on the PV29 draft, the SACC noted that "the analysis in the Evaluation does not discuss or account for the fact that downstream commercial users may be oblivious to chemical risks and lack even rudimentary industrial hygiene measures."[162] Similarly, in reviewing the 1,4-dioxane evaluation, the SACC concluded that the "consensus of the Committee believes that PPE may not be consistently and properly worn, as EPA assumed"[163] and noted that "[g]love use should not always be assumed to be protective" and, if worn improperly, gloves "could actually lead to higher exposures."[164] As it concluded, "8-hour use of PPE should not be used in the risk characterization of inhaled 1,4-Dioxane. Risk estimates should be presented without the use of PPE as reasonable worst case."[165]

In the case of HBCD, the SACC noted that "it was unreasonable to assume workers would wear PPE for entire 8-hour shifts due to underlying medical conditions, facial hair, discomfort, and other issues" and added that:[166]

[161] TCE Risk Evaluation at 286.
[162] SACC Report on PV29 at 37.
[163] These "heightened exposures" could occur as a result of "contamination of the interior of the glove" (if workers were not properly trained in glove use and replacement) or by "acting as a reservoir" for contaminants (if the gloves were not impermeable). Such occlusion (greater penetration of the skin where contaminants build up inside the glove because it is permeable) would result in *greater* dermal exposure than in the "no glove" scenario.
[164] SACC Report on 1,4-dioxane and HBCD, at 55.
[165] Id. at 53.
[166] Id at 118.

> "[M]any members of the Committee believed EPA should place more emphasis on the limited likelihood that respiratory protection will be adopted without specific occupational exposure guidelines for HBCD . . . Dust exposures in the construction trades (especially residential construction) continue to represent an occupational health concern because of the many small-to-medium size operators and the use of temporary (and, not infrequently, undocumented) workers. Workers in these small-to-medium enterprises may not be likely to adopt personal protective equipment (PPE) controls, so EPA's characterization of reasonable risk relying on use of PPE is not sufficiently supported by the practical realities of many workplaces."

The SACC report on 1-BP provides further amplification of these concerns:[167]

> "One member noted that the Committee has now received public testimony from two former highly distinguished Occupational Safety and Health Administration (OSHA) administrators expressing concerns regarding EPA's reliance upon non-regulatory guidance and PPE to reduce risks to reasonable levels. Persons familiar with PPE use realize that nominal protection factors may not be achieved in actual practice. The most recent of these comments also noted that compounds with high vapor pressures (such as 1-BP) may "breakthrough" cartridge type respirators in time frames much shorter than a work shift. Since respirators do not have real-time indicators of remaining capacity, respiratory protection failure is more likely for high vapor pressure compounds. 1-Bromopropane also is known to penetrate many glove types. This increases the likelihood of failure to select an appropriate glove."

The SACC concluded that EPA "[a]ssumptions about PPE use are likely unrealistic for many of the scenarios and so the determination of whether a condition of use results in an acceptable or unacceptable risk should be based on no PPE use, with the possible exception of in a manufacturing facility."[168]

The SACC report on the methylene chloride risk evaluation reinforced these points, stating that "[m]ost Committee members agreed that EPA's assumptions of PPE use likely do not reflect actual conditions in most workplaces."[169] The SACC added that:[170]

> "The Agency's reliance on appropriate use of personal protective equipment (PPE), including both respirators and gloves, is not supported by current research literature or industrial hygiene practice. The mere presence of a regulation requiring respirators does not mean that they are used or used effectively. Inadequacies in respirator programs are documented. Respirators require multiple respiratory protection (RP) compliance factors in order to perform as certified. Brent et al. (2005) used data from the NIOSH and Bureau of Labor Statistics (BLS) joint survey on

[167] SACC Report on 1-BP, at 30-31.
[168] Id at 66.
[169] SACC Report on methylene chloride, at 17.
[170] Id at 36.

Respirator Usage in Private Sector Firms, (BLS, 2001) to examine the adequacy of respirator protection programs in private industries. They found "large percentages of establishments requiring respirator use [under OSHA or the Mine Safety and Health Administration (MSHA) regulations] had indicators of potentially inadequate respirator programs." Later, Janssen et al. (2014) reported that 'APFs do not apply to RPD used in the absence of a fully compliant RP program; less than the expected level of protection is anticipated in these situations.' Moving beyond program elements, the frequency of proper use of gloves and respirators is largely unknown."

### B. There is Compelling Evidence that TCE-Exposed Workers are not Meaningfully Protected by PPE

Most worker exposure to TCE is in small, poorly controlled operations. For example, EPA found in its 2017 proposal to ban vapor degreasing with TCE that nearly all vapor degreasing occurs in "open-top" degreasers, estimated by EPA to number between 2,600 and 6,000. Batch systems with enclosed or closed-loop operations are considerably less common, numbering around 120 according to EPA. EPA estimates that there are 150 in-line systems currently using TCE. The Agency projects that there are approximately 40,800 to 102,000 persons (workers and occupational bystanders) exposed to TCE from open-top degreasing operations, and an additional 2,040 and 2,550 persons exposed from closed-loop and in-line systems, respectively.[171]

The current OSHA time-weighted average 8-hour Permissible Exposure Limit (PEL) for TCE is 100 parts per million (ppm), three orders of magnitude higher than the level that current TCE health effects data warrant. The PEL was adopted in 1971 and has never been updated. OSHA has no plans to revise the TCE PEL. In the absence of a health-protective OSHA limit on workplace exposure, it is inconceivable that OSHA is enforcing – or employers are systematically implementing – the stringent PPE requirements that would be necessary for the substantial reductions in worker exposure necessary to achieve safe levels.

Moreover, consistent PPE use requires effective warnings and product labels but, in its proposal to ban vapor degreasing, EPA concluded that worker comprehension of warnings and labels would be poor:[172]

> "EPA found that presenting information about TCE on a label would not adequately address the identified unreasonable risks because the nature of the information the user would need to read, understand, and act upon is extremely complex. It would be challenging to most users to follow or convey the complex product label instructions required to explain how to reduce exposures to the extremely low levels needed to minimize the risk from TCE. Rather than a simple message, the label would need to explain a variety of inter-related factors, including but not limited to the use of local exhaust ventilation, respirators and assigned protection factor for

[171] 82 Fed. Reg. 7442.
[172] 82 Fed. Reg. 7441. (emphasis added)

the user and bystanders, and time periods during pregnancy with susceptibility of the developing fetus to acute developmental effects, as well as effects to bystanders*. It is unlikely that label language changes for this use will result in widespread, consistent, and successful adoption of risk reduction measures by users and owners***.**

These conclusions are particularly compelling in light of the nature of the TCE-exposed worker population. Many TCE-using operations are small shops that lack effective worker training and hazard communication programs. Their employees may be part-time and/or short duration workers who are unlikely to study product warnings and labeling (and may not even understand English). Occupational bystanders – a group at serious risk from TCE use – may not even come into contact with warnings and labels because they are not handling TCE directly.

EPA's TCE degreasing proposal also concluded that respirators could not be relied upon to protect TCE-exposed workers because "there are many documented limitations to successful implementation." As EPA elaborated:[173]

> "Not all workers can wear respirators. Individuals with impaired lung function, due to asthma, emphysema, or chronic obstructive pulmonary disease for example, may be physically unable to wear a respirator. Determination of adequate fit and annual fit testing is required for a tight fitting full-face piece respirator to provide the required protection. Also, difficulties associated with selection, fit, and use often render them ineffective in actual application, preventing the assurance of consistent and reliable protection, regardless of the assigned capabilities of the respirator. Individuals who cannot get a good face piece fit, including those individuals whose beards or sideburns interfere with the face piece seal, would be unable to wear tight fitting respirators. In addition, respirators may also present communication problems, vision problems, worker fatigue and reduced work efficiency (63 FR 1156, January 8, 1998). According to OSHA, 'improperly selected respirators may afford no protection at all (for example, use of a dust mask against airborne vapors), may be so uncomfortable as to be intolerable to the wearer, or may hinder vision, communication, hearing, or movement and thus pose a risk to the wearer's safety or health. (63 FR 1189-1190).'"

Adding to these limitations is the difficulty of implementing an effective respirator program in the small establishments where much TCE use and exposure occur.[174] The OSHA respiratory protection standard (29 CFR 1910.134) contains numerous elements, *e.g.,* for program administration; worksite-specific procedures; respirator selection; employee training; fit testing; medical evaluation; and respirator

[173] 82 Fed. Reg. 7445

[174] A recent study of health care workers confirms the difficulty of an efficient respirator fit on men with beards. I. Sandaradura et al, *A close shave? Performance of P2/N95 respirators in healthcare workers with facial hair: results of the BEARDS (BEnchmarking Adequate Respiratory DefenceS) study*, Journal of Hospital Infection Volume 104, Issue 4, April 2020, Pages 529-533.

cleaning, maintenance, and repair. These requirements would be beyond the resources or expertise of, say, a small machine shop or metal plater, which would likely lack any previous experience with respirator programs. The difficulty of compliance would be magnified by the nature of the workforce in these shops, which is likely to have high turnover and many part-time employees with little or no industrial hygiene sophistication. Training these workers to use respirators conscientiously would be a huge challenge. And given the number and nature of the businesses involved, meaningful oversight by OSHA would likely be non-existent.

### C. OSHA Regulations Do Not Support EPA Claims that Employers Must Implement PPE

EPA has repeatedly suggested that OSHA regulations obligate employers to implement PPE where necessary to provide effective protection against chemical risks. But OSHA regulations do not require employers to follow the recommendations in an SDS, and the preamble to OSHA's hazard communication rule expressly states that "there is no requirement for employers to implement the recommended controls."[175] Moreover, OSHA regulations give employers wide latitude to interpret evidence of workplace risks and to select worker protection measures they deem appropriate. Thus, OSHA's PPE standard requires employers to assess the hazards workers face but to provide PPE only when the employer deems such measures "necessary." [176] As noted above, OSHA's decades old PEL for TCE is far higher than current science requires and does not mandate specific worker protections for TCE at the levels determined by EPA to present unreasonable risks. There is no evidence that employers are uniformly implementing PPE or workplace controls sufficient to eliminate these risks in the absence of any legal obligation to do so.

The draft TCE risk evaluation explains the well-established "hierarchy of controls" for protecting workers as follows:[177]

> "OSHA and NIOSH recommend that employers utilize the hierarchy of controls to address hazardous exposures in the workplace. The hierarchy of controls strategy outlines, in descending order of priority, the use of elimination, substitution, engineering controls, administrative controls, and lastly personal protective equipment (PPE). The hierarchy of controls prioritizes the most effective measures first which is to eliminate or substitute the harmful chemical (e.g., use a different process, substitute with a less hazardous material), thereby preventing or reducing exposure potential. Following elimination and substitution, the hierarchy recommends engineering controls to isolate employees from the hazard, followed by administrative controls, or changes in work practices to reduce exposure potential (e.g., source enclosure, local exhaust ventilation systems) . . . As the last means of control, the use of personal protective equipment (e.g., respirators, gloves) is recommended, when the other control cannot reduce workplace exposure to an acceptable level."

[175] Hazard Communication, 77 Fed. Reg. 17574, 17693 (Mar. 26, 2012).
[176] 29 C.F.R. § 1910.132(a).
[177] TCE Risk Evaluation at 119.

Thus, the SACC review of the HBCD evaluation stressed that "[m]any Committee members were concerned with the reliance on PPE or engineering controls to reduce risk, as that is contrary to the hierarchy of controls."[178]

Consistent with the hierarchy of controls and the SACC's consistent recommendations, EPA's risk determinations for TCE should assume no PPE use. How to then eliminate TCE's unreasonable risks to workers should be decided in the later TSCA risk management phase and PPE should be considered as a last resort, only after other means of control such as chemical substitution and engineering controls have been shown to be inadequate.

## VIII. EPA Must Abandon its Flawed TSCA Systematic Review Method and Apply Scientifically Valid and Peer-Reviewed Systematic Review Methodologies

Like previous evaluations, EPA is using "systematic review" criteria developed by the TSCA program[179] to evaluate the quality of available data on TCE. Our organizations have previously commented that the TSCA method represents a deeply flawed and unscientific approach to systematic review that will compromise the quality, validity and protectiveness of the 10 risk evaluations.[180] These concerns were summarized in a recent peer-reviewed commentary published in the *American Journal of Public Health*.[181]

"Systematic review" is a well-established approach for evaluating and integrating scientific evidence to arrive at judgments about hazard, exposure and risk. The EPA framework risk evaluation rule recognizes the need for a systematic review process in determining chemical risks under TSCA.[182] However, the TSCA method departs radically from accepted scientific principles for systematic review adopted by the IOM,[183]

[178] SACC Report on 1,4-dioxane and HBCD, at 73.
[179] 83 Fed. Reg. 26998 (June 11, 2018); Application of Systematic Review in TSCA Risk Evaluations, available at https://www.epa.gov/sites/production/files/2018-06/documents/final_application_of_sr_in_tsca_05-31-18.pdf
[180] Comments of Safer Chemicals Healthy Families et al. on Application of Systematic Review in Risk Evaluations under Section 6 of the Amended Toxic Substances Control Act, August 16, 2018, Docket ID EPA-HQ-OPPT-2018-0210. We incorporate these comments by reference.
[181] Singla V, Sutton P, Woodruff TW. (2019) The Environmental Protection Agency Toxic Substances Control Act Systematic Review Method May Curtail Science Used to Inform Policies, With Profound Implications for Public Health. Am J Public Health. doi: 10.2105/AJPH.2019.305068
[182] 82 Fed. Reg. 33726, 33734 (July 20, 2017).
[183] Institute of Medicine. Finding What Works in Health Care. Standards for Systematic Review. Washington, D.C.: The National Academies Press.; 2011.

the NTP[184] and EPA's Integrated Risk Information System (IRIS)[185] and endorsed by the NAS[186] and other peer review bodies.

The TSCA approach applies a rigid scoring system to grade the "quality" of studies on chemicals. This system could result in many studies being arbitrarily classified as "poor" or "unacceptable" based on a small number of reporting or methodology limitations that do not negate their overall value for assessing health and environmental risks. The consequence will be that important evidence of public health impacts – particularly epidemiological studies demonstrating harm in human populations – will be either disregarded or given limited weight in risk evaluations. Other systematic review methodologies do not use numerical scoring systems for assessing study quality and the NAS recommends strongly against such scoring.

The TSCA approach also focuses on one limited aspect of systematic review – study quality – but fails to address other critical elements that the Agency itself recognizes are essential for science-based risk judgments. EPA's July 2017 risk evaluation framework rule defines systematic review as a comprehensive, consistent and transparent process to "identify and evaluate each stream of evidence" and "to integrate evidence as necessary and appropriate based on strengths, limitations, and relevance."[187] Yet the TSCA document lacks any protocol for these important tasks. Experts agree that a protocol for the review needs to be established in advance of individual evaluations to eliminate the potential for bias and to assure that evidence reviews are conducted using consistent, well-defined criteria. EPA's failure to take this necessary step *before conducting risk evaluation*s has severely compromised the scientific validity of the 10 initial TSCA risk evaluations.

Recent draft risk evaluations have also been based on a "hierarchy of preferences," a new concept that was not part of the original TSCA systematic review document and has likewise not been subject to peer review or public comment. The 1-BP evaluation briefly explains this approach as follows:[188]

> "EPA's approach uses a hierarchy of preferences that guide decisions about what types of data/information are included for further analysis, synthesis and integration into the environmental release and occupational exposure assessments. EPA prefers using data with the highest rated

[184] National Toxicology Program. Handbook for Conducting a Literature-Based Health Assessment Using OHAT Approach for Systematic Review and Evidence Integration. In: U.S. Department of Health and Human Services, editor.: Office of Health Assessment and Translation, Division of National Toxicology Program, National Institute of Environmental Health Sciences; 2015.
[185] National Research Council. Review of EPA's Integrated Risk Information System (IRIS) Process. Washington, DC: National Academies Press; 2014.
[186] National Research Council. Review of EPA's Integrated Risk Information System (IRIS) Process. Washington, DC: National Academies Press; 2014; National Research Council. Review of the Environmental Protection Agency's State-of-the-Science Evaluation of Non Monotonic Dose–Response Relationships as They Apply to Endocrine Disruptors. Washington, DC: National Academies Press; 2014; National Academies of Sciences, Engineering, and, Medicine. Application of Systematic Review Methods in an Overall Strategy for Evaluating Low-Dose Toxicity from Endocrine Active Chemicals. Washington, DC: 2017.
[187] 40 C.F.R. 704.33.
[188] Draft Risk Evaluation for 1-Bromopropane, August 2019, at 45, available at https://www.epa.gov/sites/production/files/2019-08/documents/01._1bp_draft_risk_evaluation_hero_links_external.pdf.

quality among those in the higher level of the hierarchy of preferences (i.e. data>modeling>occupational exposure limits or release limits)."

EPA does not explain why some types of studies should receive preference over others in determining the weight of evidence for a particular endpoint and on what basis these studies should be assigned to a "higher level." Thus, there are no objective criteria for determining which evidence to rely on and which to exclude, undermining transparency and consistency in the systematic review process and encouraging subjective judgments.

As reflected in the draft MC evaluation, EPA has also updated the TSCA data quality criteria for epidemiological studies.[189] The updated criteria make it more difficult for epidemiological studies to be scored as high quality and thus limit the weight they receive in the MC evaluation, reflecting a consistent tendency by the EPA TSCA program to downplay the value of human evidence. EPA has failed to explain or justify the updated criteria.

In its peer review of the draft risk evaluation of PV29, the EPA SACC highlighted the following areas of concern with the TSCA systematic review method:

- "The Agency rationale for developing the TSCA SR should include a comparison to other SR approaches and describe the rationale for major differences."[190]
- "The Committee discussed the need to publish peer reviewed pre-established protocols for each of the Agency's reviews prior to performing the actual risk assessment. The protocol for PV29 was created concurrently with the review, which is contrary to best practices for systematic reviews."[191]
- "The Committee noted that the TSCA SR weighted scoring system may be inappropriate if there is disagreement in the weighting of different metrics. For example, a certain study characteristic that may be a 'fatal flaw' would be weighted equally to other more minor elements. The Agency should provide justification for using a weighted scoring system and the rationale for the specific metrics used for differential weighting in its evaluation of studies."[192]
- "Regarding data integration, the Committee discussed the benefits of including a more thorough and inclusive data integration discussion in the TSCA SR for PV29 … there is a need in the Evaluation for a thorough description and outline for how all evidence and data are integrated into a final weight of evidence conclusion."[193]

[189] The completed data quality evaluation for MC epi studies using the updated criteria can be found in the Supplemental File: Data Quality Evaluation of Human Health Hazard Studies – Epidemiological Studies (Oct. 2019), https://www.epa.gov/sites/production/files/2019-10/documents/10_draft_systematic_review_supplemental_file_data_quality_evaluation_of_human_health_hazard_studies_-epidemiological_studies.pdf.Systematic Review Supplemental File.
[190] PV29 SACC Report at 26.
[191] Id. at 27.
[192] Id. at 26-7.
[193] Id. at 27.

The SACC also strongly recommended that EPA move forward with National Academy of Sciences (NAS) review of its TSCA systematic review method – a commitment on which EPA dragged its feet for months until recently initiating the NAS review.[194]

The SACC's concerns were forcefully underscored in its review of the 1,4-dioxane risk evaluation:[195]

> "Committee members did not find the systematic review to be a transparent and objective method to gather the relevant scientific information, score its quality, and integrate the information. Several Committee members brought up examples of references that were not in the systematic review bibliography and/or not considered in the Data Quality evaluation step, but which were used at different stages in the Evaluation. Several Committee members found that it was difficult to determine whether the relevant information was properly evaluated and considered in the Evaluation."

The SACC "noted problems with both the systematic review design and consistent implementation of its protocols," elaborating that:[196]

> "Signs that the systematic review design has issues include the need for 'backward reference searching' or 'targeted supplemental searches,' which shouldn't be required if the initial search finds all the relevant references. Similarly, the Committee noted a high fraction of studies where the initial quality score was later changed, indicating that the data quality evaluation protocol is not clearly defined and possibly inconsistently implemented by different reviewers. The automated gray literature search found mostly several off-topic documents and also missed other useful documents."

The SACC report further indicated that "[s]everal Committee members recommended simplifying the scoring system or adopting an existing peer-reviewed method, such as the method used by the National Toxicology Program's Center for the Evaluation of Risks to Human Reproduction (NTP-CERHR)."[197]

The SACC report on the 1-BP draft evaluation noted "challenges in following how the studies identified for data integration during the SR were applied throughout the draft evaluation."[198] It elaborated that:

> "Members noted that studies identified for data integration were difficult to match with references cited in the bibliography. There are occasional cases where key references and data used in the risk characterization did not go through data quality evaluation (DQE) at all, although that is the Committee's expectation. Members noted that there were multiple instances where the explanation of why papers rated highly in the DQE but not used in the draft risk evaluation was missing or incomplete. The Committee identified at least one instance where a study was rated low under data quality evaluation based on a reference not being available. Committee members were able to readily obtain that reference in the public literature with a simple search. Examples such as this

[194] https://www8.nationalacademies.org/pa/projectview.aspx?key=51889
[195] 1,4-Dioxane and HBCD SACC Report, at 30.
[196] Id. at 31.
[197] Id.
[198] SACC Report on 1-BP, at 12.

suggest that there is continued room for improvement in EPA's internal processes for SR. The Committee also identified several areas where corrections or additional clarification is needed."

Even though EPA did not include a question on systematic review in its charge, the SACC report on methylene chloride reiterated concerns about the arbitrariness of EPA's scoring system:[199]

> "The use of the human studies for POD again highlighted how standards across types of studies should be applied more uniformly. Minor issues with studies deemed relevant to human health hazard can lead to a rating of "unacceptable" while studies for other topics (examples in Table 1-1, Evaluation page 39) that have no mention of methods are rated "low" for that criterion, yet end up being rated "high" overall.
>
> Discussion indicated that there are several definitions of "unacceptable," and different Committee members use or envision this term differently. The Agency's use of "unacceptable" relates to how the results of a study are used in the WOE argument. The Committee noted that the criteria for human health studies in animal models are disproportionately stringent, since use of a single dose, as done by Putz et al. (1979), would rate such a study as unacceptable. The Committee raised these issues previously, and the Committee again recommends improvement of the systematic review process, including the definition and use of "unacceptable" studies in TSCA risk evaluations. The Committee reiterates that single dose studies can contain useful information and should not be ranked "unacceptable" just for having a single dose."

**Thus far, the serious issues and concerns raised repeatedly by the SACC have not been addressed by EPA in its most recent draft evaluations. At a minimum, EPA's final risk evaluations must respond fully to the SACC's comments.**

**The SACC and others have raised more far-reaching concerns about the scientific validity and underpinnings of the TSCA systematic review method. Belatedly, EPA is finally following through on its commitment to seek an NAS review of its method, a course that the SACC has repeatedly recommended and to which EPA agreed nearly a year ago. While the NAS review is progressing, EPA should abandon the TSCA systematic review method immediately and not use it in developing final risk evaluations. Instead, it must adopt one of the recognized systematic review methodologies developed by IOM, NTP and EPA's IRIS program and endorsed by the NAS and other peer review bodies.**

## IX. EPA's Determinations that Individual Conditions of Use of TCE Pose "No Unreasonable Risk" Violate TSCA

EPA's draft risk evaluation proposes to determine that individual conditions of use of TCE pose no

[199] SACC Report on Methylene Chloride, at 52.

unreasonable risk of injury to human health. Draft Risk Evaluation at Table 5-1. This "use-by-use" approach to risk determinations is unlawful and threatens to prevent EPA from eliminating the unreasonable risks posed by TCE. TSCA commands that EPA determine "whether" "a chemical substance"—not particular uses of a chemical substance—presents an unreasonable risk in a single, comprehensive determination. 15 U.S.C. § 2605(b)(4)(A); *see id*. § 2605(a) (requiring risk-management rule if "any combination of" a chemical's conditions of use presents "an unreasonable risk").[200] TSCA section 6(b)'s requirement that EPA determine "whether" the substance poses an unreasonable risk "indicates a binary choice." *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1355-56 (2018). This holistic risk determination for TCE must reflect EPA's evaluation of all of TCE's conditions of use considered in combination, and EPA must "integrate and assess available information on hazards and exposures" for all of TCE's uses, including where relevant "the likely duration, intensity, frequency, and number of exposures under the conditions of use of the chemical substance." 15 U.S.C. § 2605(b)(4)(F)(i), (iv). Piecemeal determinations that isolated conditions of use of TCE pose "no unreasonable risk" violate TSCA's plain language.

**EPA must revise its risk evaluation for TCE to make a single risk determination for the chemical substance as a whole. Based on EPA's findings that some conditions of use present unreasonable risks to health, EPA must conclude under TSCA section 6(b)(4)(A) that TCE presents an unreasonable risk to human health.**

## Conclusion

We appreciate this opportunity to comment on the draft TCE risk evaluation.

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[200] To the extent that EPA's regulations purport to allow this "use-by-use" approach to risk determinations, *see* 40 C.F.R. §§ 702.41(a)(9), 702.47, 702.49(d), the regulations are unlawful and violate TSCA.