BEFORE THE ENVIRONMENTAL PROTECTION AGENCY

Comments on Trichloroethylene; Regulation Under
the Toxic Substances Control Act
(TSCA)
88 Fed. Reg. 74712 (October 31, 2023)
EPA-HQ-OPPT-2020-0465

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The Halogenated Solvents Industry Alliance, Inc. (HSIA) represents manufacturers and users of chlorinated solvents, including trichloroethylene (TCE). A list of HSIA's members is attached (Attachment A). We appreciate the opportunity to provide these comments in response to the proposed rule governing the manufacture, processing, and use of TCE under the Toxic Substances Control Act (TSCA), 88 Fed. Reg. 74712 (October 31, 2023). The proposed rule would impose limits on worker exposure which are much more restrictive than those imposed by the Occupational Health & Safety Administration (OSHA) or in effect elsewhere in the world. We address in turn below a number of significant deficiencies in the proposed rule that show it is not based on best available science or supported by substantial evidence, as required by TSCA.

As will be discussed more fully below, the proposed rule would ban most of the dozens of current conditions of TCE use, where EPA found unreasonable risk to workers. For a handful of conditions of use not prohibited, EPA proposes phaseouts with the requirement that Workplace Chemical Protection Programs (WCPPs) be implemented pending the phaseout. The WCPPs must include an Existing Chemical Exposure Limit (ECEL) of 0.0011 parts per million (ppm) (8-hour time weighted average (TWA)). This equates to 1 part per billion (ppb), which is close to a typical concentration of TCE in urban air.[1] The proposed ECEL value is based on developmental effects and is intended to address unreasonable risk for cancer as well as for non-cancer effects.

EPA describes the proposed ECEL for TCE as "the concentration at which an individual. . . would be unlikely to suffer adverse effects if exposed for a single 8-hr workday."[2] EPA is, therefore, setting the unreasonable risk standard at the ECEL -- a level which prevents likelihood of any adverse effect -- rather than proposing an ECEL which mitigates only unreasonable risk, as required by TSCA. TSCA does not direct EPA to eliminate *any* adverse effect of a chemical; it requires EPA to prevent unreasonable risks to the extent necessary. As discussed further below, setting an ECEL at a level to eliminate all risk would impose sweeping restrictions on the use of TCE that would be inconsistent with TSCA.

[1] 1 part per billion is 1 second in 32 years.

[2] 88 Fed. Reg. at 74721.

The deficiencies in EPA's Risk Evaluation,[3] on which the proposed rule is based, are addressed in Section III below. Before turning to the Risk Evaluation, however, we address in Section II the fundamental problem inherent in the proposed rule, which is that it would require owner/operators to achieve workplace exposures that are (i) not feasible, and (ii) not reliably measurable in workplaces with existing technology. We then make several recommendations specific to the proposed rule and WCPP implementation, including:

- Additional time is needed for WCPP development and ECEL implementation requirements to accommodate any new occupational exposure limit as low as the proposed ECEL.
- Monitoring technologies must be identified and lab methodologies verified for the proposed ECEL.
- Industrial hygiene professionals will need time to plan for revised risk assessments at each facility to accommodate the new ECEL and account for the much lower limits of detection (LODs).
- The WCPP should clarify that values may be evaluated for tasks as well as full shifts.
- The final rule should allow for more realistic potential exposure assumptions to be included in the ECEL formula.

The extremely low ECEL proposed by EPA is 90,000 times lower than the OSHA workplace limit, and 9000 times lower than workplace limits in effect in other countries.[4] If adopted, this would obviously have major implications for the competitiveness of American manufacturing. We submit that this divergence from every other country in the world also indicates that something is profoundly wrong with EPA's "unreasonable risk" findings, of which TCE, on the evidence of Attachment B, is the most extreme.

In a case of similar overreach by OSHA, involving comparable language in the Occupational Safety and Health Act ("OSH Act") defining an occupational safety and health standard as one "reasonably necessary or appropriate to provide safe or healthful employment," the Supreme Court found a duty on OSHA's part to make a finding that a workplace exposure

[3] EPA, Risk Evaluation for Trichloroethylene, #740-R1-8008 (November 2020) (hereafter "Risk Evaluation"); EPA-HQ-OPPT-2016-0737-0127.

[4] The table at Attachment B compares the ECEL for TCE (and those proposed/expected for a number of other compounds) to workplace limits in effect in France, Germany, Canada, and Mexico, as well as the OSHA limits.

was unsafe before adopting a workplace standard.[5] OSHA must quantify a "certain" level of risk and conclude that it is "significant" before regulating.[6] These findings must be supported by substantial evidence. The comments that follow show how EPA, in implementing a statute of similar vintage and wording (the OSH Act was enacted in 1970; TSCA in 1976) has departed from the TSCA statutory directive.

I. SUMMARY LEGAL FRAMEWORK

TSCA provides EPA authority to regulate the use of chemical substances, to impose reporting, record-keeping and testing requirements, and to limit conditions of use. Section 6(a), relevant here, requires EPA to promulgate regulations to restrict the use of chemical substances where they "present[] an unreasonable risk of injury to health or the environment." Section 6(a) permits EPA to limit, condition, and prohibit the use of any chemical substance where it presents an unreasonable risk. As noted above, Section 6(a) further states that EPA should apply requirements for addressing unreasonable risks "to the extent necessary so that the chemical substance or mixture no longer presents such risk."

TSCA § 6(c) provides that "In selecting among ... restrictions," EPA "shall factor in, to the extent practicable," considerations such as "the effects of the chemical ... on the environment," "the benefits of the chemical substance or mixture for various uses," and "the reasonably ascertainable economic consequences of the rule. The assessment of economic consequences must include the "costs and benefits" and the "cost effectiveness" of the "proposed and final regulatory action" as well as of at least one alternative. EPA must publish a statement discussing those factors. If a regulation would operate "in a manner that substantially prevents a specific condition of use of a chemical," EPA must consider "whether technically and economically feasible alternatives that benefit health or the environment, compared to the use so proposed to be prohibited or restricted, will be reasonably available as a substitute."

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[5] *Industrial Union Department, AFL-CIO v. American Petroleum Institute, et al.,* 448 U.S. 607 (1980) (*"Benzene"*).

[6] "By empowering the Secretary to promulgate standards that are 'reasonably necessary or appropriate to provide safe or healthful employment and places of employment,' the Act implies that, before promulgating any standard, the Secretary must make a finding that the workplaces in question are not safe. But 'safe' is not the equivalent of 'risk-free.' There are many activities that we engage in every day -- such as driving a car or even breathing city air -- that entail some risk of accident or material health impairment; nevertheless, few people would consider these activities 'unsafe.' Similarly, a workplace can hardly be considered 'unsafe' unless it threatens the workers with a significant risk of harm." *Id.* at 642.

The 2016 Lautenberg Act also added substantive requirements that appear in TSCA § 26. TSCA § 26(h): "In carrying out sections 4, 5, and 6, to the extent that the Administrator makes a decision based on science, the Administrator shall use scientific information. . .employed in a manner consistent with the best available science. . . and shall consider as applicable—(5) the extent of independent verification or peer review of the information. . . ." TSCA § 26(i): "The Administrator shall make decisions under sections 4, 5, and 6 based on the weight of the scientific evidence."

Finally, TSCA § 17(c) makes clear that both the final rule and the associated determination of unreasonable risk shall be held unlawful and set aside "if the court finds that the rule is not supported by substantial evidence in the rulemaking record taken as a whole."

II. THE PROPOSED RULE IS UNWORKABLE BECAUSE IT SEEKS TO REGULATE BELOW LEVELS WHICH MAY BE DIFFICULT RELIABLY AND PRACTICABLY TO MEASURE

For ongoing uses of TCE, the proposed inhalation ECEL is 0.0011 ppm (1.1 ppb), with a proposed alternative ECEL of 0.004 ppm (4.0 ppb), both orders of magnitude lower than the existing OSHA limit of 100 ppm. EPA has also proposed an "action level" for TCE exposure of 0.00055 ppm (0.55 ppb). This section addresses technical difficulties anticipated to monitor the ECEL, including when applying these methodologies to the actual workplace environments that can often cause a profound increase to the method limit of detection (LOD). And it is because of these monitoring technology challenges that Section III below addresses the additional time and considerations that should be incorporated into the final rule effectively to manage the WCPP and ECEL implementation.

A. Sensitivity of Existing Air Methods

EPA has acknowledged that "reducing and accurately detecting exposures from the current OSHA PEL of 100 ppm to the proposed TSCA ECEL of 0.0011 ppm would be very difficult."[7] Indeed, the proposal states "EPA does not believe that long-term implementation of the WCPP would be a feasible means of addressing unreasonable risk indefinitely; thus prohibition of the use of TCE for affected COUs is ultimately necessary to address the risk so

[7] 88 Fed. Reg. at 74737.

that it is no longer unreasonable."[8] For the reasons given throughout these comments, HSIA does not agree that a blanket ban is necessary or permissible under TSCA.

EPA solicits input from the regulated community regarding the feasibility of measuring air concentrations of TCE accurately at the level of the proposed ECEL. EPA also requests input on whether an interim TCE exposure level is warranted based on the LODs for currently available monitoring and analytical methods used to measure TCE in the breathing zone. Specifically, EPA requests comment on the potential use of the personal breathing zone LOD from OSHA Method 1001 of 18 ppb to establish an interim exposure value of 36 ppb and an action level of 18 ppb.[9] There are technical and feasibility challenges that may limit the ability to measure to LODs at or below the levels of the proposed TCE ECELs using current sampling and analytical methods. Further, it is even more difficult to achieve limits of quantitation (LOQ; the lowest concentrations at which a chemical can be reliably quantified) at the level of the proposed ECELs. Table 1 below summarizes select existing methods of assessing TCE concentrations in air, including available LODs, LOQs, and any challenges that the methods would face in measuring TCE concentrations at and below the proposed ECELs.

Table 1. Summary of Select TCE Air Monitoring Methods

Method	Sample Media	Limit(s) of Detection	Limit(s) of Quantification	Notes
OSHA 1001	Sorbent tubes or Passive dosimetry samplers	Charcoal tubes: 3.7 ppb SKC 575-002 Samplers[10]: 18 ppb	Charcoal tubes: 13 ppb SKC 575-002 Samplers: 61 ppb	Analytical Method: GC/FID Used as basis for proposed interim TCE exposure level

[8] *Id.* at 74736.

[9] *Id.* at 74738.

[10] While other types of passive badges exist, SKC 575-002 badges are specified by OSHA 1001.

Method	Sample Media	Limit(s) of Detection	Limit(s) of Quantification	Notes
NIOSH 1022	Solid Sorbent Tube (charcoal)	60 ppb	N/A	Analytical Method: GC/FID
Modified NIOSH 1022	Solid Sorbent Tube (charcoal)	N/A	NIOSH max volume (30L): 30 ppb[a] NIOSH max flow rate (96L): 10 ppb[b]	Analytical Method: GC/FID
Modified NIOSH 1022[c]	Solid Sorbent Tube (charcoal)	5.5 ppbv	N/A	Analytical Method: GC/MS Modified method for research purposes
EPA TO-15A	Stainless steel canister	Depends on analytical instrument platform	N/A	Analytical Method: GC/MS Not used for personal sampling
Modified EPA TO-15	Stainless steel canister (minicans)	N/A	0.8 ppbv	Analytical Method: GC/MS SGS Galson modified method

Notes:
FID = flame ionization detector; GC = gas chromatography; L = Liter; MS = mass spectrometry; N/A = Not available;; ppb = parts per billion; ppbv = parts per billion by volume; pptv = parts per trillion by volume

a) NIOSH documentation suggests an LOD of 60 ppb, but this is a modified method because individual labs may achieve lower LOD values based on the instrumentation and procedures used. This is an example from one of the IHLAP accredited labs.

b) NIOSH documentation suggests an LOD of 60 ppb, but this is a modified method because individual labs may achieve lower LOD values. This is an example from one of the IHLAP accredited labs. This calculation also includes the exceedance of the NIOSH maximum volume and accounts for the highest flow rate for 8 hours.

c) Duncan CM, Mainhagu J, Lin D, Brusseau ML. Analysis of trichloroethene vapour in soil-gas samples using solid-sorbent tubes with gas chromatography/mass spectrometry. Environ Chem. 2017;14(8):495-501. doi: 10.1071/EN17161. Epub 2018 Mar 16. PMID: 30598624; PMCID: PMC6309363.

For any of the below methods analyzed via mass spectrometry (MS) and separated with a chromatographic method, the LOD for any analyte can be affected by a number of analytical interferences. Analytical interference from the sample matrix or varying sample quality will often artificially inflate the background signal, requiring a stronger instrument response from the analyte for adequate detection, thereby increasing the LOD. As a result, while some reported instrument LODs for TCE are very low, application of these methods to different samples from actual workplace environments will often cause a profound increase to the method LOD, which may present challenges to TCE analysis. Further, each of the instrument parameters able to be changed has significant bearing on analytical capabilities, and may yield a wide range of LODs. Therefore, while analysis of TCE has been optimized through some of these methods, optimal instrumentation may be an obstacle for some analytical laboratories.

1. OSHA Method

EPA uses OSHA Method 1001 as the basis for the proposed interim exposure limit of 36 ppb. However, OSHA's documentation states that the reliable LOQ of the method for TCE is 61 ppb when using SKC-002 samplers. Thus, even though Method 1001 lists an LOD of 18 ppb for TCE, concentrations of TCE may not be able to be reliably quantified below 61 ppb using this method and specified sample device. Using sorbent tubes with coconut shell charcoal media, Method 1001 can achieve an LOD of 3.7 ppb, and an LOQ of 13 ppb**,** which are still higher than EPA's proposed ECELs and action level for TCE.

With OSHA Method 1001, analysis of indoor air samples is performed using gas chromatography (GC) separation followed by flame ionization detection (FID). While FID is typically a very sensitive detection method, TCE is highly chlorinated and therefore is more difficult to analyze with an FID detector compared to other more sensitive spectroscopic techniques.[11] Further, OSHA Method 1001 explains that when temperature or pressure are

[11] United States Pharmacopeia, 2007, "Considerations for Residual Solvent Analysis- USP Method 467."

unknown at the sampling site, analytical error associated with TCE measurements increases substantially.[12]

2. NIOSH 1022

NIOSH Method 1022 is a partially evaluated method that utilizes solid sorbent activated charcoal tubes to collect samples, followed by GC/FID for analysis of the sample desorbed from the charcoal media. NIOSH Method 1022 has a stated working range of 0.5 to 10 milligrams (mg) per sample, and the estimated LOD is 0.01 mg per sample. Based on the parameters of this method, the lowest LOD that could be achieved is approximately 60 ppb.[13] However, this assumes that the maximum air volume collected is 30 liters (L), as prescribed in Method 1022. Lower LODs may be achieved if greater air volume is collected during the sampling period, but the method has not been validated under those conditions. The methodology documentation does not describe impacts of temperature and humidity on the LOD or report an LOQ.

3. Modified NIOSH 1022

Each lab will have a slightly different LOD/LOQ based on its instrumentation and operating procedures, validation studies, and sample preparation methods. As an example, one American Industrial Hygiene Association (AIHA) Industrial Hygiene (IH) Laboratory Accreditation Program (IHLAP) accredited laboratory offers a modified NIOSH 1022 method which can achieve an LOQ of 30 ppb for a full-shift sample using GC/FID. If air volume is increased past the NIOSH method maximum to use the highest flow rate, an LOQ of 10 ppb may be achieved.

Additionally, a modified NIOSH Method 1022 using solid sorbent tubes for sample collection and gas chromatography with mass spectrometry (GC/MS) may result in lower detection limits for TCE. One study using this method determined that the quantitative detection limit for this modified method was 0.03 micrograms per liter (ug/L), or approximately 5.5

[12] Occupational Safety and Health Administration. "Tetrachloroethylene/Trichloroethylene OSHA Method 1001" at 18 (May 1999).

[13] Estimated LOD = 0.01 mg/ sample/30L (max volume) x 1000L (convert to $mg/m^{3)}$ x 24.45 (volume of mole at STP)/131 g/mol (molecular weight) = 0.062 ppm x 1000 = 62 ppb.

ppbv.[14] However, to our knowledge, this approach has not been widely used or adopted for industrial hygiene data collection.

4. EPA Method TO-15/ Modified TO-15

EPA Method TO-15, published in 1999, outlines a method for the collection and analysis of volatile organic compounds (VOCs) in air samples on a GC-MS platform. TO-15 sets a benchmark for quantifying 97 VOCs (including TCE) at a concentration as low as 0.5 ppbv. EPA TO-15 is not typically used for measuring VOC concentrations in the personal breathing zone for industrial hygiene data collection. Any use of EPA TO-15 for measuring TCE in the personal breathing zone would first require method validation, which is a time- and resource-intensive process. For example, the impact of field conditions on air flow regulator performance is one of several considerations that would require detailed evaluation.

Some IHLAP-accredited labs may offer a modified TO-15 that utilizes small summa canisters (minicans) for personal sampling and GC/MS for analysis. With this modified methodology, SGS Galson labs indicate that they can achieve an LOQ of 0.8 ppbv. The air flow intake regulator can be set to collect air over a working shift. While this modified methodology can achieve a low LOQ, based on real field experience, implementation of the methodology is made more difficult by low participant willingness and limited availability of minicans.

5. EPA Method TO-15A

EPA Method TO-15A is an updated version of TO-15 published in September 2019, that includes more sophisticated, sensitive GC-MS techniques designed to reduce limits of detection to facilitate detection of trace levels of VOCs in ambient air.[15] Like EPA Method TO-15, EPA TO-15A is not typically used for measuring VOC concentrations in the personal breathing zone for industrial hygiene data collection. Any use of EPA TO-15A for measuring TCE in the personal breathing zone would, again, first require method validation.

[14] Duncan CM, Mainhagu J, Lin D, Brusseau ML. Analysis of trichloroethene vapour in soil-gas samples using solid-sorbent tubes with gas chromatography/mass spectrometry. Environ Chem. 2017;14(8):495-501. doi: 10.1071/EN17161. Epub 2018 Mar 16. PMID: 30598624; PMCID: PMC6309363.

[15] Whitaker, D., K. Oliver, D. Turner, I. MacGregor, AND D. Shelow. Method TO-15A: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially. U.S. EPA Office of Research and Development, Washington, DC (2019).

According to the Agency for Toxic Substances and Disease Registry (ATSDR), analyses of TCE in air samples collected consistently with TO-15A demonstrated GC-MS LODs as low as 0.1 pptv.[16] However, others performing the same analysis calculated LODs that ranged from 1.9 ppt to 15 ppt. According to Eurofins, a contract testing laboratory, for routine TO-15A indoor air sample analysis for TCE, method detection limits (MDLs) are generally approximately 0.1 ppbv, and LODs may reach 0.8 ppbv. However, in estimating the LOQ by using the function LOQ=3.3*LOD, LOQs for TCE may be as high as 2.6 ppbv. Based on the proposed ECELs for TCE, some instrumental setups for EPA TO-15A may not be sensitive enough to reliably quantify TCE concentrations at the ECEL levels.

Further, according to TO-15A, moisture that is co-collected with air samples can cause losses of VOCs. In low humidity conditions, VOCs will degrade in the canister, whereas if the relative humidity is higher, there will be less of a loss of VOC in the sample. It also is worth noting that to achieve these low LODs, this method details more stringent canister cleanliness criteria, and the canisters typically require electropolishing or a special coating, which may be associated with a higher cost and lower availability. Differences in analytical instrumentation may also affect method LODs. Both TO-15 and TO-15A are vague as to the defined requirements for analytical instrumentation, allowing the use of almost any GC-MS system for the analysis. The ambiguity in GC system requirements and MS construction may lead to instrumental and method LOD discrepancies between instrument configurations.

B. Implications for Industrial Hygiene Monitoring and Risk Management

It is also important to note that general industrial hygiene best practice is to identify methodology that has a LOD/LOQ that is significantly lower than the target measurement. This is to account for factors in the field that could impact the LOQ such as environmental conditions, sample length, and sample volume, as well as the variability inherent to sample analysis, and to minimize the likelihood and impact of censored data. Although not a "bright line," targeting quantitative LODs that are 10 percent or less of the occupational exposure limit (OEL) has been suggested. Additionally, decision analyses that are based on the fraction of the samples that might approach the OEL are commonly used. This risk management decision technique requires detection to be well below the OEL. An LOQ that is close to the target measurement leaves only

[16] Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Trichloroethylene (TCE). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service (2019).

a small buffer; therefore, changes in the field that impact sample collection could result in samples below the LOQ and thus decrease the utility of the data for risk-informed decisions.

Participant willingness would also pose a challenge for using these air monitoring methodologies for personal sampling. Workers may be reluctant to carry sampling equipment over the course of a workday. For example, in the case of Method TO-15A, while stainless steel canisters are available in smaller sizes such as 1 L, workers may be reluctant to carry even a smaller canister, plus any associated equipment, during an entire workday.

Training for these specialized field and sampling methods is limited and would need to be developed for widespread adoption under the risk management rule. Additionally, for methods that are not commonly used, supplies (*e.g.,* minicans) tend to be limited and not widely available. Further, due to the limited options for sufficiently sensitive methods, it is likely that those subjected to the risk management rule will be bottlenecked by limited laboratory capability and capacity. These logistical barriers increase cost and limit the practical feasibility of these methods.

EPA proposes that owners or operators of workplaces subject to the rule would be required to demarcate the regulated area in each workplace where the ECEL is determined to be exceeded based on initial exposure monitoring. To do so, owners/operators typically rely on direct reading instruments to demarcate the regulated area in real-time. This is particularly important given that task-based work scenarios, and thus, the regulated area, may shift over time. However, the options for sampling, and for direct reading of TCE specifically, rather than of total VOCs, are limited. In short, the sampling methodologies available at present are not sufficient for what is required under the proposed rule, both in terms of measuring concentrations of TCE down to the ECEL as well as providing direct reading capabilities for assessing potential exposures within the regulated area.

C. Summary of Challenges with Existing Analytical Methods

Overall, as outlined in these comments, there are limited options for measuring TCE concentrations in the personal breathing zone at levels commensurate with EPA's proposed ECELs and action level. While some methods (namely, modified TO-15 and TO-15A) are theoretically sufficiently sensitive to accurately measure TCE concentrations at or below the ECELs, they are not practically achievable in the field. The proposed feasibility-based interim exposure value of 36 ppb and action level of 18 ppb also are not achievable using current

methods. Analytically feasible limits are consistent with current practice in the occupational health field (*e.g.*, as is done for NIOSH Recommended Exposure Limits (RELs)); however, these benchmarks should be set using the LOQ or typical method reporting limits rather than the LOD. Moreover, given that the proposed ECELs are far lower than necessary to protect worker health (*i.e.*, include a large margin of safety based on the underlying ECEL derivation bases), the use of a LOQ-based limit is a reasonable alternative option to reliance on the proposed ECEL values and action level. The LOQ-based limits can be considered as metrics to verify progress towards a general best practice goal of lowering occupational exposures over time.

Finally, monitoring methodologies, laboratory availability, monitoring protocols and control development, training, and implementation all require time to implement a new ECEL, particularly one significantly lower and more conservative than the limit currently in effect. EPA should extend the time in § 751.311 to implement the WCPPs.

III. WCPP IMPLEMENTATION CONCERNS

Monitoring methodologies, laboratory availability, monitoring protocols and control development, training and implementation all require time to implement any new ECEL, particularly one significantly lower and more conservative than the PEL currently in effect. EPA should extend the compliance timeline in § 751.311 to implement the WCPPs required under the regulations.

A. Time is needed for monitoring methodology validation and lab availability

As described in the previous section, the evaluation and implementation of a monitoring methodology will take additional time and resources. To allow proper implementation of the steps and time taken to assess or reassess an IH program for a new ECEL, at a minimum EPA should revise § 751.311(b)(3)(ii) to allow 18 months for the initial TCE exposure monitoring requirement. A typical IH reassessment at a facility, as described below in this subsection, takes approximately 12 months. OSHA also allowed 12 months for the initial exposure assessment in the beryllium standard (29 CFR § 1910.1024(d), (o)). But particularly for TCE, at least 18 months is needed for the exposure reassessment and the method revalidation as described above as well as to address the specific implementation and technical feasibility challenges of measuring the TCE ECEL for both the full shift and task measurements. Additionally, corporate and facility IH resources and third party labs may also be conducting a reassessment and analysis

for other risk management rules (IH assessments associated with methylene chloride or perchloroethylene, for example), which may lead to additional time delays. With these resource constraints, particularly for a proposed TCE limit that is 90,000 times lower than the existing PEL, at a level where monitoring will require new lab validations and/or monitoring methodologies, each facility will likely need more time to reassess its corporate exposure assessment strategy for the new ECEL evaluation.

A typical exposure assessment/reassessment strategy would include identifying and involving stakeholders in the re-evaluation, such as operations management, process engineers, PSM engineers, and HESS personnel. An exposure assessment/reassessment strategy may include confirming and/or reassessing the following exposure assessment goals and written plans for the ECEL evaluation:

1. Methods for systematic information gathering;
2. Confirm similar exposure groups (SEG) for the new ECEL;
3. Identify decision statistics and number of random samples that will be used to determine whether the exposure profile for a SEG is acceptable, unacceptable, or uncertain;
4. Identify exposure thresholds and appropriate exposure monitoring methods to meet thresholds;
5. Develop new monitoring procedures for new monitoring methodologies; and
6. Train to the new monitoring technology and/or methodology to ensure the proper execution of an exposure assessment strategy.

To proceed with an exposure reassessment against a new ECEL, each representative air sample that will be evaluated will be subject to a Qualitative Exposure Assessment to help determine the expected exposure category before attempting to perform exposure monitoring. The Qualitative Exposure Assessment includes identifying the following:

1. All tasks
2. The frequency/duration of each task
3. Estimate of quantity of stressor per task
4. Exposure controls in place for each task exposure.

Once the Qualitative Exposure Assessment is complete, the Quantitative Exposure Assessment (personal exposure monitoring) takes place. This step includes:

1. Obtaining and training to any new monitoring equipment or methodologies

2. Collecting the appropriate number of random samples (full-shift and tasks)

3. Performing statistical analysis on sample set, as appropriate

4. Comparing to exposure level

5. Decisions related to exposure profile. In addition to the reassessment strategy and implementation steps listed above, monitoring at the proposed ECEL and the proposed action level likely will require laboratory analysis (rather than direct measurement) that will delay the availability of results and make meeting a 6-month time frame challenging.

To allow proper implementation of the steps and time taken to assess or reassess an IH program for a new ECEL, given the potential resource constraints together with the new validations and methodologies that may need to be considered, at a minimum EPA should revise proposed § 751.311 to allow 12-18 months for the initial exposure monitoring requirement. It is important to note that during the reassessment the existing facility requirements will remain in place to protect workers as required by OSHA-mandated standard operating procedures (SOPs) and hazard assessments as well as facility-specific administrative, engineering, and personal protection controls, including respiratory protection requirements and permitting requirements.

B. Adequate time is needed to evaluate monitoring data, plan for and implement a performance-based WCPP

Additional time is needed by facilities to evaluate and implement a WCPP. This is consistent with the OSHA beryllium standard, which provided 36 months for evaluating and implementing engineering control requirements in a written exposure control plan (29 CFR § 1019.1024(f), (o)). An appropriate compliance deadline for evaluating the hierarchy of controls will allow entities adequately to plan for and implement the controls.

During the implementation time, protections would remain in place for workers through the existing OSHA requirements implemented by manufacturing and processing facilities such as hazard assessments, including dermal and respiratory protection requirements, and administrative controls such as SOPs and permit requirements.

Proposed § 751.311(c)(2) would require a detailed description of efforts to implement the control hierarchy in the exposure control plan (ECP). Importantly, manufacturing and processing facilities rely upon layers of protection rather than a single engineering or administrative control. Each of these layers would need to be reassessed upon completion of the initial exposure monitoring. The proposal indicates that respirator use would be permitted to supplement the exposure controls only after other feasible controls are determined to be

insufficient to achieve the ECEL. This does not recognize that currently respirator use is often required as an additional or secondary layer of protection on top of engineering controls *(e.g.,* inline sampling for sampling events). The discussion of the ECP suggests a rigid consideration of each of the steps in the control hierarchy, requiring that each step in the hierarchy be fully considered before moving to the next step. EPA should give greater flexibility to facilities when applying the hierarchy of controls to recognize there are often multiple layers of protection and the evaluation does not stop at a step when, for example, an inline sample mechanism is installed for routine samples.

To allow for the multi-layer evaluation with complex chemical manufacturing and processing facilities currently subject to OSHA requirements, we recommend that the time required to develop the plan (§ 751.311(b)(4)) be extended to 2 years from the completion of initial exposure monitoring to provide adequate time to evaluate and implement appropriate compliance approaches that are the least burdensome and most effective for workers. During the implementation time protections would remain in place for workers through the existing OSHA requirements implemented by facilities such as hazard assessments, including dermal and respiratory protection requirements, and administrative controls such as SOPs and permit requirements.

C. Exposure control plan and workplace information and training

The ECP requires a significant amount of information for this new regulatory requirement. The following comments include recommendations for streamlining the reporting requirements, removing some requirements regarding actions *not* taken which impose analysis of all potential actions, without a threshold for significance, that could dilute the documentation resources dedicated towards the controls that are identified for implementation and lead to regulatory uncertainty regarding when an item not listed becomes a violation. In general, where existing requirements and documentation exist to comply with the ECP § 751.311(c) requirements or the workplace information and training provisions in § 751.311(d), EPA should allow industrial facilities to reference existing documentation that describes controls in place or training requirements.

There follow comments associated with specific provisions of the ECP requirements in § 751.311(c)(2) by subsection:

§ 751.311(c)(2)(i): Many industrial facilities have robust hazard assessments and standard operating procedures describing the potential hazard and controls required, including PPE and actions that should be taken to prevent exposure to the hazards. For the ECP documentation requested by this subsection, EPA should allow industrial facilities to reference existing documentation relating to controls selected and in place. Additionally, the ECP should have the ability to describe how manufacturing and processing facilities rely upon layers of protection rather than a single engineering or administrative control.

§ 751.311(c)(2)(iii): This section should be removed as the provisions provide no additional value to the evaluation required in subsection (i) above. Requiring an entity to list every control not implemented and why the control not implemented does not work, without even a threshold for such an evaluation, creates administrative overwork that does not serve the purpose of documenting and implementing an ECP that meets the ECEL. This prong should be removed as a requirement.

EPA is encouraged to evaluate the ECP requirement to remove duplicative documentation requirements. Additionally, multiple references to documentation of actions that are not taken and actions that are not expected to result in exposures over the ECEL not only divert administrative resources away from the primary purpose of the ECP -- to document the exposure strategy, implementation of, and compliance with the WCPP -- but also counter the TSCA § 6(a) requirement that EPA regulate unreasonable risk to the extent necessary so that the chemical substance no longer presents such risk. A requirement to document the plan to achieve the ECEL may be seen as necessary; a requirement to document all actions not taken and/or actions or changes not anticipated to exceed the ECEL goes beyond the statutory mandate.

D. IH measurement and WCPP implementation should allow for use of the assigned protection factor (APF) for tasks to comply with the ECEL in a full shift

With the low levels of the ECEL as an 8-hour TWA, the proposed respiratory protection language in 40 CFR § 751.311(e) should be clarified so that an exceedance of the ECEL does not automatically default to a required use of the APF for the full shift. Employers should be allowed to implement IH assessments to compare to the ECEL TWA that separately measure(i) a task where potential exposure may occur (*i.e.,* 30 minutes for a sampling event); and (ii) the "rest of day" exposure (*i.e.,* 7.5 hours), where such tasks are not anticipated to have potential TCE exposure.

Effectively, this approach allows control banding to be focused on task-based scenarios that occur in well-characterized similar exposure groups (SEGs) instead of the full 8-hour data

("Control Band by Task Approach"). This approach of specifying controls for specific product uses is also included for compliance under European Union (EU) Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation (ECHA 2020). Furthermore, task-based control strategies are common in many industrial operations, particularly in chemical manufacturing. This is because the nature of many of the tasks with potential exposure are of short duration or of intermittent frequency. There are many guidance documents and reviews that reinforce the importance of task-based exposure controls and application of control banding concepts.[17] For this reason, it is very rare for a worker in chemical manufacturing to wear respiratory protection devices for the full shift.

In the Control Band by Task Approach, the use of the APF for a required respirator can be considered in evaluating compliance against the ECEL for a short-term task. For example, to compare to an 8-hr TWA ECEL, one would collect a short-term air sample (*e.g.,* 30 minutes) while a task is being performed, and apply the APF associated with the respiratory protection that is required and used for that task. An additional and separate air sample would be collected for the remainder of the shift to calculate an 8-hr TWA.

The following narrative illustrates how the Control Band by Task Approach could be implemented:

1. The IH risk assessment creates a similar exposure group (SEG) for employees that conduct sampling once a day;
2. A 30 min. "task" PBZ sample is taken on an employee conducting in-line sampling, during which time the employee is wearing a respirator with a specific APF that has been selected in compliance with the maximum use concentration (MUC) appropriate for the sampling period and as required by the facility's SOP and Hazard Assessment and/or the WCPP;
3. After the PBZ task sampling period, for the "rest of the day" tasks over the remaining 7.5 hours, the same employee will take a separate PBZ "rest of day" sample;
4. The APF associated with the respiratory protection used for the PBZ "task" PBZ sample will apply to the 30 min task sample taken, and then added to the PBZ rest-of-the day 7.5 hour sample to calculate an 8-hour TWA:

   [(PBZ task value x .5)/APF] + (PBZ rest-of-day value x 7.5) /8 = 8 hour TWA

[17] *E.g.,* National Institute for Occupational Safety and Health (NIOSH). Qualitative Risk Characterization and Management of Occupational Hazards: Control Banding (CB) (2009); available online at: https://www.cdc.gov/niosh/docs/2009-152/default.html; Zalk, D.M. Control Banding; A Simplified, Qualitative Strategy for the Assessment of Risks and Selection of Solutions, 210. Delft, The Netherlands: TU Delft Publisher (2010).

This approach would be effective in confirming that controls are in place for the short-term tasks and that the respirator use is sufficient (meets the MUC requirements) to cover any potential risk of exposure for that SEG task. The rest-of-the-day PBZ sample separates tasks where potential exposure is not expected and confirms that engineering controls are in place.

To allow for the Control Band by Task approach, 40 CFR § 751.331(e)(3)(ii) could be modified to read as follows *(new language in italics):*

> "For the purpose of this paragraph (f), the maximum use concentration (MUC) as used in 29 CFR 1910.134 must be calculated by multiplying the assigned protection factor (APF) specified for a respirator by the ECEL. *An employer may also utilize the MUC to evaluate a specific task measured separately within a full shift for comparison to the ECEL."*

The proposed language provides that MUCs could be used for short-duration exposure, as described in the example above for the CBT approach. The task-based exposure average is then combined with the exposure estimate for the remaining portion of the shift.

It is recommended that at least six samples are collected to demonstrate the MUC of the APF is appropriate for a SEG and evaluate compliance with the ECEL. This is based on AIHA guidance for assessing and managing occupational exposures, which states that according to statistical sampling theory, there is a point of diminishing returns above approximately six to ten measurements. Given the repetitive task exposure scenarios at TCE manufacturing facilities, a "rolling average" could be calculated based on the prior six measurements.

E. The Final Rule Should Allow for the ECEL Assumptions To Be Modified Based upon Facility-Specific Tasks with Potential Exposure

The acute exposure assumption of a constant 8 hours a day and the chronic constant exposure assumption of 8 hours/day for 250 days/year for 40 years is an extremely conservative exposure estimate in an overly conservative ECEL. Better data is available that should be used for manufacturing facilities, *e.g.*, a conservative potential exposure period of 2 hours/day and a high-end of years spent in these jobs of 29 years. The final rule should allow for more realistic assumptions to be included in the ECEL formula.

1. Hours potentially exposed during a day

Chlorinated organics manufacturing facilities have defined tasks with potential exposure (that include respiratory protection as a layer of protection) that take place, conservatively, 2 hours/day per employee. Assuming 250 days/year, that results in 500 hours/year. The

conservative assumption of tasks with potential exposure of 2 hours/day was provided to EPA in a presentation made to EPA on August 17, 2021 and included with the HSIA comments on the draft Revised Risk Determination for TCE.[18] EPA should allow facilities to document the window for any potential exposures as a part of the risk assessment and ECP for TCE.

2. The ECEL overestimates years of exposure

The chronic ECEL values estimate an employee will spend 40 years in a position conducting tasks with potential exposure. EPA's assumption of 40 years of exposure is not consistent with available data on employment tenure. The median employment tenure for workers in the chemical industry is 10 years or less, taking into account all age groups, according to the most recent Bureau of Labor statistics.[19] Data from the Employee Benefit Research Institute (EBRI), moreover, show that over the past 35 years, the median tenure with one employer of all wage and salary workers ages 25 or older has remained steady at approximately five years. It is most unlikely that a worker will change jobs to work at another TCE manufacturing facility, especially since there is only one domestic manufacturer and very few facilities that produce TCE unintentionally at low levels as a byproduct.

In terms of estimating a high-end employment tenure, the EBRI data show that approximately 80 percent of older workers (ages 55-64) have tenures at one employer of less than 25 years, and the current trend is consistently toward lower tenures.[20] EPA's assumption of 40 years for high-end exposures is very far outside the range of reasonable high-end exposure duration.

Based on the available information, a more appropriate assumption for the central tendency of exposure duration is in the range of 5 to 10 years (not 40 years), while a more appropriate assumption for high-end exposure duration is 25 years. This is consistent with other EPA risk assessment guidance (*e.g.,* EPA Regional Screening Levels).[21]

IV. THE RISK EVALUATION DOES NOT REFLECT BEST AVAILABLE SCIENCE OR THE WEIGHT OF THE SCIENTIFIC EVIDENCE

[18] EPA-HQ-OPPT-2016-0138 Attachment 1, Appendix 4, slide 10.

[19] https://www.bls.gov/news.release/tenure.nr0.htm

[20] https://www.ebri.org/content/trends-in-employee-tenure-1983-2018

[21] https://www.epa/risk/regional-screening-levels-rsls-users-guide

The OSHA Permissible Exposure Limit (PEL) for TCE, adopted in 1971, is 100 ppm.[22] The Threshold Limit Value (TLV©) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) is 10 ppm as an 8-hour TWA, 25 ppm as a short-term exposure limit (STEL). Compliance with the TLVs has long been recommended by HSIA members.

EPA, on the other hand, asserts that TCE is a known human carcinogen with developmental toxicity and immunotoxicity effects to justify much, much lower proposed limits, without regard to HSIA's extensive comments as described below. Notably, the Revised Risk Determination does not even mention these issues although HSIA had submitted a 76-page comment on them following publication of the Risk Evaluation.[23] Yet it is well-established that "[a]n agency must consider and respond to significant comments received during the period for public comment."[24]

A. The ECEL value derived from the fetal heart defects findings in the Johnson *et al.* (2003) study is not based on the best available science

1. Johnson *et al.* (2003) is a flawed and irreproducible study

The Risk Evaluation identifies and evaluates various non-cancer and cancer endpoints potentially associated with both acute and chronic TCE exposures, including developmental effects, immunological effects, reproductive toxicity, neurotoxicity, kidney toxicity, liver toxicity, and cancer. Immunosuppression was selected as the best overall non-cancer endpoint for deriving a POD related to acute TCE exposure, and a subsequent acute non-cancer ECEL for TCE (0.23 ppm) was released by EPA in 2021.[25]. However, in a subsequent ECEL derivation, EPA replaced the acute non-cancer endpoint of immunosuppression with that of the

[22] 29 C.F.R. part 1910, subpart Z.

[23] EPA, Trichloroethylene (TCE); Revision to the Toxic Substances Control Act (TSCA) Risk Determination (January 2023) (hereafter "Revised Risk Determination"), EPA-HQ-OPPT-0147; *see also* Trichloroethylene (TCE); Revision to Toxic Substances Control Act (TSCA) Risk Determination; Response to Public Comments (December 2022), EPA–HQ–OPPT–0151..

[24] *Perez v. Mortg. Bankers Ass'n*, 575 U.S. 92, 96 (2015).

[25] EPA, "Internal memorandum to J. Wolf re: Existing Chemical Exposure Limit (ECEL) for Occupational Use of Trichloroethylene," Existing Chemicals Risk Assessment Division, Selby-Mohamadu, Y (February 22, 2021); EPA-HQ-OPPT-2020-0642-0128.

developmental endpoint of congenital heart defects (CHDs),[26] and presented a revised acute non-cancer ECEL of 0.0011 ppm. This acute non-cancer ECEL of 0.0011 ppm, based on the developmental endpoint of CHDs, was then proposed as the ECEL.

EPA derived the ECEL of 0.0011 ppm (1.1 ppb) as an 8-hr time-weighted average (TWA) based on the flawed studies reported in Johnson *et al.* (2003)[27] as evidence that *in utero* TCE exposure causes fetal heart malformations. The increase in fetal heart defects from TCE exposure has not been replicated in three subsequent rat developmental studies, one of which was also a drinking water study similar in study design to Johnson *et al.* (2003) but enhanced to meet current EPA test guidelines and data quality standards. In the Risk Evaluation, there is considerable misrepresentation and incorrect information on all of these studies, which has been comprehensively documented in a report submitted to the EPA docket by ToxStrategies.[28] The extent to which EPA's Risk Evaluation supports Johnson *et al.* (2003) at the expense of a balanced scientific review is not only inconsistent with the requirements of the Lautenberg Act but violates fundamental principles of science.

Johnson *et al.* (2003) reported fetal cardiac defects in rats from research carried out at the University of Arizona and originally published ten years earlier by the same authors.[29] In the earlier-published study, there was no difference in the percentage of cardiac abnormalities in rats dosed during both pre-mating and pregnancy at drinking water exposures of 1100 ppm (9.2%) and 1.5 ppm (8.2%), even though there was a 733-fold difference in the concentrations. The authors reported that the effects seen at these exposures were statistically higher than the percent abnormalities in controls (3%). For animals dosed only during the pregnancy period, the

[26] EPA, "Internal memorandum to J. Wolf re: Second Existing Chemical Exposure Limit (ECEL) (Developmental Toxicity) for Occupational Use of Trichloroethylene," Existing Chemicals Risk Assessment Division, Jacobs, K. (March 31, 2022); EPA-HQ-OPPT-2020-0642-0025. The term "congenital heart defects" (CHDs) is used interchangeably, along with "cardiac" (heart) "defects," "malformations," and "abnormalities," and refers to adverse findings in the developing heart of the fetus or neonate in experimental animal, epidemiological, and/or clinical studies.

[27] 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.* 111: 289-292 (2003).

[28] ToxStrategies, Comments on USEPA Draft Risk Evaluation for Trichloroethylene – CASRN: 79-01-6, EPA 740-R1-8008 (February 21, 2020); EPA-HQ-OPPT-2019-0500-0052.

[29] Dawson, B, Johnson, PD, Goldberg, SJ, Ulreich, JB, Cardiac teratogenesis of halogenated hydrocarbon-contaminated drinking water, *J. Am. Coll. Cardiol. 21*: 1466-72 (1993).

abnormalities in rats dosed at 1100 ppm (10.4%) were statistically higher than at 1.5 ppm (5.5%), but those dosed at 1.5 ppm were not statistically different from the controls. Thus, no meaningful dose-response relationship was observed in either treatment group. Johnson *et al.* republished in 2003 data from the 1.5 and 1100 ppm dose groups published by Dawson *et al.* in 1993 and pooled control data from other studies, an inappropriate statistical practice, to conclude that rats exposed to levels of TCE greater than 250 ppb during pregnancy have increased incidences of cardiac malformations in their fetuses.

Johnson *et al.* (2003) has been heavily criticized in the published literature.[30] Moreover, as noted above, the Johnson *et al.* (2003) findings were not reproduced in a study designed to detect cardiac malformations;[31] this despite the participation of Dr. Johnson in the cardiac malformation evaluations using a technique similar to the one employed in the earlier Dawson *et al.* (1993) and Johnson *et al.* (2003) studies. No increase in cardiac malformations was observed in the second guideline study,[32] despite high inhalation exposures and techniques capable of detecting most of the malformation types reported by Johnson *et al*. (2003). The dose-response relationship reported in Johnson *et al.* (2003) for doses spanning an extreme range of experimental dose levels is considered by many to be improbable and has not been replicated by any other laboratory.[33] A third guideline study in drinking water was conducted to replicate the actual study design used in the Johnson *et al.* (2003) study; again, there was no increase in cardiac malformations.[34] Makris *et al.* (2016) from EPA claim that "Designing and conducting

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[30] Hardin, BD, Kelman, BJ, Brent, RL, Trichloroethylene and cardiac malformations, *Environ. Health Perspect.* 112: A607-8 (2004); Watson, RE, Jacobson, CF, Williams, AL, Howard, WB, DeSesso, JM, Trichloroethylene-contaminated drinking water and congenital heart defects: a critical analysis of the literature, *Repro. Toxicol.* 21: 117-47 (2006).

[31] Fisher, JW, Channel, SR, Eggers, JS, Johnson, PD, MacMahon, KL, Goodyear, CD, Sudberry, GL, Warren, DA, Latendresse, JR, Graeter, LJ, Trichloroethylene, trichloroacetic acid, and dichloroacetic acid: do they affect fetal rat heart development?, *Int. J. Toxicol.* 20: 257-67 (2001).

[32] Carney, EW, Thorsrud, BA, Dugard, PH, Zablotny, CL, Developmental toxicity studies in Crl:CD (SD) rats following inhalation exposure to trichloroethylene and perchloroethylene, *Birth Defects Res. (Part B)* 77: 405-412 (2006).

[33] "Johnson and Dawson, with their collaborators, are alone in reporting that TCE is a 'specific' cardiac teratogen." Hardin, BD, *et al.*, Trichloroethylene and cardiac malformations, *Environ. Health Perspect.* 112: A607-8 (2004).

[34] DeSesso, JM *et al.*, Trichloroethylene in drinking water throughout gestation did not produce congenital heart defects in Sprague Dawley rats. Birth Defects Res. 111: 1217-1233 (2019a).

an exact replica of Johnson et al. [2003] might be very difficult, if not impossible."[35] This statement is astonishing given that a fundamental principle of scientific research is the independent verification of data. The ability to reproduce the findings of studies provides a self-correcting process to the science and strengthens the evidence. The problem of the irreproducibility of scientific studies is a serious concern to the scientific community at large.[36] It is remarkable that EPA continues to rely on findings from an irreproducible study as the basis for assessing the human health risk of TCE.

Beyond the substantive methodological and interpretive critiques of Johnson *et al.* (2003) in the published literature, the California Office of Environmental Health Hazard Assessment (OEHHA) also rejected the study as deficient for regulatory consideration:

> "Johnson *et al.* (2003) reported a dose-related increased incidence of abnormal hearts in offspring of Sprague Dawley rats treated during pregnancy with 0, 2.5 ppb, 250 ppb, 1.5 ppm, and 1,100 ppm TCE in drinking water (0, 0.00045, 0.048, 0.218, and 128.52 mg/kg-day, respectively). The NOAEL for the Johnson study was reported to be 2.5 ppb (0.00045 mg/kg-day) in this short exposure (22 days) study. The percentage of abnormal hearts in the control group was 2.2 percent, and in the treated groups was 0 percent (low dose), 4.5 percent (mid dose 1), 5.0 percent (mid dose 2), and 10.5 percent (high dose). The number of litters with fetuses with abnormal hearts was 16.4 percent, 0 percent, 44 percent, 38 percent, and 67 percent for the control, low, mid 1, mid 2, and high dose, respectively. The reported NOAEL is separated by 100-fold from the next higher dose level. The data for this study were not used to calculate a public-health protective concentration since a meaningful or interpretable dose-response relationship was not observed. *These results are also not consistent with earlier developmental and reproductive toxicological studies done outside this lab in mice, rats, and rabbits: The other studies did not find adverse effects on fertility or embryonic development, aside from those associated with maternal toxicity (Hardin et al., 2004)*."[37]

Both transparency and independent validation of key findings of a study (reproducibility) are necessary in EPA's scientific assessments to ensure that the quality of published information

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[35] Makris, SL *et al.*, A systematic evaluation of the potential effects of trichloroethylene exposure on cardiac development. *Reprod. Toxicol.* 65: 341 (2016).

[36] McNutt, M, Reproducibility*, Science* 343: 229 (2014); Begley, CG, Ioannidis, JPA, Reproducibility in science. Improving the standard for basic and preclinical research. *Circulation Res.* 116: 116-126 (2015); Diaba-Nuhoho, P, Amponsah-Offah, M, Reproducibility and research integrity: the role of scientists and institutions. BMC Res. Notes 14: 451 (2021).

[37] California EPA Public Health Goal for Trichloroethylene in Drinking Water (July 2009), at 21 (emphasis added).

meets the standards of the scientific and technical community. Yet HSIA's attempts to obtain the raw data which formed the basis of the Johnson *et al.* (2003) study report were unsuccessful. When HSIA requested access to the data used by EPA in its evaluation of the dose-response relationship between TCE exposure and cardiac defects reported in Johnson *et al*. (2003), the Agency provided the spreadsheet, referenced as Johnson (2009) (HERO ID 783484) in the 2011 IRIS Assessment,[38] and indicated that was the entirety of the data evaluated. Examination of that spreadsheet reveals an absence of certain critical information including, most importantly, dates for any of the individual treatment/control animals.

Acknowledging the documented deficiencies in their paper (and the data provided to EPA), the authors published an erratum aimed at updating the public record regarding methodological issues for Johnson *et al.* (2003).[39] According to Makris *et al*. (2016):

> "[S]ome study reporting and methodological details remain unknown, *e.g*., the precise dates that each individual control animal was on study, maternal body weight/food consumption and clinical observation data, and the detailed results of analytical chemistry testing for dose concentration. Additional possible sources of uncertainty identified for these studies include that the research was conducted over a 6-yr period, that combined control data were used for comparison to treated groups, and that exposure characterization may be imprecise because tap (rather than distilled) drinking water was used in the Dawson *et al.* (1993) study and because TCE intake values were derived from water consumption measures of group-housed animals."

HSIA submits that the information contained in the above paragraph alone should disqualify Johnson *et al.* (2003) as "best available science" as required under TSCA §§ 6 and 26 and EPA's July 2017 procedures for chemical risk evaluation under TSCA.[40] The transparency problem with Johnson *et al.* (2003) was pointed out by the external peer reviewers of the TSCA Chemicals Work Plan assessment for TCE. An excerpt from the peer review report is reproduced below:

> "Unfortunately, Johnson et al (2003) failed to report the source or age of their animals, their husbandry or provide comprehensive historical control data for

[38] EPA, Toxicological Review of Trichloroethylene (CAS No. 79-01-6) In Support of Summary Information on the Integrated Risk Information System (IRIS), EPA/635/R-09/011F (2011) (hereafter "IRIS Assessment").

[39] Johnson PD, Goldberg SJ, Mays MZ, Dawson BV, Erratum: Erratum for Johnson *et al.,* [*Environ. Health Perspect.* 113: A18 (2005)]; *Environ. Health Perspect*. 122: A94 (2014); http://dx.doi.org/10.1289/ehp.122-A94.

[40] 82 Fed. Reg. 33726 (July 20, 2017).

spontaneous cardiovascular malformations in their colony. The Johnson study with 55 control litters compared to 4 affected litters of 9 treated was apparently conducted over a prolonged period of time (perhaps years); it is possible this was due to the time required to dissect and inspect fresh rodent fetuses by a small academic group. However, rodent background rates for malformations, anomalies and variants show temporal fluctuations (WHO, 1984) and it is not clear whether the changes reported by Johnson et al. (2005) were due to those fluctuations or to other factors. Surveys of spontaneous rates of terata in rats and other laboratory animals are common particularly in pharmaceutical and contract laboratory safety assessments (e.g., Fritz et al., 1978; Grauwiler, 1969; Palmer, 1972; Perraud, 1976). The World Health Organization (1984) advised: 'Control values should be collected and permanently recorded. They provide qualitative assurance of the nature of spontaneous malformations that occur in control populations. Such records also monitor the ability of the investigator to detect various subtle structural changes that occur in a variety of organ systems.'

"Rates of spontaneous congenital defects in rodents can vary with temperature and housing conditions. For example, depending on the laboratory levocardia and cardiac hypertrophy occur in rats at background rates between 0.8-1.25% (Perraud, 1976). Laboratory conditions can also influence study outcome; for instance, maternal hyperthermia (as a result of ambient elevated temperature or infection) can induce congenital defects (including cardiovascular malformations) in rodents and it acts synergistically with other agents (Aoyama et al., 2002; Edwards, 1986; Zinskin and Morrissey, 2011). Thus while the anatomical observations made by Johnson et al. (2003) may be accurate, in the absence of data on maternal well-being (including body weight gain), study details (including investigator blind investigations), laboratory conditions, positive controls and historical rates of cardiac terata in the colony it is not possible to discern the reason(s) for the unconventional protocol, the odd dose-response and marked differences between the Johnson et al. (2003) results and those of other groups."

"As noted by previous investigators, the rat fetus is 'clearly at risk both to parent TCE and its TCA metabolite' given sufficiently high prenatal TCE exposures that can induce neurobehavioral deficits (Fisher et al, 1999; Taylor et al., 1985), but to focus on cardiac terata limited to studies in one laboratory that have not been reproduced in other (higher dose) studies and apply the BMD01 with additional default toxicodynamic uncertainty factors appears misleading."[41]

HSIA has consistently maintained that the data presented in Johnson *et al.* (2003) and subsequently clarified in the two errata do not allow calculations of the incidence of cardiac malformations per litter that is time-matched to concurrent controls (the standard practice for evaluation of developmental toxicity studies). *Accepting the authors' claim in the 2014 erratum*

[41] OPPT Trichloroethylene (TCE) Draft Risk Assessment Final Comments of 9 Member Peer Review Panel (September 5, 2013), at 73; EPA-OPPT-HQ-2012-0723.

that exposure times cannot be confirmed for substantial amounts of either control or treatment data, it also can be presumed that it is now impossible to reconstruct a calculation of per litter incidence of cardiac malformations that is appropriately matched to concurrent controls. Thus, the data reported in Johnson *et al.* (2003), even as amended in two subsequent errata, do not allow for data analysis generally accepted as essential to interpreting outcomes of developmental toxicity study findings. The lack of data availability and clarity sufficient to construct key analyses associated with a study should disqualify the use of that study for regulatory purposes.

In its peer review of the TCE Risk Evaluation, the Scientific Advisory Committee on Chemicals (SACC) also commented on the failings of the cardiac defect studies conducted at the University of Arizona, and in particular the Johnson *et al.* (2003) study:

> "It was apparent to the Committee that the EPA places significant weight on the Dawson et al. (1990, 1993) and Johnson et al. (2003) studies in its weight of evidence (WOE) analysis, even though these studies have several significant problems in their design and execution despite being scored as of medium quality. Johnson et al. (2003) reports results using pooled data for controls and treatment groups from the multiple studies conducted over six years. Johnson et al. (2003) has inadequate reporting of methods used. Use of non-concurrent, pooled controls per the TSCA scoring definition for this metric meets the TSCA definition of "Unacceptable for Risk Assessment." The earlier studies from this laboratory also met the definition of unacceptable. Having even one study quality metric rating of '*Unacceptable for Risk Assessment*' meets TSCA definition for overall rating of 'Unacceptable for Risk Assessment' [emphasis added]. Some of the Committee members felt the Johnson et al. (2003) study lacked credibility and should not be relied upon by the EPA. Members of the Committee recognized that the results of the Dawson/Johnson experiments were obtained in one laboratory and have not been replicated in another *in vivo* mammalian study. Dr. Paula Johnson participated in a subsequent investigation by Fisher et al. (2001) to score slides and assure the same cardiac dissection technique was used as in the prior studies. No anomalies were found in the heart of offspring of these rats given multiple high doses of trichloroethylene, trichloroacetic acid (TCA) or dichloroacetic acid (DCA) during pregnancy. The negative findings of this oral bolus assay were supported by the GLP drinking water study by Charles River Laboratories (2019). These results were published by DeSesso et al. (2019)."[42]

> The SACC also wrote in its final report:

> "For this Evaluation, it appears data for the inhalation route would be preferred because inhalation exposures are most relevant to COUs. As a result, findings from studies based on the inhalation route of exposure offer less uncertainty on POD

[42] Transmittal of Meeting Minutes and Final Report for the TSCA Science Advisory Committee on Chemicals Meeting via Phone and Webcast Held March 24 to 27, 2020, at 63; EPA-HQ-OPPT-2019-0500-0111.

estimates. PBPK models are useful; however, they do add uncertainty when conducting route-to-route extrapolation; hence, data from inhalation exposures and oral exposures are not equivalent. There are several high-quality developmental studies conducted with inhalation exposures. It is recommended that the Evaluation focus on these (but not ignore the oral studies)."[43]

2. EPA's review of the Charles River Laboratory (CRL) rat developmental toxicity study is inaccurate and biased

The Risk Evaluation for TCE includes an HSIA-sponsored rat drinking water developmental toxicity study conducted at the Charles River Laboratories in 2018 to replicate Johnson *et al.* (2003). The HSIA study is cited in the Risk Evaluation as the "Charles River" study,[44] though it has been published in the peer-review literature and can be cited as DeSesso *et al.* (2019a).[45] There are many inaccuracies and distorted information in the Risk Evaluation regarding this study even though Exponent, on behalf of HSIA and the American Chemistry Council, submitted comments (Attachments C-E)[46] on several critical issues in response to EPA's unfounded criticisms, including: (1) EPA's evaluation of the negative control data; (2) specific incidences of overall heart defects across drinking water study; (3) incidences of ventricular septal defects (VSDs); and (4) incidences of atrial septal defects (ASDs).

3. The rat inhalation developmental toxicity study by Carney *et al.* (2006) is the most reliable and appropriate study for assessing developmental toxicity from TCE exposure

The Lautenberg Act requires that EPA use the best available science and decisions based on the weight of the scientific evidence in its TSCA risk evaluations. Thus, it is disappointing that EPA does not consider the rat inhalation developmental toxicity study published by Carney

[43] *Id.*, at 64-65

[44] Charles River Laboratories, *An Oral (Drinking Water) Study of the Effects of Trichloroethylene (TCE) on Fetal Heart Development in Sprague Dawley Rats*, Laboratory Project ID 00459506.

[45] DeSesso, JM, Coder, PS, York, RG, Budinsky, RA, Pottenger, LH, Sen, S, Lucarell, JM, Bevan, C, Bus, JS, Trichloroethylene in drinking water throughout gestation did not produce congenital heart defects in Sprague Dawley rats, *Birth Defects Res.* 111: 1217-1233 (2019a).

[46] Exponent, Comments on the Environmental Protection Agency's Toxicological Review of Trichloroethylene (TCE): Developmental Effects, prepared by DeSesso, JM and Williams, AL (2020), EPA-HQ-OPPT-2019-0500-0048 (Attachment C). Resubmitted due to copyright restrictions by the EPA docket even though the two publications in the appendices are open access publications. These two publications have been submitted separately as Attachment D (DeSesso *et al.,* 2019a) and Attachment E (DeSesso *et al*., 2019b).

et al. (2006)[47] of sufficient merit to be a critical study in the human health hazard assessment for the developmental endpoint. Not only does this study provide developmental toxicity information from the relevant route of exposure, it was conducted to fill a priority data need identified by the Agency for Toxic Substances and Disease Registry (ATSDR) and EPA and underwent a rigorous two-level review process required of toxicity testing under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, 42 U.S.C. 9604(i).

Toxicology studies on TCE were conducted as part of a voluntary TSCA testing program between HSIA and ATSDR.[48] As required by CERCLA, ATSDR must collaborate with EPA and the National Toxicology Program (NTP) for the identification of priority data needs as well as oversight of testing programs. For TCE, ATSDR signed a Memorandum of Understanding (MOU) in February 2000 with HSIA to conduct the study "Trichloroethylene: Inhalation Developmental Toxicity Study in CD Rats." It is important to note that developmental toxicity studies conducted prior to this date had been considered inadequate to address "comprehensive public health assessments of populations living near hazardous waste sites." Although ATSDR priority data needs were for oral exposure, other governmental agencies [presumably EPA] needed inhalation data. The final testing agreement was for a rat developmental toxicity study by the inhalation route, with extrapolation of the data to oral exposures using physiologically-based pharmacokinetic (PBPK) rat and human models.

The TCE study was conducted according to EPA test guidelines for prenatal developmental toxicity and included two levels of external review over the course of protocol development to the final report. At one level, the study was reviewed by the Tri-Agency Superfund Applied Research Committee (TASARC) involving scientists from ATSDR, NTP, and EPA. CERCLA § 104(i)(13) also requires a second level of review:

> "All studies and results of research conducted under this subsection (other than health assessments) shall be reported or adopted only after appropriate peer review. Such peer review shall be completed, to the maximum extent practicable, within a period of 60 days. In the case of research conducted under the National Toxicology Program, such peer review may be conducted by the Board of

[47] Carney, EW, Thorsrud, BA, Dugard, PH, Zablotny, CL, Developmental toxicity studies in Crl:CD (SD) rats following inhalation exposure to trichloroethylene and perchloroethylene, *Birth Defects Res. (Part B)* 77: 405-412 (2006).

[48] 67 Fed. Reg. 4835 (Jan. 31, 2002).

> Scientific Counselors. In the case of other research, such peer review shall be conducted by panels consisting of no less than three nor more than seven members, who shall be disinterested scientific experts selected for such purpose by the Administrator of ATSDR or the Administrator of EPA, as appropriate, on the basis of their reputation for scientific objectivity and the lack of institutional ties with any person involved in the conduct of the study or research under review."

The independent reviewers for the TCE study included four world-renowned experts in developmental toxicity from academia and contract laboratories. As a result of this comprehensive review process, Carney *et al.* (2006) achieves a high data quality standard, as reflected in the high reliability score in EPA's Systematic Review for the Risk Evaluation. Yet, EPA continues not to use this study in the Risk Evaluation even though inhalation is the relevant route of exposure, but instead relies on studies that have been deemed outdated or inadequate. The disregard of Carney *et al.* (2006) in the Risk Evaluation points to a bias in EPA's approach to evaluating the developmental data rather than supporting an agenda based on the weight of the evidence.

4. TCE and TCA toxicokinetics data are critical in the assessment of rat fetal heart defects

EPA consistently disregards TCE kinetics in its analysis of the fetal cardiac malformations. Toxicokinetic data linking chemical exposure to internal tissue concentrations are critical to understanding toxicological responses. Some of the questions that can be addressed from the use of internal dosimetry data are whether exposures to TCE (and/or its metabolites) from a particular route reach the target organ of concern; dose-response relationships of parent compound and/or its metabolites; and comparison of the toxicological responses from studies conducted by different routes of exposure (*i.e.*, drinking water, oral gavage, and inhalation). Moreover, toxicokinetic data can be used to extrapolate doses used in *in vitro* mechanistic studies to *in vivo* exposures. For these reasons, HSIA included in the Charles River Laboratory (CRL) study protocol measurements of TCE and trichloroacetic acid (TCA) in maternal blood or plasma during the critical period of fetal heart development and also in maternal and fetal blood or plasma at the end of the gestation period.[49] Blood or plasma levels of

[49] Charles River Laboratories, *An Oral (Drinking Water) Study of the Effects of Trichloroethylene (TCE) on Fetal Heart Development in Sprague Dawley Rats*, Laboratory Project ID 00459506; DeSesso, JM, Coder, PS, York, RG, Budinsky, RA, Pottenger, LH, Sen, S, Lucarell, JM, Bevan, C, Bus, JS, Trichloroethylene in drinking water throughout gestation did not produce congenital heart defects in Sprague Dawley rats, *Birth Defects Res.* 111: 1217-

TCE and TCA are expected to provide a reasonable estimate of the concentrations of these two substances in fetal heart tissue.

The table below compares the TCE exposures and the peak concentrations of TCE and TCA in maternal blood or plasma from three routes of exposure. While only the CRL developmental study (DeSesso *et al.*, 2019a) included a TCE metabolite component in the study design, TCE and/or TCA blood levels are available from TCE-exposed pregnant rats from inhalation, oral gavage, and drinking water routes of exposure.[50] TCE and TCA blood levels have also been measured in rats given oral gavage doses of TCE.[51]

Trichloroethylene (TCE) and Trichloroacetic acid (TCA) concentrations in blood or plasma of TCE-exposed pregnant and non-pregnant rats

	DeSesso *et al.* (2019a)[a]				**Fisher *et al.* (1989)[a]**			**Larson and Bull (1992)[b]**
Route of Administration	**Drinking water**				**Drinking water**	**Inhalation (4-hr)**	**Oral gavage**	**Oral gavage**
TCE exposure/dose	0.25 ppm	1.5 ppm	500 ppm	1,000 ppm	350 ppm	600 ppm	2.3 mg/kg	591 mg/kg
TCE in maternal plasma	ND (0.006 ppb)[c] [ng/ml]	ND (0.04 ppb)[c] [ng/ml]	ND (12.5 ppb)[c] [ng/ml]	ND (25 ppb)[c] [ng/ml]	ND (15 ng/ml)[d]	24 µg/ml	0.26 µg/ml	1.2 µg/ml
TCA in maternal plasma (GD 21)[e]	ND	ND	1.1 µg/ml	1.2 µg/ml	2.8 µg/ml	13 µg/ml	0.7 µg/ml	25 µg/ml
TCA in fetal plasma (GD 21)	ND	ND	1.2 µg/ml	1.2 µg/ml	-	-	-	-

ND, not detected.
[a]Pregnant rats
[b]Non-pregnant rats.
[c]Extrapolated assuming concentration of ½ LOQ (50 ppb) at highest dose and linear toxicokinetics across dose range.

1233 (2019a); DeSesso, JM, Coder, PS, York, RG, Budinsky, RA, Pottenger, LH, Sen, S, Lucarell, JM, Bevan, C, Bus, JS, Response to the comments of Runyan et al. on "Trichloroethylene in drinking water throughout gestation did not produce congenital heart defects in Sprague Dawley rats, *Birth Defects Res.* 111: 1237-1239 (2019b).

[50] Fisher, JW, Whittaker, TA, Taylor, DH, Clewell III, HJ, Andersen, ME, Physiologically based pharmacokinetic modeling of the pregnant rat: a multiroute exposure model for trichloroethylene and its metabolite, trichloroacetic acid, *Toxicol. Appl. Pharmacol.* 99: 395-414 (1989).

[51] Larson, JL, Bull, RJ, Species differences in the metabolism of trichloroethylene to the carcinogenic metabolites trichloroacetate and dichloroacetate, *Toxicol. Appl. Pharmacol.* 115: 278-285 (1992).

[d]Extrapolated assuming concentration of ½ LOQ (30 ng/ml).
[e]TCA was also measured in maternal plasma at GD 8 and GD 12 (period of fetal heart development). The concentrations were 1.7 and 1.8 μg/ml for the 500 ppm group, respectively; and 1.7 and 2.2 μg/ml for the 1,000 ppm group, respectively.

Two important conclusions may be made from the data:

- TCE is unlikely to reach the fetal heart from exposure to TCE in drinking water because of substantial hepatic first-pass metabolism in contrast to routes of exposure involving oral gavage and inhalation.
- Higher peak TCA plasma levels are achieved in the oral gavage and inhalation developmental toxicity studies (Fisher *et al.*, 2001; Carney *et al.*, 2006) reporting no increase in cardiac malformations compared to the drinking water study (Johnson et al., 2003) reporting cardiac malformations.

Makris *et al.* (2016) stated "the evidence supports a conclusion that TCE has the potential to cause cardiac defects in humans when exposure occurs to TCE at *sufficient doses* during a sensitive period of fetal development."[52] However, this statement is at odds with the toxicokinetic data on TCE in the rat. Of the three routes of exposure, exposure by drinking water does not achieve systemic doses that are comparable with inhalation or oral gavage, as evidenced in the considerable differences in blood or plasma levels of TCE and TCA, respectively. Given that the TCE developmental studies by the oral gavage (Fisher *et al.*, 2001) and inhalation (Carney *et al.*, 2006) routes failed to show an increase in fetal heart malformations, even at systemic doses that were considerably higher than can be achieved by the drinking water route, the findings of Johnson *et al.* (2003) cannot be a biologically plausible effect.

The internal dosimetry data on TCE and TCA provide an important perspective on the *in vitro* mechanistic studies reported in the Risk Evaluation. The doses of TCE used in the *in vitro* studies ranged from 1 ppb to 250 ppm. In the CRL rat developmental toxicity study (DeSesso *et al.*, 2019a,b), however, TCE was not detected in maternal blood of pregnant rats given 1,000 ppm TCE in drinking water (level of detection was 50 ng/mL or 50 ppb). For comparison purposes, it has been assumed that the TCE blood concentration is 25 ppb (1/2 LOQ) at 1,000 ppm, with linear toxicokinetics across the dose levels used in the CRL study (0.006 to 25 ppb). For many of the *in vitro* mechanistic studies, the doses used were several orders of magnitude higher than would be obtainable in blood from drinking water exposures administered at the limit

[52] Makris, SL *et al.*, A systematic evaluation of the potential effects of trichloroethylene exposure on cardiac development. *Reprod. Toxicol.* 65: 321 (2016) (emphasis added).

of TCE water solubility. Apart from the fact that these *in vitro* studies are based on the premise that the drinking water study by Johnson *et al.* (2003) is valid and reproducible, the findings from these studies at such enormously high doses question their biological relevance. In the Risk Evaluation, EPA also includes several *in vitro* studies that claim to support a non-monotonic dose response, with effects seen at lower, but not, higher TCE doses. However, the doses used in these studies are either within or higher than the worst-case estimates for TCE blood levels in the CRL drinking water study. Since cardiac malformations were not increased at any dose level in the CRL study, the conclusion that these low-dose effects seen in some of the *in vitro* studies are non-monotonic is without merit.

5. The developmental toxicity studies on trichloroacetic acid (TCA) and dichloroacetic acid (DCA) do not provide support for Johnson *et al.* (2003)

The Risk Evaluation states: "Both TCA and DCA were convincingly shown to produce strong dose-related cardiac defects in the (Smith *et al.*, 1992, 1989) studies[53]."[54] These two studies are developmental toxicity studies in which rats were dosed by oral gavage with DCA or TCA, respectively. Unfortunately, EPA failed to put these studies into perspective for the TCE hazard assessment by providing an estimate of the TCE exposures that would be required to attain the same TCA or DCA blood levels where cardiac defects were observed.

Kinetic studies from Larsen and Bull (1992) have shown that the peak blood concentrations of TCA in rats given approximately 3,000 mg/kg TCE by oral gavage corresponds to an oral dose of <33 mg/kg TCA; whereas DCA blood concentrations were below the detection limit of 0.0005 mg/ml in rats.[55] The oral LD_{50} of trichloroethylene in rats ranges from 5,400 to 7,200 mg/kg.[56] However, the lowest dose levels where cardiovascular anomalies were reported to be significantly increased over controls in the Smith *et al.* studies were 300 and

[53] Smith, MK, Randall, JL, Read. EL, Stober, JA, Developmental toxicity of dichloroacetate in the rat, *Teratol.* 46: 217-223 (1992); Smith, MK, Randall, JL, Read, EJ, Stober, JA, Teratogenic activity of trichloroacetic acid in the rat, *Teratol.* 40: 445-451 (1989).

[54] Risk Evaluation, at 648.

[55] Larson, JL, Bull, RJ, Species differences in the metabolism of trichloroethylene to the carcinogenic metabolites trichloroacetate and dichloroacetate, *Toxicol. Appl. Pharmacol.* 115: 278-285 (1992).

[56] ECHA REACH database: https://echa.europa.eu/information-on-chemicals/registered-substances.

400 mg/kg for TCA and DCA, respectively, and are substantially greater than the maximum TCA and DCA doses resulting from a toxicity-limited dose of TCE. Thus, very high and almost certainly *lethal* oral doses of TCE would have to be administered to pregnant female rats to obtain the equivalent TCA or DCA blood levels where cardiac anomalies were reported in the Smith *et al.* studies. Likewise, EPA also commented that "The [Fisher et al., 2001] study…only showed a small, non-statistically significant increase in cardiac defects for both TCA and DCA, but the single dose level used in these studies was too low to rule out effects at higher doses based on results of the other studies." However, Fisher *et al.* (2001) dosed pregnant female rats with 300 mg/kg TCA, which equaled the Smith *et al*. 300 mg/kg TCA dose. As discussed above, the oral dose of TCE required to reach equivalent peak blood levels of TCA resulting from a 300 mg/kg oral gavage dose of TCA would likely be lethal to the animals. So, Fisher *et al.* (2001) should be given greater emphasis in the weight of evidence in the Risk Evaluation as it provides important information showing that TCE metabolites do not plausibly cause fetal heart malformations in rats at doses considerably higher than what would be considered likely lethal or possibly a Maximum Tolerated Dose (MTD) for TCE.

These toxicokinetic comparisons indicate that the 300 mg/kg oral TCA dose used in Fisher *et al.* (2001) produced a maximum systemic blood concentration of TCA that far exceeded the maximum TCA blood concentrations resulting from 1,000 ppm TCE drinking water or 600 ppm inhalation exposures. The data also indicate that the EPA comment that the Fisher *et al.* (2001) 300 mg/kg-day TCA dose was "too low to rule out effects at higher doses" is a dosimetric red herring in that TCA maximum blood concentrations resulting from this dose cannot be plausibly attained from TCE administered in drinking water or by inhalation. Thus, the failure by Fisher *et al.* (2001) to observe cardiac malformations following TCE, TCA, and DCA exposures, although the study used Johnson's method and included her as a co-investigator, substantially challenges the Johnson *et al.* (2003) conclusion that TCE in drinking water or by inhalation exposure induces cardiac malformations.

It is incomprehensible that EPA ignored toxicokinetics in its discussion of the developmental toxicity data on TCE and its metabolites, and thus biased its conclusions in support of the poorly designed and reported drinking water findings of Johnson *et al.* (2003). This is particularly so in that EPA and OECD developmental toxicity testing guidelines

encourage consideration of toxicokinetic data to enhance the overall interpretation of the human health significance of developmental toxicity findings.[57]

B. An ECEL value derived from the serum DNA autoantibody response in Keil *et al.* (2009) is not based on the best available science

EPA selected an autoimmunity endpoint as the basis of its derivation of a chronic non-cancer ECEL (0.004 ppm), designated as the Primary Alternative ECEL in the proposed rule. HSIA considers the serum DNA autoantibody responses reported in the study by Keil *et al.* (2009)[58] to be unreliable for the basis of a chronic, non-cancer ECEL value for TCE. In this study, female B6C3F$_1$ mice were administered 0, 1.4, or 14 ppm TCE in drinking water containing 1% Emulphor for up to 27 or 30 weeks. Serum single and double-stranded DNA-autoantibodies (ssDNA- and dsDNA-autoantibodies, respectively) were measured at interim time points over a period of 26-39 weeks of age. Based on the ss- and ds-DNA autoantibody data, EPA derived the Human Equivalent Dose at the 99th percentile (HED$_{99}$) of 0.048 mg/kg-day, which was used to derive a chronic, non-cancer ECEL value of 0.004 ppm (4 ppb) as an 8-hr TWA. However, EPA did not utilize the best science in its choice of the immunotoxicity data for the Risk Evaluation. The scientific validity problems that should preclude relying on the serum DNA autoantibody findings to derive the ECEL value include:

- Lack of analytical verification of dosing concentrations.
- Lack of biological plausibility with no accompanying pathological changes and the same effects not seen in autoimmune-prone mouse strain.
- Lack of dose-response seen for most measurements at most time points throughout the study.
- Inadequate number of dose groups for dose-response modeling.

1. Lack of documented analytical data on TCE levels in drinking water is a major deficiency of Keil *et al.* (2009) because of TCE volatility concerns

Keeping TCE in the drinking water solutions and achieving acceptable target concentrations of TCE in the drinking water is very challenging because of the high propensity

[57] EPA, Guidelines OPPTS 870.3700. Prenatal Developmental Toxicity Study, EPA 712-C-98-207, August 1998; OECD, Guideline for the Testing of Chemicals. Prenatal Developmental Toxicity Study, OECD 414, Adopted 22nd January 2001.

[58] Keil, DE, Peden-Adams, MM, Wallace, S, Ruiz, P, Gilkeson, GS, Assessment of trichloroethylene (TCE) exposure in murine strains genetically-prone and non-prone to develop autoimmune disease, *J. Environ. Sci. Health Part A* 44: 443-453 (2009).

of TCE to volatilize into the air. Three separate drinking water studies have reported losses of TCE from drinking water bottles over a 24-hour period in the range of approximately 30-50%,[59] even when volatilization is minimized because the water is provided in glass bottles fitted with Teflon-lined caps and sipper tubes with double ball bearings. Because of this immense difficulty, Emulphor, a polyethoxylated vegetable oil, is frequently used to produce stable, uniform aqueous emulsions of a variety of volatile substances, including chlorinated hydrocarbons. In Keil *et al.* (2009), TCE was administered to mice in drinking water solutions containing 1% Emulphor; the solutions were changed every three days. While the publication reports that the levels of TCE in the drinking water solutions were confirmed by an outside laboratory services company, no analytical data are provided in the publication, and it cannot be confirmed whether the target concentrations were met at the beginning as well as the end of the three-day water bottle exposure period. The variability of the concentrations over the entire course of the 27- or 30- treatment period is also unknown. Furthermore, Keil *et al.* (2009) do not provide any description of the water bottles used and what measures were taken to minimize potential losses from volatilization. While it is assumed that volatilization of TCE was minimal over the three-day period in the water bottle, data from Sanders *et al.* (1982) from another immunotoxicity study show otherwise.[60] Using 1% Emulphor to maintain TCE in drinking water and using amber-colored water bottles with sipper spouts, a 45% loss of TCE over a 4-day period was reported from drinking water containing 100 ppm TCE. Whether similar losses occurred in Keil *et al.* (2009) cannot be evaluated without analytical data, which is missing from the publication, being provided. These shortcomings introduce considerable uncertainty in interpretation of the study findings.

The Exposure Characterization component of EPA's systematic review of Keil *et al.* (2009) reflects a naïve understanding of the technical difficulties with administrating TCE in drinking water in animal studies and is based on presumptions rather than documentation of

[59] Fisher, JW, *et al.*, Physiologically based pharmacokinetic modeling of the pregnant rat: a multiroute exposure model for trichloroethylene and its metabolite, trichloroacetic acid, *Toxicol. Appl. Pharmacol.* 99: 395-414 (1989); Johnson, PD *et al*., Threshold of trichloroethylene contamination in maternal drinking waters affecting fetal heart development in the rat, *Environ. Health Perspect.* 111: 289-292 (2003); DeSesso, JM, *et al.*, Trichloroethylene in drinking water throughout gestation did not produce congenital heart defects in Sprague Dawley rats, *Birth Defects Res.* 111: 1217-1233 (2019).

[60] Sanders, VM, Tucker, AN, White Jr, KL, Kauffman, BM, Hallett, P, Carchman, RA, Borzelleca, JF, Munson, AE, Humoral and cell-mediated immune status in mice exposed to trichloroethylene in drinking water, Toxicol. Appl. Pharmacol. 62: 358-368 (1982).

analytical data. The metrics for "Preparation and Storage of Test Substance" and "Consistency of Exposure Administration" were given "Medium" and "High" scores, respectively; and for both metrics EPA concluded that "TCE levels were confirmed." Yet, there are no analytical data in the Keil *et al.* paper to support that conclusion; instead EPA relied simply on a statement in the paper that "levels of TCE were confirmed by General Engineering (Charleston, SC) to ensure maintenance of TCE levels during exposure." Moreover, EPA gave a "High" score for "Exposure Route and Method" with the comment "Frequent changing of water with exposure level analysis to avoid decreased dosing to vaporization." In the absence of analytical data, there is no basis for EPA's conclusion and, in fact, the findings from Sanders *et al.* (1982) suggest that TCE could have significantly volatilized from the drinking water because of the infrequent changing of the water bottles. Moreover, Keil *et al.* (2009) provide no description of the water bottles used and any efforts to minimize the TCE loss from the water bottles in the animal cages. Overall, the exposure characterization of the Keil *et al.* (2009) study has considerable deficiencies that have led to an overestimation of the study quality rating given to this study by EPA.

2. Keil *et al.* (2009) does not convincingly show adverse effects that are indicative of an autoimmune disease from TCE exposure

Keil *et al.* (2009) reported a significant increase in serum levels of auto-dsDNA and ss-DNA antibodies at some but not all time points in the non-autoimmune $B6C3F_1$ mice. The data are difficult to interpret because the increases in these autoantibodies were not consistently seen throughout the treatment period and a dose-response is lacking for most of the time points, *i.e.,* the response is greater at 1.4 ppm or equivalent to the 14 ppm exposure group. Furthermore, the potential for highly variable and/or altered TCE concentrations in the drinking water throughout the treatment period further complicates the data interpretation. An unusual finding from this study was that endpoints indicative of autoimmunity were seen to a far lesser extent in the autoimmune-prone NZBWF1 mouse compared to the non-autoimmune prone $B6C3F_1$ mouse.

Autoimmunity from environmental exposures, such as increases in specific autoantibodies (*i.e.*, auto-DNA antibodies) from environmental exposures can occur without any evidence of a specific autoimmune disease.[61] The National Institutes of Environmental Health

[61] Pollard, KM, Environment, autoantibodies, and autoimmunity, *Frontiers Immunol*. 6: 14 (2015).

Sciences (NIEHS) convened a workshop in 2010 to examine the role of the environment in the development of autoimmune disease. One of the key points made by the Panel is the following:

> "Our survey of the literature clearly shows that an autoimmune response following exposure to environmental factors is dependent upon genetic background of the host and can vary widely among species and strains. Our review also revealed that most animal models only recapitulate some features of human disease but that this provides useful information given the genetic heterogeneity of individual human autoimmune diseases. It is also clear that to establish the validity of any animal model of environmentally induced human autoimmunity there should be *well defined markers of disease expression and pathology that are easily accessible in biological samples* of both humans and the animals under investigation."[62]

In Keil *et al.* (2009), renal glomerular changes (minimal pathologic details given) were noted in 1.4 ppm, but not the 14 ppm, animals; the interpretation of these effects is unclear since there was no dose-response and it was reported that the pathologic changes did not involve inflammation. This is surprising since the role of anti-DNA antibodies in the pathogenesis of lupus nephritis has been well established.[63] Other pathologic effects reported in Keil *et al.* (2009) were not suggestive of an autoimmune disease. Regarding the $B6C3F_1$ mouse strain, chronic exposures to TCE did not result in any pathologic evidence of adverse effects indicative of an autoimmune disease.[64] Therefore, additional studies are needed to substantiate the findings of Keil *et al.* (2009) with a clear link to "disease expression and pathology" before it can be considered sufficiently reliable to be used for risk assessment purposes.

A dose-dependent decrease in thymus weights in the TCE-dosed $B6C3F_1$ mice were reported in the Keil *et al.* study; however, measurements of thymus weights are prone to inaccuracies from the difficulties of trimming the tissue and the interpretation of the change is uncertain in the absence of any other clear treatment-related effects. Another deficiency of Keil *et al.* (2009) was a lack of a water-only control group to rule out any potential effects on the immune system from the 1% Emulphor in the drinking water. Information is also lacking on

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[62] Germolec, D, Kono, DH, Pfau, JC, Pollard, KM, Animal models used to examine the role of the environment in the development of autoimmune disease: findings from a NIEHS expert panel workshop*, J. Autoimmun*. 39: 285-293 (2012) (emphasis added).

[63] Pisetsky, SD, Anti-DNA autoantibodies. *Curr. Opin. Rheumatol.* 12: 364-367.

[64] National Toxicology Program, Carcinogenesis studies of trichloroethylene (without epichlorohydrin) (CAS No. 79-01-6) in F344/N rats and B6C3F1 mice (gavage studies), Research Triangle Park, NC, U.S. Department of Health and Human Services, Public Health Services, National Institutes of Health (1990).

whether 1% Emulphor in the drinking water impacts TCE pharmacokinetics, in particular absorption and distribution.

TCE was one of the chemicals evaluated in the 2010 NIEHS autoimmune workshop. The published reports from this workshop cited TCE studies conducted on the MRL-Fas$^{+/+}$ mouse; Keil *et al.* (2009) was not mentioned. The expert panel concluded:

> "Based on existing evidence, we consider the following likely but requiring confirmation. . . Trichloroethylene (TCE) exacerbates systemic autoimmunity although responses are often limited and transient. More studies are needed with additional species/strains to examine induction of autoimmune liver disease and in developmental studies."

Aside from the methodological problems and inconsistencies in the results with Keil *et al.* (2009), the human relevance of this study is unclear. Antinuclear antibodies, either to the DNA, RNA, proteins, and complexes of DNA and/or RNA and proteins, are characteristic of systemic lupus erythematosus (SLE), an autoimmune disease. TCE was widely used as a solvent for metal degreasing from the 1920s to the 1970s, with a decline in use thereafter.[65] TCE has also been used as a solvent in other industries. To date, there have been no reported cases of SLE in the literature attributed to TCE exposure. Bakke *et al.* (2007) reported average mean TCE exposures over at least a 6-hour period ranging from 25 to 63 ppm (maximum: 33 to 89 ppm), with one facility reporting an average mean TCE exposure of 86 ppm (maximum 274 ppm) in facilities in which TCE was used in degreasing operations in the 1970s and 1980s.[66] These values are approximately 200- to >500-fold (up to 2,283-fold) higher than the human POD value (a LOAEL of 0.12 ppm or 120 ppb) based on increase in serum anti-DNA antibodies reported in mice exposed to TCE in drinking water in Keil et al. (2009), which was then used by EPA to derive the ECEL value. Given the extensive use of TCE in degreasing over many years, it is very surprising that there have been no reported cases of SLE in TCE-exposed workers.

3. Alternative "high" quality immunotoxicity studies for the ECEL value are available

EPA was encouraged to consider endpoints from two other immunotoxicity studies given "high" data quality scores in the systematic review for the POD for chronic non-cancer

[65] Bakke, B, Stewart, PA, Waters, MA, Uses of and exposure to trichloroethylene in U.S. industry: a systematic literature review. *J. Occup. Environ. Hyg.* 4: 375-390 (2007).

[66] *Id.*

exposures: Sanders *et al.* (1982) and Boverhof *et al.* (2013).[67] Both studies reported treatment-related effects in conventional assays measuring immunosuppression in mice and rats, respectively, which is consistent with the effects on the immune system seen in acute TCE exposures by Selgrade and Gilmour (2010). The Sanders *et al.* study suffers, however, from some of the same problems as Keil *et al.* (2009), in that analytical measurements of TCE in the drinking water solutions throughout the treatment period were not provided in the publication. It should be noted that, in contrast to the 100 ppm TCE drinking water solution where 45% of the TCE was lost over a 4-day period in the water bottle, less than 20% of TCE was lost from the water bottles over the same period at higher TCE concentrations (1,000 to 5,000 ppm). On the other hand, Boverhof *et al.* (2013) was conducted by the relevant route of exposure for the Risk Evaluation (inhalation), was undertaken to fulfill a Priority Data Need identified by EPA and ATSDR, and underwent a rigorous two-level review process required of toxicity testing under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) 42 U.S.C. 9604 (i). See Section IV.A.3 for further details on the testing program and peer-review process.

C. Cancer

1. EPA's meta-analysis in the Risk Evaluation is not reliable and does not support TCE as a risk factor for NHL, kidney cancer, or liver cancer

In the Risk Evaluation, EPA conducted meta-analyses to combine the results of existing epidemiology studies of TCE and non-Hodgkin lymphoma (NHL), kidney cancer, and liver cancer. These meta-analyses built on meta-analyses in the 2011 IRIS assessment and included 10 new epidemiology studies of NHL, kidney cancer, or liver cancer that were published since that time.

EPA developed extensive Data Quality Criteria that were relied upon for both study selection (*i.e.*, only studies of "Acceptable" data quality were included) and to evaluate the

[67] Boverhof, DR, Krieger, SM, Hotchkiss, JA, Stebbins, KE, Thomas, J, Woolhiser, MR, Assessment of the immunotoxic potential of trichloroethylene in rats following inhalation exposure, *J. Immunotoxicol.* 10: 311-320 (2013); Sanders, VM, Tucker, AN, White Jr, KL, Kauffman, BM, Hallett, P, Carchman, RA, Borzelleca, JF, Munson, AE, Humoral and cell-mediated immune status in mice exposed to trichloroethylene in drinking water, *Toxicol. Appl. Pharmacol.* 62: 358-368 (1982).

quality of included studies.[68] Despite an extensive assessment of study quality, EPA relied only on a summary score to represent each study's overall quality without discussing specific aspects of study quality in individual studies or how they could have affected the validity of individual effect estimates and the interpretation of meta-analysis results. For example, many of the studies measured TCE exposure based on limited information or methods that are less established or not validated, as a result of which some participants who were truly exposed to TCE might have been classified as unexposed or vice versa (*i.e.*, exposure measurement error). Many of the studies did not sufficiently account for the fact that participants exposed to TCE were also simultaneously exposed to other chemicals that may be associated with the cancer outcomes or that they might have been more or less susceptible to cancer than those unexposed to TCE due to certain sociodemographic or behavioral characteristics, regardless of TCE exposure (*i.e.*, confounding). Either scenario could have led to biased results of the individual studies and, collectively, biased summary results of the meta-analyses. Gradient, on behalf of HSIA, examined both the overall study quality and specific aspects of study quality, and showed that most of the studies, including several rated as having "High" quality overall by EPA, may have had serious limitations (particularly with regard to exposure measurement error and confounding) that likely biased individual studies' results and the results of the meta-analyses that included them.[69]

EPA applied the Data Quality Criteria to all the included studies, but then adjusted its overall (as opposed to aspect-specific) quality ratings for three studies (*i.e.*, Vlaanderen *et al*., 2013; Buhagen *et al*., 2016; Bahr *et al*., 2011) based on aspects that had already been accounted for in the Data Quality Criteria.[70] It is unclear why some of the same aspects were considered

[68] EPA, Risk Evaluation for Trichloroethylene (CASRN: 79-01-6) Systematic Review Supplemental File: Updates to the Data Quality Criteria for Epidemiological Studies, EPA-HQ-OPPT-2019-0500-0017.

[69] Gradient, Comments on the Kidney Cancer, Liver Cancer, and Non-Hodgkin Lymphoma Meta-analyses in US EPA's Draft Risk Evaluation for Trichloroethylene CASRN: 79-01-6, submitted as Appendix 2 to HSIA Comments on the draft Risk Evaluation, EPA-HQ-OPPT-2019-0500-0094.

[70] Vlaanderen, J, Straif, K, Pukkala, E, Kauppinen, T, Kyyronen, P, Martinsen, JI, Kjaerheim, K, Tryggvadottir, L, Hansen, J, Sparen, P, Weiderpass, E., Occupational exposure to trichloroethylene and perchloroethylene and the risk of lymphoma, liver, and kidney cancer in four Nordic countries. *Occup. Environ. Med.* 70: 393-401 (2013); Buhagen, M, Gronskag, A, Ragde, SF, Hilt, B., Association between kidney cancer and occupational exposure to trichloroethylene. *J. Occup. Environ. Med.* 58:957-959 (2016); Bahr, DE; Aldrich, TE, Seidu, D, Brion, GM, Tollerud, DJ, Plant, PGD, Occupational exposure to trichloroethylene and cancer risk for workers at the Paducah gaseous diffusion plant. *Int. J. Occup. Med. Environ. Health* 24: 67-77 (2011).

twice in the rating. It does not appear that these aspects were reconsidered for all of the included studies. Further, it is unreasonable to change the overall rating of a study (*i.e.*, a weighted average across ratings of individual quality aspects) for issues that are addressed by ratings of individual quality aspects themselves. EPA's post hoc adjustment of study quality ratings was likely biased and it likely introduced bias to the meta-analyses and their results.

EPA's omission of Vlaanderen *et al*. (2013) was inappropriate. Primarily, the decision-making process solely relied on results from fixed-effects models when results from random-effects models were more appropriate in the presence of notable differences across study results. Even though removing Vlaanderen *et al*. (2013) led to the results across remaining studies being more similar, these studies still had important differences. Further, other influential studies that remained in the analyses are not immune from the methodological limitations observed in Vlaanderen *et al*. (2013).

The Risk Evaluation concluded that "[f]or all three tissues, the meta-RR was greater among the high quality studies compared to medium or low quality studies".[71] However, this finding is likely impacted by the quality rating of Vlaanderen *et al.* (2013), which was adjusted post hoc; it also did not take into consideration random-effects model results or the methodological limitations of the "High" quality studies.

In assessment of publication bias (*i.e.*, studies that find effects are more likely to be published), EPA stated in the Risk Evaluation that "[f]unnel plots including all studies (Figure_Apx H-16, a-c) were consistent with modest publication bias, with a possible tendency toward omission of moderate-sized studies with weak or null associations".[72] In other words, EPA concluded that publication bias was likely. However, EPA noted in the Risk Evaluation that, with the Vlaanderen *et al.* (2013) study omitted, "the plots became more symmetrical, consistent with an absence of publication bias among the remaining studies." This assessment was not performed appropriately. Funnel plots are intended to be used as a visual aid for detecting publication bias based on *all* available studies (*i.e.*, deviation from a symmetric funnel indicates a possibility of publication bias). It is not a tool that can eliminate publication bias by omitting certain studies *post hoc*.

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[71] Risk Evaluation, at 694.

[72] *Id*., at 696

Taken together, due to the methodological limitations of the individual epidemiology studies and limitations in the approach used in synthesizing the epidemiology evidence, the results of EPA's meta-analyses in the Risk Evaluation are not reliable and thus do not support TCE as a risk factor for NHL, kidney cancer, or liver cancer.

2. Data from Charbotel *et al.* (2006) are not sufficient for deriving risk estimates for kidney cancer

Based on the discussion above, the meta-analysis of the epidemiology studies on kidney cancer risk does not show TCE as a risk factor. Therefore, EPA is not justified in using the Charbotel *et al.* (2006) case-control study[73] on renal cell carcinoma (RCC) as the basis for the inhalation unit risk (IUR) value in the Risk Evaluation. EPA had originally used Charbotel *et al.* (2006) to derive the IUR in the 2011 IRIS assessment based on EPA's meta-analysis of kidney cancer risk in that assessment. But the new meta-analysis with epidemiology studies on kidney cancer risk published since the 2011 IRIS Assessment shows that TCE is not a risk factor for kidney cancer; therefore, it is not appropriate to derive the IUR using Charbotel *et al.* (2006), which only investigated RCC.

The National Academy of Sciences Committee that reviewed a draft IRIS assessment released in 2001 recommended that:

> "[t]here appear to be insufficient epidemiologic data to support quantitative dose-response modeling for trichloroethylene and cancer. The committee recommends that toxicologic data be used to fit the primary dose-response model(s) and that the available epidemiologic data be used only for validation. The committee does not believe that the available information is sufficient to determine the best dose-response model for trichloroethylene."[74]

EPA should follow the recommendation of the National Academy of Sciences, which referenced the Charbotel *et al.* (2005) final study report in its review of TCE.[75] The authors'

[73] Charbotel, B, Fevotte, J, Hours, M, Martin, J-L, Bergeret, A., Case-control study on renal cell cancer and occupational exposure to trichloroethylene. Part II: Epidemiological aspects. Ann Occup Hyg 50: 777-787 (2006); http://dx.doi.org/10.1093/annhyg/mel039.

[74] National Research Council, Assessing the human health risks of trichloroethylene: key scientific issues, National Academies Press, Washington, DC (2006); http://www.nap.edu/openbook.php?record_id=11707&page=R1.

[75] Charbotel B, Fevotte J, Hours M, *et al.*, Case-control study on renal cell cancer and occupational trichloroethylene exposure, in the Arve Valley (France), Lyon, France: Institut Universitaire de Médecine du Travail, UMRESTTE, Université Claude Bernard (2005); http://hal.archives-ouvertes.fr/docs/00/54/59/80/PDF/charbotel_octobre_05.pdf

own conclusions that the study only "suggests that there is a weak association between exposures to TRI [TCE] and increased risk of RCC" argue against the existence of the robust relationship which should be required for a dose-response assessment that may be used as the basis for regulation.[76]

The exposure assessment for Charbotel *et al.* (2006) was based on questionnaires and expert judgment, not direct measures of exposure.[77] Worker exposure data from deceased individuals were included in the study. In contrast to living workers, who were able to respond to the questionnaires themselves, exposure information from deceased workers (22.1% of cases and 2.2% of controls) was provided by surviving family members. The authors acknowledge that "this may have led to a misclassification for exposure to TCE due to the lower levels in the quality of information collected."

Analysis of the data revealed evidence of confounding from cutting fluid exposure. When exposure to cutting fluid exposure was adjusted for, there was no longer statistical significance with increased risk of RCC at the highest cumulative dose. As noted by Charbotel *et al.* (2006), "Indeed, many patients had been exposed to TCE in screw-cutting workshops, where cutting

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[76] This concern was recognized by the European Chemicals Agency (ECHA) in its 2013 Chemical Safety Report on TCE:

> "[T]here are several concerns with this study that should be taken into consideration when assessing its use in risk assessment and hazard characterization. For example, potential selection bias, the quality of the exposure assessment, and the potential confounding due to other exposures in the work place. With respect to the potential for selection bias, no cancer registry was available for this region to identify all relevant renal cell cancer cases from the target population. Case ascertainment relied on records of local urologists and regional medical centers; therefore, selection bias may be a concern. Given the concerns of the medical community in this region regarding renal cell cancer (RCC) among screw cutting industry workers, it is likely that any cases of renal cell cancer among these workers would likely be diagnosed more accurately and earlier. It is also much more unlikely that an RCC case among these workers would be missed compared to the chance of missing an RCC case among other workers not exposed to TCE. This preference in identifying cases among screw-cutting industry workers would bias findings in an upward direction. Concerning the potential for other exposures that could have contributed to the association, screw-cutting industry workers used a variety of oils and other solvents. Charbotel *et al.* reported lower risks for TCE exposure and renal cell cancer once data were adjusted for cutting oils. In fact, they noted, 'Indeed many patients had been exposed to TCE in screw-cutting workshops, where cutting fluids are widely used, making it difficult to distinguish between cutting oil and TCE effects.' This uncertainty questions the reliability of using data from Charbotel *et al.* since one cannot be certain that the observed correlation between kidney cancer and exposure is due to trichloroethylene."

[77] Fevotte J, Charbotel B, Muller-Beauté P, *et al.*, Case-control study on renal cell cancer and occupational exposure to trichloroethylene, Part I: Exposure assessment, Ann Occup Hyg 50: 765-775 (2006); http://dx.doi.org/10.1093/annhyg/mel040.

fluids are widely used, making it difficult to distinguish between cutting oil and TCE effects." A strong correlation was observed between TCE exposure and cutting oil and other petroleum oils. Of the patients exposed to cutting oils, 90.3% were also exposed to TCE; 57.9% of the patients exposed to TCE were also exposed to cutting fluids. Furthermore, of the patients exposed to cutting oils, 56% were also exposed to a high cumulative TCE dose compared to only 44% of the control patients. Charbotel *et al.* (2006) used modeling approaches to try to disaggregate cutting oil exposure from TCE exposures; there is, however, considerable uncertainty in the outcome because of the small number of cases in the study. In general, the relatively small size of this case-control study (86 RCC cases) is a limiting factor to achieve the level of confidence needed for quantitative cancer risk estimates.

In their 2006 publication of the study results, the authors assigned cumulative exposures into tertiles (*i.e.*, low, medium and high), yet the dose-response evaluation conducted as part of the IRIS Assessment relied on mean cumulative exposure levels provided at a later date.[78] Although the IRIS Assessment references the email submission of the data to EPA, it provides no detail on the technical basis for the table, raising serious transparency issues.

In an apparent acknowledgement of the uncertainty of the exposure information, Charbotel *et al.* (2006) included an evaluation of "the impact of including deceased patients (proxy interviews) and elderly patients (>80 years of age)" on the relationship between exposure to TCE and RCC. Interestingly, it was stated that "only job periods with a high level of confidence with respect to TCE exposure were considered" in the study, an apparent reference to the use of two different occupational questionnaires, one "devoted to the screw-cutting industry and a general one for other jobs." As the Adjusted Odds Ratio (OR) for the high cumulative dose group was actually higher in the censored subgroup than in the uncensored group [3.34 (1.27-8.74) vs 2.16 (1.02-4.60)], the authors suggested that "misclassification bias may have led to an underestimation of the risk."

3. <u>EPA's adjustment of the kidney cancer-based IUR value for TCE to account for potential liver cancer and NHL is not scientifically defensible</u>

In addition to the inappropriateness of basing the IUR for TCE on epidemiology data, as described above, HSIA has serious concerns about the scientific appropriateness of adjusting the

[78] Charbotel, B (2008) [e-mail from Barbara Charbotel, University of Lyon, to Cheryl Scott, EPA].

IUR derived from kidney cancer data to account for NHL and liver cancer. An analysis conducted by Gradient for HSIA concluded that it was not appropriate for EPA to adjust the IUR based on kidney cancer for multiple cancer sites because the available epidemiology data are not sufficiently robust to allow such calculations and the data that are available indicate that the IUR for kidney cancer is protective for all three cancer types.[79]

4. The role of glutathione conjugate-derived metabolites in TCE kidney toxicity and kidney cancer needs to be reconsidered

EPA used the same IUR value for TCE as one estimated in the 2011 IRIS Assessment, which was derived using a linear non-threshold approach. The Risk Evaluation states that "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".[80] EPA's justification for the linear non-threshold approach is based on the assumption that TCE-induced kidney toxicity is caused predominantly by glutathione (GSH) conjugate metabolites, and that these metabolites are responsible for the kidney tumors via a mutagenic mode of action. However, the 2011 TCE IRIS Assessment is outdated, and EPA has failed to include in the Risk Evaluation any of the more recent published studies that undermine the validity of EPA's assumptions in the estimation of human kidney toxicity and cancer risks. A discussion of the new science is summarized below.

a. EPA's reliance on quantitation of TCE GSH-conjugated metabolites by HPLC/UV method results in exaggerated kidney toxicity and cancer risks

The Risk Evaluation, which is based on the TCE IRIS Assessment, relies in part on the conclusion that S-(1,2-dichlorovinyl-glutathione (DCVG) and S-(1,2-dichlorovinyl)-L-cysteine (DCVC), which are weakly active renal toxicants and genotoxicants, are formed in toxicologically significant concentrations following human exposures to TCE. This conclusion rests primarily on studies in which a relatively high blood DCVG concentration (100 nM) was observed in volunteers exposed for 4 hours to 50 or 100 ppm TCE.[81] However, Lash *et al.* (1999a,b) relied on a spectrophotometric chromatographic

[79] Gradient, Evaluation of US EPA's inhalation unit risk calculation for trichloroethylene (2020), submitted as Appendix 3 to HSIA Comments on the draft Risk Evaluation, EPA-HQ-OPPT-2019-0500-0094.

[80] Risk Evaluation, at 33-34.

[81] Lash, LH, Putt, DA, Brashear, WT, Abbas, R, Parker, JC, Fisher, JW, Identification of S-(1,2- dichlorovinyl) glutathione in the blood of human volunteers exposed to trichloroethylene, *J. Toxicol. Environ. Health Part A* 56: 1-21 (1999b). It is also supported by *in vitro* kinetic studies that measured the glutathione conjugation of TCE in human hepatocytes and human liver and kidney subcellular fractions. Lash, LH, Lipscomb, JC, Putt, DA, Parker, JC, Glutathione conjugation of trichloroethylene in human liver and kidney: kinetics and individual variation, *Drug. Metab. Dispos.* 27: 351-35 (1999a).

method analysis of TCE glutathione conjugate-derived metabolites which had substantial potential for detection of non-TCE-specific endogenous substances. This is because the HPLC/UV method is a non-specific assay based on UV detection of fluorodinitrobenzene (DNP) conjugated with nucleophiles such as sulfhydryls and primary amine groups, such as DCVG, DCVC, or glutamate.

In a recent study by Zhang *et al.* (2018), the HPLC/UV method used by Lash *et al*. (1999a,b) was found to overestimate the levels of DCVG in blood, liver, and kidney compared to the more specific and reliable HPLC/MS/MS method.[82] The reason for this overestimation was an interfering peak that was primarily contributed by endogenous glutamate present in biological matrices. It is imperative that the analytical data used in human health risk assessments be as accurate and reliable as possible, particularly if those data are used as surrogates for exposure to estimate potential health effects in humans. The Zhang *et al.* findings demonstrate that DCVG formation may have been substantially overestimated based on the levels that were quantified by the HPLC/UV method where the DNP-DCVG and the DNP-glutamate conjugate co-elute, with the DNP-glutamate peak being much larger than DNP-DCVG. The implications of this apparent uncertainty are that the GSH pathway in humans is exaggerated when it contributes a more limited role, if any, in kidney toxicity attributed to TCE-GSH conjugates; and that the risk of kidney toxicity and carcinogenicity from TCE exposure, particularly in humans, may be overestimated and may be occurring by alternative mode(s) of action not inclusive of reactive GSH-derived metabolites.

EPA's TCE IRIS Assessment acknowledged that the HPLC/UV method used by Lash *et al.* (1999a,b) likely overestimated DCVG formation from TCE. The following is an excerpt from the TCE IRIS Assessment regarding the different rates for TCE conjugation in human liver and kidney cell fractions reported from different investigators:

> "The reasons for such discrepancies [in the rates for TCE conjugation] are unclear, but they may be related to different analytical methods (Lash *et al*., 2000). In particular Lash *et al.* (1999b) employed the "Reed method," which used ion-exchange high-performance liquid chromatography (HPLC) of derivatized analytes. This HPLC method is characterized by variability and an overall decline in retention times over the life of the HPLC column due to derivatization of amine groups on the column (Lash *et al*., 1999a). Although data are limited, the GSH pathway metabolite levels reported by methods that utilize [^{14}C]-TCE and radiochemical detection followed by mass spectrometry (MS) identification of the metabolites are lower. In particular, Green *et al*. (1997) and Dekant *et al.* (1990) both used HPLC with radiochemical detection. Peak identity was confirmed by Green *et al.* (1997) using liquid chromatography (LC)/MS and by GC/MS following hydrolysis by Dekant *et al.* (1990). In addition, studies such as Kim *et al*. (2009) using HPLC-MS/MS techniques with stable isotope-labeled DCVG and dichlorovinylcysteine

[82] Zhang, F, Marty, S, Budinsky, R, Bartels, M, Pottenger, LH, Bus, J, Bevan, C, Erskine, T, Clark, A, Holzheuer, B, and Markham, D, Analytical methods impact estimates of trichloroethylene's glutathione conjugation and risk assessment, *Toxicol. Lett*. 296: 82-94 (2018).

(DCVC) standards have also been used to detect GSH pathway metabolite levels. Based on the in vitro work presented in Table 3-23 using the "Reed method," one would expect mouse serum DCVG levels to be ~4-6 times lower than humans. However, using the HPLC-MS/MS technique of Kim *et al.* (2009), the peak DCVG serum levels are ~1,000 times lower in mouse serum than determined by Lash *et al.* (1999b) in human serum. Although advances in LC technology, and differences in exposure routes (inhalation vs. oral, with different first pass), exposure doses, and the degree of competition with TCE oxidation (greater in mouse than in human) should be considered, this much-larger-than-expected difference is consistent with the suggestion that the "Reed method" provides an overestimation of DCVG levels in humans. This could occur if the "Reed method" identifies nonspecific derivatives as DCVG or other GSH pathway metabolites."[83]

In the IRIS Assessment, EPA used a PBPK model[84] in mice, rats, and humans to derive non-cancer and cancer risk values that incorporated *in vitro* kinetic data on the liver and kidney GSH metabolism of TCE, derived primarily using the HPLC/UV ("Reed") method. In addition, the human model included a DCVG compartment, so that the DCVG blood data quantitated using the "Reed method" from the human TCE exposure study by Lash *et al.* (1999b) could be used. As noted above and by other investigators,[85] the prediction from the EPA PBPK model regarding the TCE GSH conjugation pathway is not reliable because of the faulty analytical method used to quantitate DCVG and DCVC in cell fractions and blood.

The Risk Evaluation continues to rely on the same EPA PBPK model used in the 2011 IRIS Assessment. This is a mistake. Human health risks assessments that rely on the blood and tissue levels of DCVG and DCVC measured by the "Reed method" will overestimate the risks of kidney effects from TCE exposure. Without the data generated by the "Reed method," EPA will have to rely on a different approach to estimating the flux of TCE through the GSH conjugation pathway, such as using the urinary metabolite data from Bernauer *et al*. (1996);[86] this will also require reconsideration of what PBPK model can be used. Moreover, the kinetic parameters for the β-lyase enzyme in rats and humans currently in the

[83] IRIS Assessment at 3-41, 3-42.

[84] Chiu, WA, Okino, NS, Evans, MV, Characterizing uncertainty and population variability in the toxicokinetics of trichloroethylene and metabolites in mice, rats, and humans using an updated database, physiologically based pharmacokinetic (PBPK) model, and Bayesian approach, *Toxicol. Appl. Pharmacol.* 241: 36-60 (2009) [hereafter the "EPA PBPK model"].

[85] Dekant, W, Koob, M, Henschler, D, Metabolism of trichloroethene – in vivo and in vitro evidence for activation by glutathione conjugation, *Chem. Biol. Interact.* 73: 89-101 (1990); Green, T, Dow, J, Ellis, MK, Foster, JR, Odum, J, The role of glutathione conjugation in the development of kidney tumours in rats exposed to trichloroethylene, *Chem. Biol. Interact.* 105: 99-117 (1997).

[86] Bernauer, U, Birner, G, Dekant, W, Henschler, D, Biotransformation of trichloroethene: dose-dependent excretion of 2,2,2-trichloro-metabolites and mercapturic acids in rats and humans after inhalation, *Arch. Toxicol.* 70: 338-346 (1996).

EPA PBPK model, which originated from Harvey Clewell's original model (Clewell *et al.*, 2000),[87] have not been documented and pre-date the values that were developed by Green *et al.* (1997) from *in vitro* studies [Harvey Clewell, personal documentation]. The activity of β-lyase in the metabolism of DCVC to the reactive metabolites in the kidney was lower in humans compared to rats.

b. Compelling evidence that the GSH conjugation pathway is an extremely small contributor to TCE metabolism

Since the publication of the TCE IRIS Assessment, additional studies have evaluated the kidney concentrations of the oxidative and glutathione conjugate-derived metabolites of TCE in a variety of mouse strains administered five daily oral doses of 600 mg/kg TCE.[88] Metabolites were quantitated two hours after the last daily dose; this time point was chosen because previous studies had shown that the approximate maximum plasma concentrations of TCA, DCA, DCVG, and DCVC occur two hours after an oral dose of TCE.[89] Using a structure-specific HPLC-ESI-MS/MS method, Yoo *et al.* (2015) demonstrated that DCVG and DCVC were only a very small fraction of total metabolites quantitated in kidney. Trichloroethanol (TCOH) kidney concentrations were 2- to 4-fold greater than TCA, TCA concentrations were 100- to 1,000-fold greater than DCA, and DCA concentrations were 100- to 1,000-fold greater than either DCVG or DCVC. These results show that TCE oxidative metabolism was up to five orders of magnitude greater than glutathione conjugate-derived metabolism, thus questioning the role of the GSH conjugation pathway in the kidney cancer MOA. These findings are consistent with the earlier report from Kim *et al.* (2009), in which the time course of TCA, DCA, DCVG, and DCVC in serum was investigated following a single oral dose of 2,100 mg/kg TCE dose to male $B6C3F_1$ mice. The total area under the curve (AUC) of TCA and DCA (oxidative metabolites) was 40,000-fold higher than the total AUC of DCVG and DCVC (glutathione conjugates). It should

[87] Clewell III, HJ, Gentry, PR, Covington, TR, Gearhart, JM, Development of a physiologically based pharmacokinetic model of trichloroethylene and its metabolites for use in risk assessment, *Environ. Health Perspect.* 108(Suppl. 8): 283-305 (2000).

[88] Yoo, HS, Bradford, BU, Kosyk, O, Uehara, T, Shymonyak, S, Collins, LB, Bodnar, WM, Ball, LM, Gold, A, Rusyn, I, Comparative analysis of the relationship between trichloroethylene metabolism and tissue-specific toxicity among inbred mouse strains: kidney effects, *J. Toxicol. Environ. Health Part A* 78: 32-49 (2015).

[89] Kim, S, Kim, D, Pollack, GM, Collins, LB, Rusyn, I, Pharmacokinetic analysis of trichloroethylene metabolism in male B6C3F1 mice: Formation and disposition of trichloroacetic acid, dichloroacetic acid, S-(1,2-dichlorovinyl)glutathione and S-(1,2-dichlorovinyl)-L-cysteine, *Toxicol. Appl. Pharmacol.* 238: 90-99 (2009).

be noted that this study did not quantify the oxidative metabolite TCOH, which would have further increased the disparity of glutathione conjugate-derived metabolites relative to the oxidative-derived metabolites. When TCOH and NAcDCVC are quantified, the flux of TCE through the GSH conjugation pathway was 0.010% to 0.013% of the dose; the estimated reactive species generated from DCVC was approximately 0.0002% to 0.0003% of the dose (Luo *et al.*, 2018). These data demonstrate a dramatically lower function for glutathione-conjugate metabolism relative to oxidative metabolism in mice.

c. Estimated levels of DCVC and its reactive metabolites in kidneys of TCE-exposed mice are insufficient to account for toxicity

KIM-1 expression (measurement of cytotoxicity and regeneration) in renal proximal tubules was not significantly correlated with DCVC levels in the kidney in mice from seven inbred strains dosed by oral gavage with 600 mg/kg TCE for five consecutive days.[90] Of the 15 mice in the study, the three mice with the highest levels of DCVC (57.4, 102.6, and 113.7 pmol/g tissue) in kidney tissue had low or no KIM-1 expression (0, 0, and 3.2% KIM-1 positive renal tubules, respectively). In contrast, three of the mice with the highest KIM-1 expression (32.3, 48.2, and 52.1 KIM-1 positive renal tubules) had relatively low levels of DCVC (12, 32.2, and 11.1 pmol/g tissue, respectively) in the kidney. In another experiment, KIM-1 expression was significantly elevated in renal proximal tubules of C57BL/6J mice (400 mg/kg TCE, but not at 100 mg/kg) and NZW/LacJ mice (100 and 400 mg/kg TCE) after 5 days of oral gavage doses; cell proliferation was increased in the NZW/LacJ strain only after 4 weeks of treatment. Yet, the levels of DCVC and DCVG in the kidneys of these two mouse strains were below the LLOQ of 1 pmol/g kidney for DCVG and 10 pmol/g kidney for DCVC. The NZW/LacJ mouse strain also showed high levels of KIM-1 expression in the proximal tubules, but relatively low levels of DCVC in kidney tissue, when dosed with 600 mg/kg TCE for 5 days.

Additional insight into whether DCVC-derived reactive species can be generated in sufficient quantities to be primarily responsible for TCE-induced toxicity comes from a comparison of the DCVC toxicity studies with recent measurements of the flux of TCE via the

[90] Yoo, HS, Bradford, BU, Kosyk, O, Uehara, T, Shymonyak, S, Collins, LB, Bodnar, WM, Ball, LM, Gold, A, Rusyn, I, Comparative analysis of the relationship between trichloroethylene metabolism and tissue-specific toxicity among inbred mouse strains: kidney effects, *J. Toxicol. Environ. Health Part A* 78: 32-49 (2015).

GSH conjugation pathway.[91] In the studies by Green *et al.* (1997), male B6C3F$_1$ mice were given either a single oral gavage dose of 10 or 50 mg/kg DCVC or 10 consecutive oral doses of 0.1, 0.5, 1, or 5 mg/kg DCVC. After a single oral dose, kidney toxicity (increased serum γ-glutamyl transferase) was observed at ≥1 mg/kg DCVC, with histopathologic changes at ≥10 mg/kg. After 10 consecutive oral doses, histopathologic changes were noted in the kidneys of mice at ≥1 mg/kg-day, with a No-Observed-Effect-Level (NOEL) at 0.5 mg/kg-day. Luo *et al*. (2018) reported that the flux of TCE through the GSH conjugation pathway in male B6C3F1 mice given a single oral gavage dose of 800 mg/kg TCE was 0.013% of the dose, which would be 0.10 mg DCVC/kg-day. A comparison of the NOEL for kidney toxicity from male B6C3F$_1$ mice dosed orally with DCVC (0.5 mg/kg-day) with the amount of DCVC formed from a nephrotoxic and carcinogenic dose of TCE (assuming all DCVC reaches the kidney) shows about a 5-fold difference in dose. Even taking into account that bioavailability of DCVC to the kidney from an oral gavage dose could be less than 100% and that the most sensitive markers of kidney toxicity (*i.e.*, KIM-1 expression) were not used by Green *et al.* (1997), this difference in availability of DCVC-derived reactive species from an 800 mg/kg oral dose of TCE and the NOEL for DCVC-induced kidney toxicity clearly indicates that these DCVC-derived reactive species cannot be primarily responsible for TCE-induced kidney toxicity.

The rat may be fairly similar to the mouse quantitatively in the amount of TCE metabolized by the GSH conjugation pathway. Using toxicokinetic modeling, Luo *et al.* (2018) estimated that the ratios of oxidative metabolites (TCA + TCOH) to GSH conjugates (presumably NAcDCVC) in the urine from three different strains of 800 mg/kg orally dosed male mice were 1,206 to 3,664. These ratios are very similar to the ratio reported by Bernauer *et al.* (1996) from male Wistar rats exposed to 160 ppm TCE for 6 hours: the urinary ratio was 2,562 for excreted oxidative metabolites (TCA + TCOH) to NAcDCVC (used as an indicator of GSH conjugation).[92] If the flux of TCE via the GSH conjugation pathway is similar across

[91] Green, T, Dow, J, Ellis, MK, Foster, JR, Odum, J, The role of glutathione conjugation in the development of kidney tumours in rats exposed to trichloroethylene, *Chemico-Biol. Interact.* 105: 99-117 (1997); Luo, Y-S, Hseih, N-H, Soldatow, VY, Chiu, WA, Rusyn, I, Comparative analysis of metabolism of trichloroethylene and tetrachloroethylene among mouse tissues and strains, *Toxicol.* 409: 33-43 (2018).

[92] Bernauer, U, Birner, G, Dekant, W, Henschler, D, Biotransformation of trichloroethene: dose-dependent excretion of 2,2,2-trichloro-metabolites and mercapturic acids in rats and humans after inhalation, *Arch. Toxicol.* 70: 338-346 (1996).

rodent species, then the GSH conjugation metabolites are even less like to be responsible for the kidney toxicity in the rat compared to the mouse. Green *et al.* (1997) showed that the rat was approximately an order of magnitude less sensitive to the nephrotoxic effects of DCVC compared to the mouse following 10 days of consecutive dosing.

D. EPA did not use best available science in its occupational exposure assessments

1. Inhalation Exposure Assessment

Although HSIA provided industrial hygiene (IH) data for manufacturing and feedstock use,[93] for the most part EPA relied in the Risk Evaluation on workplace inhalation exposure data that were of low quantity or were not representative of current industry practices for certain commercial or industry uses. Despite these inadequacies, EPA utilized these exposure data in the Risk Evaluation rather than considering alternative approaches that would result in a higher confidence in estimating workplace exposures. Generally, for these COUs there was a lack of workplace inhalation exposure data, or the data were of low quality or not representative of current industry practices. There are numerous ways in which EPA's occupational exposure assessment methodologies could have been refined to better characterize exposures with high confidence, particularly for historical and small data sets, as described in a recent publication by Lynch *et al*.[94] Had EPA developed more robust exposure estimates consistent with best practices for occupational risk assessment,[95] it would have been better able to gauge the likelihood that specific industry sectors would be able to meet the proposed ECEL for TCE.

Combining multiple exposure information sources for COUs and COU subcategories with limited information, rather than relying strictly on empirical data, also would have allowed EPA to better understand potential occupational exposures to TCE for the purposes of risk management. Owing to EPA's hierarchy of data sources, empirical data are typically preferred over modeling, regardless of the number of data points. Small datasets were a limitation of the exposure estimates for many of the COU subcategories in the TCE risk assessment. AIHA and

[93] EPA-HQ-OPPT-2016-0737-0103.

[94] Lynch, HN, Allen, LH, Hamaji, CM, Maier, A, Strategies for refinement of occupational inhalation exposure evaluation in the EPA TSCA risk evaluation process, *Toxicol Ind Health* 39: 169-182 (2023a) (Attachment F).

[95] For example, a 2015 textbook from the American Industrial Hygiene Association: Jahn SD, Bullock WH, Ignacio JS, et al. A Strategy for Assessing and Managing Occupational Exposures. 4th Edition. AIHA (2015).

other occupational health professional associations recommend that if empirical data are limited or of low quality, these data should be supplemented by exposure modeling, or the data be used to parameterize a model.[96] Alternatively, empirical data can be used as a method to validate exposure modeling. Regardless of specific approach, integrating several sources of exposure information generally increases the confidence in the resulting exposure estimate. Again, had EPA followed best practices recommendations for handling small industrial hygiene datasets, it would have been able to better characterize the likelihood of exceedance of the ECEL for specific uses and base its risk management recommendations on this understanding.

2. Dermal Exposure Assessment

In both the Risk Evaluation and the Revised Risk Determination for TCE, EPA found unreasonable risks to workers from acute and chronic dermal exposure in the manufacture of TCE and its use in the production of other chemicals (feedstock or intermediate use), even with the most protective glove use (Protection Factor of 20). Although EPA assumed glove use in the Risk Evaluation for dermal protection, the models EPA used to estimate the amount of TCE that is retained by workers from dermal contact was not based on any supporting information and overestimated any potential exposure. These "worst-case scenarios" assumed unrealistic dermal exposure durations and fail to recognize basic industrial hygiene (IH) practices, including implementation of OSHA-compliant standard operating procedures (SOPs), as well as engineering controls required by the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Synthetic Organic Chemical Manufacturing Industry (SOCMI)[97] and Miscellaneous Organic Chemical Manufacturing (MON),[98] which require closed systems where exposure is tightly controlled. Thus, they are clearly inapplicable to facilities that manufacture TCE or use TCE as a process reactant or intermediate.

The manufacture of TCE and its use in the production of other chemicals (*i.e.*, refrigerants) are COUs that occur in closed system process units where potential dermal contact

[96] Mulhausen J, Milz, S, Hewett, P, et al. Chapter 8: Quantitative Exposure Data: Interpretation, Decision-Making, and Statistical Tools. A Strategy for Assessing and Managing Occupational Exposures. 4th Edition. AIHA, pp. 124-141 (2015).

[97] 40 C.F.R. Part 63 Subparts F, G, H, I.

[98] 40 C.F.R. Part 63, Subpart FFFF.

is limited to short-term tasks in the operation of unit activities. "Closed systems (including rigorous containment by technical means) generally relate to high integrity plant/machinery where the opportunity for exposure is negligible, both in terms of frequency and magnitude".[99] Following several meetings with OPPT staff, HSIA submitted to EPA two documents that provide comprehensive details on the typical tasks involved in the manufacturing of carbon tetrachloride and the Standard Operating Procedures (SOPs) for these tasks including personal protection equipment (PPE) use.[100] HSIA emphasized repeatedly to OPPT staff that these comments apply equally to manufacture of the other chlorinated solvents, including TCE, and their use as intermediates in manufacturing fluorochemicals. The typical short-term (5-30 minutes) tasks that could potentially involve contact with liquid phase TCE are loading transport equipment, conducting minor maintenance and line openings, packaging wastes, and collecting process samples. Although not expected, should accidental contact with TCE occur during the performance of these tasks, concentrations and amounts are minimal. Incidental, intermittent, or splash contact may only occur if there is an accidental spill, overspray conditions, or unexpected failure of a control device.

Despite the engineering, personal protective equipment (PPE), training, and SOPs in place to prevent any exposure and potential for exposure limited to the short-term tasks described above, EPA estimated dermal exposure to TCE for workers using Kasting and Miller (2006)[101] with the following assumptions: (1) one dermal contact with undiluted TCE which coats fully one or both hands per work shift; (2) workers do not wash their hands at any point during the 8-hour work shift if gloves are not worn; and (3) a worker wears the same pair of gloves for the entire 8-hour work shift without stopping to wash their hands and/or change their gloves.[102] Incredibly, EPA provided no documentation or justification for these assumptions other than the

[99] European Chemicals Agency (ECHA), Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.14: Occupational Exposure Assessment, Version 3.0 (2016).

[100] SOPs for Personal Protection at CTC Manufacturing Sites; HSIA Response to EPA's Questions on Standard Operating Procedures (SOPs) at Carbon Tetrachloride and Other Solvent Manufacturing Facilities (September 27, 2021); EPA-HQ-OPPT-2020-0592-0003. Although EPA has had this documentation for over two years, it did not revise the assessment in its Revised Risk Determination and made no reference to the submission.

[101] 40 C.F.R. 63 Subparts F, G, H, I (hereafter "the NESHAP").

[102] Risk Evaluation, Supplemental Information on Releases and Occupational Exposure Assessment.

intent to establish a theoretical "worst-case scenario." As a result of these assumptions, EPA very substantially overestimated worker exposure to TCE from dermal contact in facilities that manufacture and use TCE as a reactant or intermediate.

According to EPA, risk evaluations under TSCA § 6(b) are not screening level risk assessments, but are intended to "use scientific information, technical procedures, measures, protocols, methodologies and models consistent with the best available science." Therefore, EPA should use in its dermal exposure models data and assumptions that are relevant and appropriate to actual workplace practices for the COUs being evaluated, information which EPA has had now for several years.[103] Unfortunately, the Risk Evaluation fails to acknowledge basic IH practices.

As noted in the information provided to EPA on use of PPE at chlorinated solvent production facilities with closed systems, any potential dermal exposures are for short durations and, combined with the industry standards for good IH practices at these facilities which require removal and disposal of potentially contaminated gloves and hand washing after each task completion, do not justify an 8-hour period for absorption of TCE through skin. Moreover, TCE will evaporate from the skin and gloves between exposure periods.

Lynch *et al.* reviewed the methodology in the Risk Evaluation for estimating dermal exposures of workers to several chlorinated chemicals for the COUs involving manufacturing and feedstock use.[104] They also provided best practice recommendations which can be broadly applied to any of the exposure scenarios used in the Risk Evaluation. The authors recommended a "tiered, integrated approach to dermal exposure assessment that emphasizes collecting qualitative data; employing validated, peer-reviewed models that align with current industrial practices; and gathering empirical sampling data when needed." They also recommended that a

[103] In this regard, the SACC concluded that "the worker exposures characterized in the draft risk evaluation are best described as a screening-level assessment. Due to the lack of readily available monitoring data and low confidence in the data sources, this assessment should not be used to decide whether health risks are reasonable or unreasonable. The results of a screening-level assessment can be used to determine if further refinement and more data are needed." See Summary of External Peer Review and Public Comments and Disposition for Perchloroethylene (PCE): Response to Support Risk Evaluation (epa.gov) at 217. In spite of having had very reliable monitoring data for these COUs for years, EPA has continued to ignore this comment.

[104] Lynch, HN, Gloekler, LE, Allen, LH, Maskrey, JR, Bevan, C, Maier, Analysis of dermal exposure assessment in the US Environmental Protection Agency Toxic Substances Control Act risk evaluations of chemical manufacturing, *Toxicol Ind Health* 39: 49-65 (2023b) (Attachment G).

more realistic approach to estimating the dermal dose of TCE in workers in closed system facilities (manufacturing and process reactant/intermediate use) can be obtained using the IH Skin Perm model.[105] This tool is commonly used by practitioners of IH and exposure assessment to produce reliable estimates of dermal exposure. And, as noted in the Risk Evaluation, "this model takes into account losses to evaporation and estimates the mass that is absorbed." In addition, IH SkinPerm can be used to evaluate the impacts of differing patterns of exposure on fractional and total dose of absorption, *i.e.*, it allows for the incorporation of realistic exposure patterns.

Recognition of standard work practices and reliance on reasonable and realistic exposure data are critical to meet the statutory requirements of TSCA, as well as the "objectivity" criterion of the Information Quality Act. EPA's reliance on hypothetical assumptions for modeling of the amount of TCE that is absorbed by workers from dermal contact cannot be justified. Assumptions used for estimating worker exposures should be as relevant as possible for the COUs being evaluated. EPA's use of unrealistic dermal exposure assumptions has led to erroneous conclusions regarding the health risks to workers using TCE in closed systems.

3. Flawed assumptions regarding use of PPE in Revised Risk Determinations

In its justification for the Revised Risk Determination for all COUs of TCE, EPA states that this change "reflects EPA's recognition that unreasonable risk may exist for subpopulations of workers that may be highly exposed because they are not covered by OSHA standards, such as self-employed individuals and public sector workers who are not covered by a State Plan, or because their employer is out of compliance with OSHA standards, or because many of OSHA's chemical-specific permissible exposure limits largely adopted in the 1970's are described by OSHA as being 'outdated and inadequate for ensuring protection of worker health,' (Ref. 13), or because the OSHA PEL alone may be inadequate to protect human health, or because EPA finds unreasonable risk for purposes of TSCA notwithstanding existing OSHA requirements."[106]

EPA has generalized this concern to all COUs for TCE, yet it is not pertinent at all to the manufacture of TCE, or its use as a fluorochemicals feedstock, based on the information

[105] IH SkinPerm is a peer-reviewed exposure assessment tool published by the American Industrial Hygiene Association (AIHA) Exposure Assessment Strategies Committee.

[106] 88 Fed. Reg. at 1225.

provided by HSIA to EPA on industry best practices for industrial hygiene. HSIA submitted to EPA two documents that provide comprehensive details on the typical tasks involved in the manufacture of chlorinated solvents, and the SOPs for these tasks including PPE use.[107] These documents also provide a summary of the extensive training that are in place for employees (new and seasoned) to ensure SOP requirements are followed. There are no exceptions – the SOPs and training apply to all workers. EPA has no rational basis to assume that any worker that is potentially exposed to TCE would be a public sector employee or self-employed individual. Furthermore, EPA's assumption that existing OSHA requirements are not met by employers of covered workers would be misuse, in contravention of Congress's understanding, when it amended TSCA, that the term "conditions of use" is "*not intended to include 'intentional misuse' of chemicals*."[108]

For the manufacture and feedstock COUs for TCE, EPA must assess in the Risk Evaluation the circumstances under which TCE is intended, known, or reasonably foreseen to be manufactured/used. Where PPE use is required by all US manufacturers and that information has been "clearly articulated" to EPA, EPA must take that information into account in its Risk Evaluation.

4. EPA did not use best available science in its systematic review

The preamble states "The proposed numeric ECEL values considered for incorporation into the WCPP are derived from the analysis in the 2020 Risk Evaluation for TCE, which EPA considers to represent the best available science under TSCA section 26(h) because it was subject to peer review and is the result of a systematic review process that considered reasonably available information in order to identify relevant adverse health effects."[109] This was not the view of the outside peer reviewers, who have been generally critical of the systematic review process EPA employed in the Risk Evaluation.

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[107] SOPs for Personal Protection at CTC Manufacturing Sites; HSIA Response to EPA's Questions on Standard Operating Procedures (SOPs) at Carbon Tetrachloride and Other Solvent Manufacturing Facilities (September 27, 2021); EPA-HQ-OPPT-2020-0592-0003.

[108] *See* U.S. Congress (2015), *Frank R. Lautenberg Chemical Safety for the 21stCentury Act, Report together with Minority Views,* 114th Congress, 1st Session, Report 114-67, at 7 (emphasis added), available at https://www.congress.gov/114/crpt/srpt67/CRPT-114srpt67.pdf.

[109] 88 Fed. Reg. at 74721.

TSCA §§ 6 and 26 require EPA to use the best available science and weight of the scientific evidence when considering study quality and relevance for multiple lines of evidence. EPA developed its fit-for-purpose systematic review approach because other existing approaches did not satisfy these TSCA statutory requirements. However, the TSCA systematic review approach used for the Risk Evaluation does not include sufficiently detailed guidance for evidence integration and weight of evidence methodology, and EPA did not consistently apply a weight of evidence approach in the Risk Evaluation.

EPA's Scientific Advisory Committee on Chemicals (SACC) recommended a number of improvements in the systematic review process, as did many commenters on the draft Risk Evaluation. More specifically, the Committee to Review EPA's TSCA Systematic Review Guidance Document convened by the Board on Environmental Studies and Toxicology of the National Academy of Sciences was unable to conclude that the TSCA systematic review process is comprehensive, workable, objective, and transparent. Indeed, the Committee used TCE to illustrate the shortcomings in EPA's approach.[110] Given the significant criticisms from both SACC and National Academy, for EPA to continue to rely upon the 2018 systematic review process undermines EPA's position that its risk evaluation has met TSCA § 26 requirements.

V. EPA FAILED TO CONSIDER THE IMPACTS OF THE PROPOSED RULE ON SMALL BUSINESSES OR TO DETERMINE WHETHER EFFECTIVE ALTERNATIVES ARE AVAILABLE, AS REQUIRED BY TSCA AND SBREFA

A. The proposed rule discriminates against small businesses

EPA has adopted an unprecedented reading of TSCA that allows it actively to discriminate against small businesses, by prohibiting almost all small business uses outright without even providing an opportunity to those businesses to continue to use TCE in compliance with a WCPP:

> "Given that the magnitude of risk from TCE is so high, and that the extremely high level of PPE would be an ineffective long-term way of addressing that risk along with information provided by stakeholders, including during consultations (Refs. 70, 31), EPA has significant uncertainty that any measures short of prohibition would be sufficient to address the unreasonable risk. Therefore, EPA proposes that prohibition is the preferred option to ultimately address unreasonable risk. EPA believes that the extremely low ppm level of the ECEL, while fully addressing unreasonable risk, will be infeasible for industry to reliably

[110] The Use of Systematic Review in EPA's Toxic Substances Control Act Risk Evaluations, National Academy Press (2021), at 31-34.

> meet due to the need for a combination of engineering, administrative controls, and full-face, self-contained, air-supplied respirators. As such, the only way to protect human health consistently, reliably, and continually from unreasonable risk would be to prohibit TCE.
>
> "Ultimately, a prohibition would result in elimination of unreasonable risk from TCE, rather than allowing TCE use to continue in perpetuity, which would necessitate burdensome requirements to achieve exposure reductions to implement a technically challenging long-term program to meet a very low exposure limit. . . . As noted in Unit V.A.2., EPA has significant uncertainty about the extent to which some members of the regulated community could measure or reliably meet either the ECEL of 0.0011 ppm (in the proposed WCPP) or the ECEL of 0.0040 ppm (in the primary alternative regulatory action), which contributes to EPA's proposal that prohibition is the best long-term risk management option for TCE."[111]

HSIA submits that EPA's "uncertainty" as to whether most users can comply with its ECEL is not a sufficient reason to eliminate any compliance option for these users, most of which are small businesses. The only justification for such a ban is that it would present an "unreasonable risk," which EPA has determined is not present where the user is in compliance with a WCPP.

In its proposed risk management rule for perchloroethylene (PCE), at least, EPA recognized in an alternative regulatory option "that, for some of the occupational conditions of use that it is proposing to prohibit, there may be some activities or facilities that could conceivably implement requirements under a PCE WCPP to ensure that exposure remain below an ECEL and prevent direct dermal contact with PCE. In some cases, they may be able to undertake more extensive risk reduction measures than EPA currently anticipates."[112] Similar provision should be made in the final TCE rule.

EPA's rationale for excluding most TCE uses, for many of which small businesses predominate, appears to be based upon a lack of knowledge of both the business operations and whether the ECEL can be achieved:

> "EPA also considered the feasibility of exposure reduction sufficient to reduce the unreasonable risk, including in facilities currently complying with the OSHA PEL for TCE or implementing other recommended OELs such as the ACGIH TLV. While EPA acknowledges the regulated community's expected familiarity with OSHA PELs generally, as well as facilities' past and ongoing actions to

[111] 88 Fed. Reg. at 74762.

[112] 88 Fed. Reg. at 39696-97.

> implement the TCE PEL, the value of EPA's exposure limit is almost five orders of magnitude lower than the OSHA PEL. . . .This creates a significant degree of uncertainty as to whether facilities engaging in most conditions of use could implement engineering or administrative controls to reduce exposures in a manner aligned with the hierarchy of controls to meet the ECEL (and associated action level) and whether they could do so without relying primarily on the use of PPE (which is the least preferred option in the hierarchy of controls) to supplement exposure reduction efforts."[113]

Given EPA's uncertainty regarding whether most users will be able to achieve the ECEL, it is unclear why EPA chose to implement a default prohibition. Likewise, this uncertainty also prevented EPA from following the TSCA § 6(c) mandate to consider "whether technically and economically feasible alternatives that benefit health or the environment, compared to the use so proposed to be prohibited or restricted, will be reasonably available as a substitute." As discussed in the following section, this alternatives analysis requirement has not been met.

Where other options are available to regulate "to the extent necessary so that the chemical substance or mixture no longer presents such risk," it is inconsistent with TSCA to allow only regulated entities that may have fewer challenges implementing requirements to meet an ECEL because work activities may occur in sophisticated facilities or take place in a closed system. At least in the case of perchloroethylene, EPA acknowledged "uncertainties regarding (i) the feasibility of implementing workplace safety control measures in open-systems or when worker activities require manual application or removal of PCE or PCE-containing products, (ii) availability of alternatives, or (iii) whether the use is ongoing or phased out. . . . and request[ed] comment on the ways in which PCE may be used in these conditions of use, including whether activities may take place in a closed system and the degree to which users of PCE in these sectors could successfully implement an ECEL, DDCC, and ancillary requirements described in Unit IV.A."[114] For TCE, the uncertainty has led EPA to propose a blanket ban. This seems arbitrary and capricious.

Finally, in passing the Regulatory Flexibility Act, subsequently amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), Congress stated:

> ''(a) The Congress finds and declares that—

[113] 88 Fed. Reg. at 74764.

[114] 88 Fed. Reg.at 39683-84.

‘‘(1) when adopting regulations to protect the health, safety and economic welfare of the Nation, Federal agencies should seek to achieve statutory goals as effectively and efficiently as possible without imposing unnecessary burdens on the public;

‘‘(2) laws and regulations designed for application to large scale entities have been applied uniformly to small businesses, small organizations, and small governmental jurisdictions even though the problems that gave rise to government action may not have been caused by those smaller entities;

‘‘(3) uniform Federal regulatory and reporting requirements have in numerous instances imposed unnecessary and disproportionately burdensome demands including legal, accounting and consulting costs upon small businesses, small organizations, and small governmental jurisdictions with limited resources;

‘‘(4) the failure to recognize differences in the scale and resources of regulated entities has in numerous instances adversely affected competition in the marketplace, discouraged innovation and restricted improvements in productivity;

‘‘(5) unnecessary regulations create entry barriers in many industries and discourage potential entrepreneurs from introducing beneficial products and processes;

‘‘(6) the practice of treating all regulated businesses, organizations, and governmental jurisdictions as equivalent may lead to inefficient use of regulatory agency resources, enforcement problems, and, in some cases, to actions inconsistent with the legislative intent of health, safety, environmental and economic welfare legislation;

‘‘(7) alternative regulatory approaches which do not conflict with the stated objectives of applicable statutes may be available which minimize the significant economic impact of rules on small businesses, small organizations, and small governmental jurisdictions;

‘‘(8) the process by which Federal regulations are developed and adopted should be reformed to require agencies to solicit the ideas and comments of small businesses, small organizations, and small governmental jurisdictions to examine the impact of proposed and existing rules on such entities, and to review the continued need for existing rules.

‘‘(b) It is the purpose of this Act [enacting this chapter] to establish as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required

> to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration.''[115]

The instant proposal appears to have completely ignored this law. The docket includes 404 pages describing concerns raised by small businesses representing several use sectors.[116] Nowhere in the docket or the preamble to the proposed rule is there substantive discussion of these comments. Additionally, although SBREFA clearly encourages implementation of alternatives to minimize the impact upon small businesses, the proposal instead prohibits almost all small business uses. At the very least, the final rule should allow small businesses the opportunity to implement a WCPP as an alternative.

B. EPA's consideration of alternatives is inadequate

Regarding uses that are to be phased out rather than eliminated outright, EPA acknowledges that:

> "EPA does not have sufficient information as to whether the conditions of use that would continue for longer than one year under the primary alternative regulatory action listed in this unit could meet requirements of a WCPP for TCE, including an ECEL of 0.0040 ppm for TCE. Therefore, EPA requests comment on the existing practices (*e.g.,* engineering controls, administrative controls, PPE) involving TCE use in these conditions of use, as to whether activities may take place in closed systems and the degree to which users of TCE in these sectors could successfully implement an ECEL of 0.0040 ppm, dermal protection, and ancillary requirements, described in Unit V.A.2., until the prohibitions would become effective, including for the manufacturing, processing, and distribution in commerce that account for the supply chain."[117]

Why EPA has not requested such comment for all uses of TCE is unclear. EPA's failure to meet its obligation adequately to consider alternatives cannot, however, justify its exclusion of thousands of users from the opportunity to implement a WCPP. TSCA § 6(c) provides that if a regulation would operate "in a manner that substantially prevents a specific condition of use of a chemical," EPA must consider "whether technically and economically feasible alternatives that

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[115] Regulatory Flexibility Act, Pub. L. 96-351, as amended by Small Business Regulatory Enforcement Fairness Act (SBREFA), Pub. L. 96–354, Section 2; see note following 5 USC § 601.

[116] Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule Toxic Substances Control Act (TSCA) Section 6(a) for Trichloroethylene (TCE) (Oct. 30, 2023). EPA-HQ-OPPT-2020-0642-0054. Several small entity representatives (SERs) provided compelling arguments as to why the available alternatives are not technically or economically feasible. In sum, given the information EPA has received from small businesses, the alternatives on the market constitute neither technically nor economically feasible alternatives.

[117] 88 Fed. Reg. at 74754.

benefit health or the environment, compared to the use so proposed to be prohibited or restricted, will be reasonably available as a substitute." Here EPA proposes to eliminate uses constituting a significant amount of the TCE market, including uses such as degreasing and aerosol brake cleaning that originated decades ago and continue to be important. EPA's economic analysis, however, completely fails to consider the impact on American manufacturing competitiveness of eliminating such uses by adopting a workplace limit much lower than those of other countries. TSCA contains no authorization for EPA to consider "significant uncertainty that any measures short of prohibition would be sufficient to address the unreasonable risk"[118] to prohibit a use. Just the opposite: it affirmatively requires EPA to consider "whether technically and economically feasible alternatives . . . will be reasonably available."

EPA's Alternatives Assessment fails to identify technically and economically feasible alternatives because it does not consider whether any particular alternative will work effectively in a given use. Rather, the Alternatives Assessment simply presents "(1) a representative list of reasonably available alternatives for consideration by EPA, to the extent practicable to form a snapshot of the current market; and (2) where practicable, information to enable EPA to compare the human health hazards, environmental hazards, potential persistence, and bioaccumulative properties of each chemical for each product in each product category."[119] Thus, EPA's Alternatives Assessment does not address the fundamental question of whether the alternatives identified are "reasonably available" "technically and economically feasible alternatives." Indeed, it acknowledges that:

> "In some cases, the Agency did not find it practicable to consider alternative processes that may be reasonably available as a substitute for processes involving TCE when the proposed prohibitions or restrictions would take effect, as described in more detail in Appendix C. This is due to numerous considerations including uncertainties about alternative processes that may be reasonably available, the difficulty of ascertaining whether any alternative processes may be technically and economically feasible, and the challenges of comparing the benefits of alternative processes to the benefits of the TCE-containing processes."[120]

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[118] *Id.* at 74762.

[119] Alternatives Assessment, at 8-9.

[120] *Id*. at 8.

Rather, the analysis is intended "to enable EPA to compare the human health hazards, environmental hazards, potential persistence, and bioaccumulative properties of each chemical for each product in each product category," an exercise of no practical utility for any specific condition of use if the alternatives considered do not perform the functions for which TCE is used.

Such alternatives analysis as there is appears in the Economic Analysis:

> "This analysis compares the hazard endpoints and fate characteristics of TCE (the subject of this TSCA section 6(a) risk management proposed rulemaking) to chemical ingredients in alternative products known to be reasonably available. Consideration of whether there are technically and economically feasible alternatives, when compared with TCE for the uses proposed to be prohibited or restricted, is discussed in the Economic Analysis of the Proposed Regulation of TCE Under TSCA section 6(a)."[121]

The Economic Analysis, however, does not remedy the shortcomings of the Alternatives Assessment. It notes at the outset:

> "This economic analysis does not include quantified cost estimates for all costs under the regulatory options. Although certain costs cannot be quantified, this does not mean that they are less important than the quantified costs. Additional unquantified costs are discussed in more detail in section 7.11, but the unquantified cost includes the following:
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> - Applications where TCE is more effective, reducing labor time and wait time that this analysis was unable to quantify.
> - Potential facility closures resulting from challenges to switching to TCE alternatives.
> - Costs associated with developing and testing alternatives to TCE for rocket booster nozzles.
> - Under the proposed option, the disposal of TCE to industrial pre-treatment, industrial treatment, or publicly owned treatment work is prohibited after the 6(g) exemption ends, 25 years after the rule is finalized. Cleanup sites would need to identify and implement alternative disposal or treatment methods. The information to estimate how often these costs might be incurred or what the specific costs would be per site when they are incurred is not available.
> - Unquantified costs associated with implementing a respirator program, since respirators have been found to interfere with many physiological and psychological aspects of task performance (Johnson 2016).
> - The costs of switching to alternatives to TCE are unknown for battery separator manufacture, synthetic paper manufacture, HFC manufacturing, use

[121] *Id.* at 8.

> as an intermediate in HCl production, and fluoroelastomer manufacture (see section 7.11.6)."[122]

Additionally, "there may be some safety-critical applications where alternatives would need to undergo extensive safety reviews and testing before they could replace the TCE products. The impact of a prohibition of TCE for these uses could potentially result in important negative impacts of the proposed options."[123]

As in the Alternatives Assessment, the Economic Analysis is mostly limited to a comparison of hazards and physical properties, not an evaluation of the actual feasibility of replacement. It compares certain physical and chemical characteristics, human health/ecological toxicity, and environmental fate of potential alternatives, and even customer satisfaction, but does not consider the physical/chemical properties of TCE that make it *uniquely* suited to many uses. Given the limitations of the analysis, it is hardly surprising that the analysis concludes that the proposed rule will have minimal cost impacts on small businesses. Again, nowhere does EPA address the myriad reasons that small businesses told it in the Small Business Advocacy Review (SBAR) that alternatives are not suitable.[124]

Indeed, the Economic Analysis recognizes that it does not adequately consider costs with regard to alternatives:

> "[A]lternative products with similar cost and efficacy are available for most of the products that are formulated with TCE. For some applications, there may be additional unquantified costs associated with the alternatives or in cases where alternatives are not currently available. End users with economic and technologically feasible alternatives available do not have impacts that are estimated beyond rule familiarization costs. For the costs of the products themselves, in most cases there were both alternatives that were more costly and less costly, but it is unclear whether average product costs would be higher or lower after a prohibition of TCE in these products. Alternative products that are drop-in substitutes (i.e., requiring no changes by the user in how the product is used) are generally available. However, in some cases some effort might be required by firms using TCE products to identify suitable alternatives, test them for their desired applications, learn how to use them safely and effectively, and implement new processes for using the alternative products. The information to

[122] Economic Analysis of the Proposed Regulation of Trichloroethylene Under TSCA Section 6(a) (June 2023), EPA-HQ-OPPT 2020-0642-0178 (hereafter "Economic Analysis"), at ES-13.

[123] *Id.* at 7-53.

[124] Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule Toxic Substances Control Act (TSCA) Section 6(a) for Trichloroethylene (TCE) (Oct. 30, 2023). EPA-HQ-OPPT-2020-0642-0054.

> estimate how often these costs might be incurred or what the specific costs would be per-user or per-firm when they are incurred is not available. Therefore, EPA is unable to consider these costs quantitatively."[125]

The Agency's proposed rule also fails to meet the requirements of TSCA § 6(c)(2)(A), which requires that EPA consider fully the benefits of chemical products it seeks to prohibit in one or more conditions of use. EPA's analysis is flawed because it assumes benefits based on tenuous evidence and ignores nearly certain costs. EPA may not assume benefits while ignoring costs. *Michigan v. EPA*, 576 U.S. 743, 757 (2015). Many small business participants at the SBAR submitted information demonstrating that TCE-based formulations are the most efficient products available. Equally, they submitted information demonstrating that the alternatives available do not work effectively. Only by ignoring these submissions was EPA able to conclude, incorrectly, that alternative products are technically and economically feasible.

While EPA included flammability properties of replacement chemicals in its Alternatives Assessment, EPA did not further assess the comparative fire risks of TCE-based products and alternatives, nor has it addressed concerns about fire risk and overall safety of the available alternatives. For example, for TCE use in electrical cleaning applications, SERs explained that use of a nonflammable solvent is critical, and potential alternatives include fluorinated compounds, but manufacturers would require additional testing to ensure they can provide proper cleaning, especially to avoid damaging the energized equipment.[126] Other representative comments include:

- SERs provided examples where TCE use as a degreaser may be essential, such as to remove grease where there has been significant buildup over time (*e.g.,* oil wells).
- SERs noted that for several uses (*e.g.,* brake and parts cleaners, as a lubricant for spray applications), TCE is preferred due to certain characteristics (non-flammable, degreasing performance, rapid evaporation).
- SERs also noted that chlorinated brake and parts cleaners are preferred among alternative chemicals and explained that to comply with lower volatile organic compound (VOC) limits, companies tend to put in one or two exempt compounds

[125] Economic Analysis at 7-53.

[126] Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule Toxic Substances Control Act (TSCA) Section 6(a) for Trichloroethylene (TCE) (Oct. 30, 2023), at 28. EPA-HQ-OPPT-2020-0642-0054.

(e.g., acetone or methyl acetate) which have less preferred cleaning or degreasing ability.

- One dry cleaning SER discussed how prohibiting TCE use for dry cleaners would cause higher costs in thousands of dollars compared to current conditions in additional labor and running time and would also cause adverse effects to production.
- The consulting SER also stated that there are some potential alternatives to TCE for use in the aerospace industry as a solvent degreaser, but that these alternatives are currently very expensive and have additional hazards, such as flammability and toxicity.
- A product formulation and vapor degreasing SER discussed the challenges of alternative chemicals. Specifically, the SER described how most alternatives to TCE are flammable, boil at a much lower temperature, and, in their experience, perform worse at cleaning parts than TCE. The SER provided an example of a solvent mixture they have used before, containing varying percentages of trans-1,2 dichloroethylene. The SER stated that, in their experience, solvents using fluorinated compounds and trans-1,2 dichloroethylene tend to have a higher amount of trans-1,2 dichloroethylene than the fluorinated compounds, making the resulting solvent mixture flammable.
- Additionally, this SER mentioned that a ban on TCE for use in the aerospace industry would have major implications, including the inability to operate, because, as they described, TCE is required to meet many specifications for production which take great effort, expense, and time to modify and/or change.[127]

In sum, TSCA § 6(c) provides that "in selecting among . . . restrictions," EPA "shall factor in, to the extent practicable," considerations such as "the effects of the chemical ... on the environment," "the benefits of the chemical substance or mixture for various uses," and "the reasonably ascertainable economic consequences" of the rule. The assessment of economic consequences must include the "costs and benefits" and the "cost effectiveness" of the "proposed and final regulatory action" as well as of at least one alternative. EPA must publish a statement discussing those factors. If a regulation would operate "in a manner that substantially prevents a specific condition of use of a chemical," EPA must consider "whether technically and economically feasible alternatives that benefit health or the environment, compared to the use so proposed to be prohibited or restricted, will be reasonably available as a substitute." Having

[127] Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule Toxic Substances Control Act (TSCA) Section 6(a) for Trichloroethylene (TCE) (Oct. 30, 2023), at 29-34. EPA-HQ-OPPT-2020-0642-0054

failed to conduct a meaningful alternatives analysis, EPA should reevaluate the proposed ban on TCE in the final rule and allow the implementation of WCPPs.[128]

VI. PHASED OUT USES

EPA proposes that 10 current uses of TCE would be allowed to continue for a limited period of time subject to WCPP requirements to be implemented by owners or operators. The most important of these are:

- manufacture (including import) and processing of TCE as an intermediate for the manufacturing of HFC-134a;
- two batch vapor degreasing conditions of use in open-top and closed-loop batch vapor degreasers;
- industrial and commercial use of TCE as a solvent for closed-loop batch vapor degreasing for rayon fabric scouring for end use in rocket booster nozzle production for Federal agencies and their contractors;
- manufacture (including import), processing, distribution in commerce, and use of TCE as a processing aid for battery separator manufacturing; and
- manufacture (including import), processing, distribution in commerce, and industrial and commercial use of TCE as a solvent in closed loop vapor degreasing necessary for human-rated rocket engine cleaning by the National Aeronautics and Space Administration (NASA) and its contractors.[129]

As described in the preceding section, EPA proposes prohibition, rather than compliance with a WCPP, of the other commercial and consumer uses of TCE. Having determined that its ECEL eliminates unreasonable risk, any use that can meet the ECEL should be allowed to continue subject to WCPP requirements. Similarly, the proposal to eliminate the uses allowed to

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[128] Some of the foregoing discussion is acknowledged in the preamble:

> "There are a number of notable unquantified costs. These are described in this Unit and more fully in section 7.11 of the Economic Analysis (Ref. 3). Alternative products with similar cost and efficacy are available for most of the products that are formulated with TCE. However, for some applications, there may be additional unquantified costs associated with the alternatives or in cases where alternatives are not currently available. For instance, in some cases, some effort might be required by firms using TCE products to identify suitable alternatives, test them for their desired applications, learn how to use them safely and effectively, and implement new processes for using the alternative products. There may also be some safety-critical applications where alternatives would need to undergo extensive safety reviews and testing before they could replace the TCE products. The information to estimate how often these costs might be incurred or what the specific costs would be per user or per-firm when they are incurred is not available. Therefore, EPA is unable to consider these costs quantitatively."

88 Fed. Reg. 74717.

[129] *See* 88 Fed. Reg. at 74715.

continue after specified phase out dates does not meet the requirements of TSCA. As noted above, TSCA § 6(a) mandates that EPA should apply requirements for addressing unreasonable risks only "to the extent necessary so that the chemical substance or mixture no longer presents such risk."

Finally, EPA acknowledges that a WCPP is in addition to, and not a substitute for, OSHA requirements. Having two regulators responsible for the same workplace obviously will raise serious compliance issues for employers which now find themselves subject to both sets of regulations. Compliance issues relating to uses allowed with WCPPs are addressed in § III above.

A. Battery Separator Manufacturing

EPA proposes a ten-year exemption under § 6(g)(1)(B) for industrial and commercial use of TCE as a processing aid for battery separator manufacturing. The exemption is warranted because, as EPA notes, the batteries powered by such separators "are essential to serve critical infrastructure" like "transportation systems, security systems" and "energize the national defense base," and a ban on their production would "significantly disrupt national security and critical infrastructure."[130]

However, EPA's proposed exemption for battery separator manufacturing is too short and imposes unreasonable and infeasible conditions -- not required by TSCA -- that function to ban or severely constrain this essential TCE use. Among numerous flaws, first, a ten-year exemption is insufficient adequately to protect the nation's access to battery separators. EPA has recognized there are no feasible alternatives to this industry's use of TCE to produce battery separators, and it will take many years to implement any alternative that may become available.[131] Though EPA's proposal acknowledges a possibility of extending the exemption in 10 years, there is no existing mechanism under TSCA or its regulations to ensure that happens. Second, for these manufacturers, compliance with the ECEL and with a WCPP's tiered respirator and monitoring requirements (none of which is required by TSCA) is completely infeasible for

[130] 88 Fed. Reg. at 74746. EPA confirmed that "a restriction on TCE use for the production of battery separators would critically impact the U.S. battery manufacturing supply chain and impede the expansion of domestic battery production capacity." 88 Fed. Reg. at 74744.

[131] 88 Fed. Reg. at 74746.

multiple reasons.[132] Third, the proposed rule's ban on wastewater discharges would also independently bar separator manufacturing by prohibiting discharges of wastewater with TCE (in any amount or concentration) from all manufacturing facilities (even exempt ones) to publicly owned treatment works, even when expressly permitted by the treatment facility.[133] It is imperative that EPA revise these elements of the battery separator manufacturing § 6(g) exemption to render it effective to protect this critical use.

B. HFC-134a manufacturing

Koura operates the largest HFC-134a manufacturing facility in the world in St. Gabriel, Louisiana. TCE is used there in a closed loop system where potential for human exposure is extremely low. Koura's facility is covered by the National Emission Standards for Hazardous Air Pollutants (NESHAP) for the Synthetic Organic Chemical Manufacturing Industry (SOCMI),[134] which require closed systems where exposure is tightly controlled. And the facility must meet OSHA workplace limits.

Complying with a WCPP would provide an additional layer of protection to ensure that any potential for TCE exposure, however low, would be eliminated. The alternative ECEL and the longer compliance time frame proposed by EPA are critical to Koura's continued ability to operate this plant.

C. Narrow tube manufacturing

Since the 1960s the main cleaning standard for removing lubricants and metal fines from fabricated metal parts has been vapor degreasing with a nonflammable chlorinated solvent. The solvent is heated to its boiling point creating a vapor zone. At the top of the vapor zone are cooling coils which condense the vapor back into a liquid. Dirty parts are lowered into the hot liquid chamber for cleaning. In the second step, parts are raised to the always clean vapor zone for rinsing. The oils removed from parts have higher boiling points, hence the oils remain in the boiling chamber. The solvent in the boiling chamber is constantly distilled/recycled, keeping the boiling chamber clean of oil. The cleaning chamber, rinse chamber and drying chamber are

[132] *See* ENTEK and Microporous comments on EPA Proposed TCE Risk Management Rule; EPA-HQ-OPPT-2020-0642 (Dec. 15, 2023).

[133] *See* 88 Fed. Reg. at 74787.

[134] 40 C.F.R. 63 Subparts F, G, H, I.

stacked vertically yielding a small footprint in the manufacturing facility. The vapor degreasing cleaning process is very efficient and has a very small footprint compared to an aqueous cleaning process.[135]

Parts that are difficult to clean have numerous attributes. Small holes and crevices are difficult to clean because cleaning chemistries have different surface tensions and viscosities which impact how effective they are in getting into and out of the small holes. During the manufacturing process metal parts are formed to specifications for size, geometric shape, and performance. Lubricants are used to prevent damage to the metal parts during the manufacturing process. The more difficult the formation of a part, the heavier lubricant must be to protect the part, and the lubricant is baked on due to high pressure. These parts are very difficult to clean. Part of the cleaning process is melting the baked-on lubricant prior to cleaning/removing it.

A specific example is the narrow diameter tube industry, which makes medical devices such as pacemakers. These are manufactured in an extrusion process where the tube is drawn from a solid billet and extruded into a hollow tube. This process has two difficult cleaning problems. First, the lubricants are baked on because of the high pressure of the drawing process. Most cleaners are not strong enough and/or can't reach a high enough temperature to remove the baked-on lubricant. Second, the small diameter tubes (some as small as 0.005 inch) are too small for most cleaners to enter and exit. Most cleaning agents are unable to enter the small diameter tubes and very few will remove baked-on lubricant. . These facilities have a large investment in their cleaning process and a significantly larger investment in the upstream manufacturing processes. If TCE is banned in the United States, these companies will have two choices: go out of business or relocate outside the United States.

Currently the only viable cleaning process for narrow diameter tubes in the medical industry is vapor degreasing with TCE. TCE is nonflammable, has a boiling point of 188° F, and has low surface tension, all critical factors in cleaning metal parts with small holes and for small diameter medical tubes. For this reason, narrow tube manufacturing was excluded from the

[135] Most aqueous processes have a wash chamber, rinse chamber and drying chamber laid out horizontally. In addition, an aqueous cleaning process has numerous ancillary equipment such as heated cleaning solution tanks, heated rinse tanks (usually three separate rinse tanks) and numerous other tanks for removing oil from the aqueous cleaner and rinse. Compared to vapor degreasing systems, the aqueous systems have a much larger footprint, are three to four times the price and very expensive to operate.

National Emission Standards for Halogenated Solvent Cleaning (the "Degreasing NESHAP"), as described in § X below.

VII. TCE UNINTENTIONALLY PRODUCED AS A BYPRODUCT SHOULD NOT BE PROHIBITED FROM PROCESSING/RECYCLING USES

The manufacturing processes of 1,2 dichloroethane (ethylene chloride or EDC), perchloroethylene (PCE), and carbon tetrachloride (CTC) have been designed to process and recycle chlorinated streams. In lieu of disposal, the processing and recycling of chlorinated streams allows a manufacturing facility to obtain and utilize the full value of every chlorine molecule processed at a plant. As a very small percentage of the streams, these manufacturing processes unintentionally produce TCE as a byproduct that is processed/recycled to create additional product. The inability to reuse streams that contain TCE unintentionally produced as a byproduct not only creates an unfathomable amount of waste that would require new loading and incineration facilities to handle, but would also compromise and potentially shut down highly specialized manufacturing processes and facilities.

To allow for the ongoing processing and recycling of these critical streams, EPA should clarify/confirm in the final rule that the definition of manufacturing does not include TCE produced as a byproduct. Additionally, the final rule preamble and amended 40 CFR Part 751 should confirm or be modified to address the following processing conditions of use under processing as a reactant:

1) TCE unintentionally produced as a byproduct in the EDC manufacturing process and then reprocessed as a feedstock to HCl, which is used to manufacture additional EDC (including the EDC feedstock to vinyl chloride where TCE is removed as an impurity and recycled back to the EDC manufacturing process) should be evaluated in the EDC risk evaluation.
2) TCE unintentionally produced as a byproduct which is processed/recycled as a part of a larger reactant intermediate in the PCE/CTC reactor should be an allowed condition of use under a WCPP, without time limitation, when the processing/recycling can meet the ECEL or a *de minimis* exception.

These two clarifications or modifications are needed in the final rule to allow for the continued processing/recycling of streams containing TCE as a byproduct in EDC and the PCE/CTC manufacturing processes. Allowing for recycling in these processes would also align with EPA's proposed CTC rule (proposed 40 CFR § 751.707(6)) that allows Processing:

Recycling in compliance with the WCPP. These process/recycling uses are described further in the section below.

Following the process use descriptions, the next section summarizes the engineering, administrative, and personal protection controls that are in place at chlorinated organic facilities. These controls have been provided to the Agency in the comments on all four of the proposed chlorinated solvent rules and are reiterated here as they also apply to the processed/recycled streams that include TCE as a byproduct in the PCE/CTC reactor.

For consideration in the final rule under TSCA § 6(c), the negative economic impacts and costs of prohibiting these processed/recycled streams are summarized, including manufacturing production reductions and downstream supply impacts; increased wastes and associated disposal costs; potential increased use of raw material (*e.g.,* chlorine, ethylene); extensive and costly capital modifications, and if not possible, shutting down domestic manufacturing facilities. In lieu of these negative outcomes, EPA should allow the continued use of the processing/recycling streams that contain unintentional TCE produced as a byproduct in compliance with the WCPP requirements, or where applicable, under a *de minimis* level, without time limitation.

A. TCE Byproduct Processing/Recycling

The subsections below describe the TCE byproduct produced and processed/recycled in two processes: (1) the EDC manufacturing process; and (2) in the PCE/CTC reactor. With a focus on the EDC manufacturing process, the Vinyl Institute has also described these manufacturing processes that produce TCE as a byproduct and subsequently process/recycle TCE in prior submissions to EPA.[136]

1. TCE Produced as a Byproduct and then Processed/Recycled in the EDC Manufacturing Process

EPA proposes to exclude from the definition of domestic manufacturing (including manufacturing for export) production of TCE as a byproduct, including during the manufacture of EDC, which EPA intends to consider in the upcoming risk evaluation for EDC. The preamble describes domestic manufacture as follows:

[136] *See,* for example, VI Comments to EPA on the Draft Risk Evaluation for TCE submitted April 27, 2020; EPA-HQ-OPPT-2016-0737. The VI Comments on the proposed TCE Risk Evaluation and Risk Management Rule are supported by HISA members.

> "This condition of use refers to the making or producing of a chemical substance within the United States (including manufacturing for export), or the extraction of a component chemical substance from a previously existing chemical substance or a complex combination of substances. This description does not apply to TCE production as a byproduct, *including during the manufacture of 1,2- dichloroethane*, which EPA intends to consider in the risk evaluation for 1,2-dichloroethane (Ref. 39)." [137]

This preamble description, and a similar statement in the Response to Comments for the TCE Risk Evaluation, not only excludes TCE as a byproduct from the definition of domestic manufacturing but also specifically points out that the EDC manufacturing process, which both produces and recycles the TCE byproduct, will be addressed in the EDC risk evaluation.

In the EDC manufacturing process, TCE is unintentionally produced as a byproduct of the oxychlorination and direct chlorination of ethylene. TCE will always be produced in very small concentrations (ppm levels) as part of the chemical reaction; the process cannot be altered to prevent the unintentional TCE byproduct formation.

In the purification step of the EDC manufacturing process, the TCE that is produced as a byproduct is present in the heavy ends at levels averaging 0.2% and light ends at levels of 0.13%. These resulting heavy and light end streams from the oxychlorination and direct chlorination manufacturing processes are processed/recycled as a feedstock in the Catoxid^{TM} reactor to manufacture hydrogen chloride gas (HCl) which in turn is used to manufacture additional EDC.

The finished EDC product includes TCE as a byproduct at levels averaging 0.92%. The TCE impurity in the EDC feedstock goes to the vinyl chloride monomer (VCM) manufacturing process, where the TCE is removed as an impurity and recycled back to the EDC manufacturing process. Failure to allow TCE that is unintentionally produced in this manufacturing process to be processed/recycled will have significant downstream impacts on the EDC and vinyl chloride manufacturing processes as well as the costs of products associated with EDC and vinyl chloride.

HSIA members are participating in the Vinyl Institute's TSCA Consortium which is actively working on an industrial hygiene study for EDC as required under EPA's EDC Test Order. Given the statement by the Agency that TCE produced as a byproduct in the EDC manufacturing process is a subject of the EDC risk evaluation, and ongoing industry efforts to comply with EPA's EDC Test Order, we request that the final TCE risk management rule clarify

[137] *Id.* at 74726 (emphasis added).

that TCE produced as a byproduct and then reused/recycled in the EDC manufacturing process will be addressed in the EDC risk evaluation.

HSIA looks forward to working with the Agency in the scoping of the risk evaluation for EDC manufacturing to ensure resulting streams with low levels of TCE byproduct produced in the EDC manufacturing process can continue to be processed/recycled in the manufacturing of chlorinated organics. In summary, TCE unintentionally produced as a byproduct in the EDC manufacturing process and then processed/recycled in a feedstock to HCl, which is used to manufacture additional EDC (including the EDC feedstock to vinyl chloride where TCE is removed as an impurity and recycled back to the EDC manufacturing process) should be evaluated in the EDC risk evaluation.

2. TCE Byproduct Processed/Recycled in PCE/CTC Reactor Manufacturing Process

The chloromethanes manufacturing process, which produces methyl chloride, methylene chloride, chloroform, and carbon tetrachloride via hydro and thermal chlorination, produces TCE as an unintentional byproduct. The resulting heavy-end streams, light-end streams, and crude CTC, depending on the manufacturing process, contain unintentional TCE produced as a byproduct/impurity ("Chloromethane Streams"). Most (an estimated 99.7%) of the Chloromethane Streams include an average of 0.9% TCE. A small (0.3%) heavy end component going to the Chloromethane Streams includes an average of 1%-3% of TCE. The Chloromethane Streams are processed/recycled in a PCE/CTC reactor to produce PCE and CTC.

Select streams from some oxychlorination and direct chlorination EDC manufacturing processes are also processed/recycled in the PCE/CTC reactor (Select EDC Streams). The Select EDC Streams processed/recycled in the PCE/CTC reactor include an average of 0.21% TCE. The final PCE/CTC reactor CTC product contains up to 0.01% TCE; the final PCE product contains up to 0.001% TCE. Diluent outlet streams from the PCE/CTC reactor that do not meet final CTC or PCE product specifications are recycled back into the PCE/CTC reactor and contain a concentration of 0.5% TCE.

If the proposed rule were adopted in a manner that prohibits the processing/recycling of streams with TCE byproduct in the PCE/CTC reactor, that prohibition would have an enormous impact on downstream production and would greatly increase waste. Disposal impacts would impose hefty operational and regulatory requirements and unnecessary costs merely to avoid

reusing streams with low levels of TCE byproducts. The Chloromethane Streams and EDC Streams that are reused in the PCE/CTC reactor total approximately 370 MM lbs annually, all of which would require thermal incineration. Additional costs associated with impacts of disposal are discussed below.

Before describing the negative waste and cost impacts associated with prohibiting the processing/recycling of these streams, it is important to reiterate the engineering, administrative and personal protection controls that are in place at chlorinated organic facilities. These controls have been provided to the Agency in comments on proposed rules for all four chlorinated solvents, and also apply to the processed/recycled streams that include TCE as a byproduct in the PCE/CTC reactor.

B. Controls in Place for Chlorinated Organic Facilities that Reuse/Recycle Feedstock Streams with TCE Impurities

As an advocacy organization for producers, distributors and users of chlorinated organics, HSIA has been engaged with EPA since the Agency issued the initial list of ten priority substances under the amended TSCA in December 2016.

Chlorinated organic facilities that produce TCE as a byproduct/impurity must comply with OSHA regulations for worker exposure and EPA regulations relating to emissions. These regulatory requirements apply to chlorinated organic facilities that utilize TCE as a byproduct/impurity, even at low levels. On May 25, 2021, HSIA met with EPA to discuss cross cutting issues relating to chlorinated organics in preparation for the upcoming rulemakings for TCE and the other chlorinated solvents ("May 2021 Presentation"). Several slides were presented that communicated the worker protection requirements in place for processing conditions of use. For example, slide 11 in the May 2021 Presentation walks through the engineering, administrative and PPE requirements that impose layers of protection in chlorinated organic facilities; these controls apply to facilities that process feedstock streams containing TCE produced as byproduct/unintentional impurity. While most of the facility is closed loop, for the limited time where there is potential for exposure in tasks such as loading/unloading, sampling or line opening, administrative, engineering and PPE controls are required for each task based upon the potential for exposure (May 2021 Presentation, slide 12-14). Additionally, an August 17, 2021 presentation specific to CTC went into greater detail on the SOPs for loading, sampling, and line opening tasks where potential exposure may occur ("August 2021 Presentation"). These

SOPs are only representative examples; SOPs at each chlorinated organic facility are designed and implemented to fit the specific process and stream, including streams that are reused as a feedstock which may contain TCE as an impurity at low levels.

In a letter dated September 27, 2021 (September 2021 Letter), HSIA responded to several EPA questions relating to controls and procedures in place for all four chlorinated solvents as described in the presentations referenced above. The September 2021 Letter provided an overview of the new employee training, specific task training and requalification training tailored to each unit. This training applies to units where TCE is produced as a byproduct and processed/recycled as an impurity in a feedstock stream. Other topics address how PPE selection is based upon the chemical of highest concern or that presents the most likelihood of exposure for the specific process. The September 2021 Letter also includes responses relating to PPE use (p. 4-6), leak inspection and response requirements (p. 6-7), and respirator use requirements (p. 8). Each of these responses applies to chlorinated organic units where TCE is produced as an unintentional byproduct/impurity in the stream which is then reused as feedstock in other chemical process instead of sent to disposal via incineration.

The documents and comments previously discussed with EPA were also submitted as attachments to the HSIA comments on the TCE Revised Risk Determination.[138]

C. Negative Impacts Caused by Prohibiting Feedstock Streams that Include Low Levels of TCE Byproducts/Impurities

This section addresses the negative waste, increased upstream production, and economic impacts that a prohibition on reuse of TCE as a byproduct would impose. These points were not considered in the proposed rule or the Agency's Economic Analysis.

1. Downstream Production Impacts

a. PCE/TCE Reactor

Ending the processing/recycling of streams that include TCE as a byproduct in the PCE/CTC reactor would have immediate manufacturing and downstream impacts. For example, CTC is used as a feedstock and transformed to 4CPe and 5CP; if CTC production were limited due to an inability to process/recycle streams that include TCE byproducts/impurities, there would be an almost immediate downstream impact on the production of next-generation,

[138] EPA-HQ-OPPT-2016-0737-0138.

climate-friendly refrigerants and foam blowing agents with low global-warming and zero ozone-depletion potential that rely on 4CPe and 5CP as feedstocks, respectively.

The alternatives are costly and inefficient. To replace the processed/recycled material with the TCE impurity, additional make-up volumes of raw material, *e.g.*, chlorine and ethylene, would need to be produced. These replacement streams would require an increase in current production capacity to make up for the lost raw materials. These increased production costs were not considered in the proposed rule.

Additionally, the current PCE/CTC reactor efficiently utilizes the dilute, recycled stream to manage the exothermal reaction. Further technology and engineering changes would be required to evaluate the feasibility to replace the reuse/recycled steam with virgin feedstock streams. The time and costs associated with identifying and implementing alternative feedstock streams have not been calculated. But, as an example of the time and costs required to develop an alternative manufacturing process, the current 4CPe production process which uses CTC as feedstock was developed over several years and the manufacturing facility was built at a cost of approximately $130 million in 2017.

b. EDC Manufacturing Process

Failure to allow TCE that is unintentionally produced in the EDC manufacturing process to be processed/recycled will also have immediate manufacturing and significant downstream impacts on the EDC and vinyl chloride manufacturing processes as well as the costs of products associated with EDC and vinyl chloride. One downstream product is polyvinyl chloride (PVC), which includes products such as:

- Medical grade PVC is used for tubing (IV & ventilator), bags (blood & IV), masks, gloves, catheters, drip chambers, and other disposable applications.
- PVC is a preferred material for potable water and wastewater infrastructure due to its durability, ease of maintenance, and low susceptibility to corrosion.
- Consumer-oriented PVC products and construction material include wall coverings, pipe, pipe fittings, flooring, and fencing.

The Vinyl Institute reports that the US vinyl industry has an annual economic impact of $54 billion and supports more than 350,000 jobs across more than 2,900 product manufacturing facilities, so the effects would be felt widely. Furthermore, since US manufacturing of EDC, VCM, and PVC resin is among the cleanest in the world, favoring imported supply would also

have the unintended consequence of increasing emissions from manufacturing and transport of material overseas.

2. Increased Waste

The proposed rule's prohibition of the processing/recycling of TCE unintentionally produced as a byproduct would stop the beneficial reuse/recycling of intermediate streams, which is counter to the Agency's own Waste Management Hierarchy that encourages reuse and recycling versus disposal or incineration.

For example, if streams that include TCE produced as a byproduct cannot be processed/recycled in the PCE/CTC reactor, then a stream totaling 370 MM lbs (referred to below as the "Total Stream") annually would require loading and transportation to an incinerator for destruction.

To transport an annual waste stream of approximately 370 MM lbs to offsite incinerators, total waste transferred by truck would increase to an estimated 8,222 trucks, at 45,000 lbs/truck. Manufacturing facilities also do not currently have the loading/unloading facilities to support offsite disposal. The cost to transport the Total Stream in 8,222 trucks for disposal is estimated at $21.9 million. Incineration rates for chlorinated wastes per pound range from $0.65/lb – $1.37/lb. This would add an additional estimated cost of $240.5 MM – $506.9 MM for disposal by incineration. In sum, total transportation and disposal costs would then total an estimated $261.9 MM – $528.8MM to divert streams currently reused/recycled to disposal due to an unintentional TCE impurity.

Significantly, this cost does not include the cost required to build truck loading facilities to support offsite disposal by truck, nor does it include the increase personnel, training, and IH costs associated with controls implemented for the increased loading activities. Additionally, the transportation of these streams for disposal would increase the time spent by employees involved in the loading process wearing respiratory protection and other PPE.

Finally, the existing hazardous waste incinerators are struggling to keep up with increasing demand for incineration services. The proposal does not factor in the need for increased waste management capacity in the United States, particularly for incineration, if streams such as the Total Stream are required for diversion, *e.g.,* destruction by incineration, because of the low levels of TCE byproduct.

D. Low Levels of TCE Produced as a Byproduct/Impurity Should Be Allowed under a *De Minimis* Exemption or in Compliance with a WCPP

As described above, prohibiting the reuse of TCE produced as a byproduct/impurity would have broad manufacturing and downstream impacts, increase waste and decrease manufacturing efficiencies.

Having determined that its ECEL eliminates unreasonable risk, EPA should allow this reuse of low-level unintentional TCE byproducts/impurities that can meet the ECEL to continue subject to WCPP requirements without time limitation, or where applicable, under a 0.5% *de minimis* level. See comments on the need for a TCE *de minimis* level in the following section.

Although HSIA strongly disputes the science supporting EPA's ECEL proposals, as described above, EPA should not propose to ban a processing use because the Agency assumes the proposed ECEL is not unattainable. For example, considering a PCE manufacturing or processing facility with an exposure concentration of 0.140 ppm that meets the PCE ECEL, and assuming that TCE is present (on a weight/weight basis) in the PCE stream at 0.1% or 0.5%, the PCE stream containing TCE byproduct of 0.5% could potentially meet the TCE proposed ECEL of 0.0011 ppm. Thus, a facility that meets the PCE ECEL should also be allowed to use PCE as a surrogate to show it meets the TCE ECEL when concentrations of TCE byproduct in the PCE process stream are known.

Additionally, as described above in Section VI.C, facilities that produce and process the TCE byproduct streams implement engineering, administrative and PPE controls, including respirator use, where there is potential for exposure. The incorporation of the WCPP implementation considerations described in Section III, such as allowing for ECEL compliance based upon facility-specific factors and allowing for a Control Band by Task approach to ECEL compliance, also would allow manufacturing processes that are well-characterized for risks to better refine the WCPP to the specific facility.

A proposed prohibition, rather than allowing compliance with a WCPP or recognizing a *de minimis* exception, exceeds the TSCA § 6(a) mandate that EPA should apply requirements for addressing unreasonable risk only "to the extent necessary so that the chemical substance or mixture no longer presents such risk."

HSIA urges EPA to consider the factors discussed above to clarify in the final risk management rule that TCE unintentionally produced as a byproduct should not be prohibited from processing/recycling. TCE unintentionally produced as a byproduct in the EDC

manufacturing process, including the associated processed/recycled streams in HCl/EDC and the vinyl chloride process, should be evaluated in the EDC risk evaluation as addressed in the preamble to the instant proposed rule. TCE unintentionally produced as a byproduct which is processed/recycled as part of a larger reactant intermediate in the PCE/CTC reactor should be an allowed condition of use under a WCPP or a *de minimis* exception, without time limitation.

VIII. THE FINAL RULE SHOULD ESTABLISH A *DE MINIMIS* EXEMPTION FOR TCE

EPA requests comment on whether it should consider a *de minimis* level of TCE in formulations to account for impurities (*e.g.*, 0.1 % or 0.5%). The final rule should set the TCE *de minimis* level at 0.5% of TCE or less to account for impurities in the production process and in products. The Agency followed a similar approach in its recent proposed risk management rule for perchloroethylene (PCE), where it included a provision that products containing PCE at concentrations less than 0.1% by weight would not be subject to the rule:

> "To aid the regulated community with implementing the prohibitions, and to account for de minimis levels of PCE as an impurity in products, EPA is proposing that products containing PCE at concentrations less than 0.1% by weight are not subject to the prohibitions described in this unit. EPA has determined that the prohibitions are only necessary for products containing PCE at levels equal to or greater than 0.1% by weight in order to eliminate the unreasonable risk of injury resulting from inhalation and dermal exposures from PCE-containing products during occupational and consumer conditions of use."[139]

While HSIA does not have information available on the universe of products, if any, that might fall within this exception, any formulated products that do contain such *de minimis* concentrations of TCE likewise would not pose a risk and should not be covered. HSIA urges EPA to include a similar *de minimis* provision in the instant rule at the level of 0.5%

Finally, while a TCE *de minimis* level would address several feedstock streams that contain TCE as an impurity, there are some feedstock streams that contain TCE levels higher than the 0.5%. For these streams, it is critical that in addition to the *de minimis* level the final rule allow that TCE unintentionally produced as a byproduct/impurity, as discussed in the preceding section, be allowed to continue in compliance with a WCPP.

IX. THE PROHIBITION ON SALES BY RETAILERS, IF NOT CHANGED, WILL DESTROY THE SUPPLY CHAIN FOR SMALL COMMERCIAL USERS

[139] 88 Fed. Reg. 39652, 39671 (June 16, 2023).

As if the prohibitions/restrictions described above were not onerous enough, EPA also proposes essentially to ban distribution of TCE in commerce by retail establishments:

> "TSCA section 6(a)(2) provides EPA with the authority to prohibit or otherwise restrict the manufacture (including import), processing, or distribution in commerce of a substance or mixture ''for a particular use'' to ensure that a chemical substance no longer presents unreasonable risk. For this rulemaking, EPA proposes that ''for a particular use'' include consumer use, which encompasses all known, intended, and reasonably foreseen consumer uses for TCE (Ref. 1). Given the severity and ubiquitous nature of the risks identified in the 2020 Risk Evaluation for TCE for processing of TCE into formulation as well as for all but one consumer use (pepper spray) and, noting that those conditions of use encompass all known, intended, and reasonably foreseen consumer use, EPA proposes that prohibiting manufacture (including importing), processing, and distribution in commerce of TCE for consumer use is reasonable and necessary to address the unreasonable risk from TCE driven by manufacturing (including importing) and processing TCE into formulation (the upstream conditions of use for products intended for consumer use), and that this proposed approach will also address the unreasonable risk to consumers and bystanders."[140]

The remarkably overbroad restriction on commerce reflected in the final clause above appears to be based on a similar requirement adopted by EPA in connection with the consumer use of methylene chloride paint stripping products.[141] In effect, if a person or business entity distributes or makes available any product to at least one consumer, then it is considered a retailer (40 CFR § 751.5). For a distributor not to be considered a retailer, the distributor must distribute or make available products *solely* to commercial or industrial end-users or businesses. In its proposed regulation of methylene chloride, EPA noted that "during litigation on the 2019

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[140] 88 Fed. Reg. at 74763.

[141] For PCE, EPA noted:

> "Previously, in the 2019 methylene chloride TSCA section 6(a) risk management rule addressing consumer use of methylene chloride in paint and coating removal (40 CFR part 751, subpart B), EPA prohibited retailers from distributing in commerce paint and coating removers containing methylene chloride (see 40 CFR 751.105(b) and (c)). To meet the same goal of protecting consumers from accessing PCE-containing products that could pose unreasonable risk, for a broader range of consumer conditions of use, EPA considered and is proposing a similar provision to ensure that retailers will not be able to purchase PCE for sale or distribution to consumers and will not be able to sell or distribute PCE to consumers, including making available to consumers products containing PCE. For these reasons, as described in Unit IV.A., EPA's proposal to address unreasonable risk from PCE includes prohibition on the distribution in commerce of PCE to and by retailers."

88 Fed. Reg. at 39692-93. While not including similar discussion for TCE, the meaning of "retailer" is identical in both proposed rules. *See* 88 Fed. Reg. at 74786.

final rule petitioners argued that EPA's definition of 'retailer' was so broad as to cover all commercial entities, creating supply chain issues for commercial users seeking to attain and use the chemical for commercial activities" (*Lab. Council for Latin Am. Advancement* v. *United States Env't Prot. Agency,* 12 F.4th 234 (2d Cir. 2021)). In its proposed PCE rule, EPA did not find this the case, instead identifying that "small businesses that are non-retail distributors exist and even participated as small entity representatives consulted as part of the SBAR process for this rulemaking."[142] EPA has not addressed this issue in the proposed TCE rule.

HSIA's concern here is the ongoing ability of small businesses to purchase the TCE-based products they need in order to continue to provide services efficiently. Entities such as those eliminated through EPA's overbroad definition of retailer provide a valuable service by making TCE available in bulk to large commercial users. If, as EPA identified in the preamble to its proposed rule on perchloroethylene, it is true that the definition of "retailer" is so broad that it eliminates virtually all supply outside of one or two non-retail distributors, it should be obvious that one or two bulk distributors of TCE cannot serve a geographically dispersed nation of tens of thousands of small businesses desiring to purchase small containers for allowed uses. In the absence of availability at hardware and home improvement stores, these small businesses will be unable to access a supply. In this as in other ways, the definition of retailer in the proposed rule discriminates unlawfully against small businesses.

The remarkably broad definition of "retailer" would solve a problem that exists only in EPA's imagination: there is no evidence of any consumer attempting to purchase from a bulk seller. The solution is for EPA to eliminate the overbroad definition of "retailer," while leaving in place the prohibition on selling to consumers. Thus, sales of TCE-based products for consumer use will be unlawful, and formulators and distributors would have to provide notice of that prohibition down the distribution chain. Sales could be restricted to individuals with commercial accounts or those who can show tax IDs or other verification methods to establish that they are businesses. This would also be administratively straight-forward, requiring only the elimination of the prohibition on distributing to retailers and limiting the prohibition on retailers from distributing TCE-containing products "for any use" to distributing to "consumers." A definition of "consumer" could also be provided to replace that of "retailers." Laws in all states prevent sales by retailers of alcohol or tobacco products to minors, and limit sale of drugs to

[142] 88 Fed. Reg. at 28308.

customers who have a prescription. Clearly a limitation on sales of TCE-based products to commercial users could be effective.

X. EPA HAS NOT MET THE REQUIREMENTS OF TSCA § 9

TSCA § 9, as originally enacted and as updated by the Lautenberg Act, requires EPA to consult and coordinate with other federal agencies "for the purpose of achieving the maximum enforcement of this Act while imposing the least burdens of duplicative requirements on those subject to the Act and for other purposes." Worker health and safety falls under the jurisdiction of the federal OSHA, and use of TCE is already regulated under the OSH Act. Taking steps that would lead to the removal of products from the marketplace where the existing OSHA requirements are met is not consistent with TSCA either as initially enacted or as revised.

A. From its inception, TSCA has been intended to fill gaps in regulation, not to supplant existing regulatory frameworks

TSCA § 9, as amended, provides:

> "(a) LAWS NOT ADMINISTERED BY THE ADMINISTRATOR.—(1) If the Administrator determines that the manufacture, processing, distribution in commerce, use, or disposal of a chemical substance or mixture, or that any combination of such activities, presents an unreasonable risk of injury to health or the environment, without consideration of costs or other nonrisk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified as relevant by the Administrator, under the conditions of use, and determines, in the Administrator's discretion, that such risk may be prevented or reduced to a sufficient extent by action taken under a Federal law not administered by the Administrator, the Administrator shall submit to the agency which administers such law a report which describes such risk and includes in such description a specification of the activity or combination of activities which the Administrator has reason to believe so presents such risk. Such report shall also request such agency—
>
> > (A)(i) to determine if the risk described in such report may be prevented or reduced to a sufficient extent by action taken under such law, and
> > (ii) if the agency determines that such risk may be so prevented or reduced, to issue an order declaring whether or not the activity or combination of activities specified in the description of such risk presents such risk; and
> > (B) to respond to the Administrator with respect to the matters described in subparagraph (A).
>
> "Any report of the Administrator shall include a detailed statement of the information on which it is based and shall be published in the Federal Register.

The agency receiving a request under such a report shall make the requested determination, issue the requested order, and make the requested response within such time as the Administrator specifies in the request, but such time specified may not be less than 90 days from the date the request was made. The response of an agency shall be accompanied by a detailed statement of the findings and conclusions of the agency and shall be published in the Federal Register.

"(2) If the Administrator makes a report under paragraph (1) with respect to a chemical substance or mixture and the agency to which such report was made either—

(A) issues an order, within the time period specified by the Administrator in the report, declaring that the activity or combination of activities specified in the description of the risk described in the report does not present the risk described in the report, or

(B) responds within the time period specified by the Administrator in the report and initiates, within 90 days of the publication in the Federal Register of the response of the agency under paragraph (1), action under the law (or laws) administered by such agency to protect against such risk associated with such activity or combination of activities, the Administrator may not take any action under section 6(a) or 7 with respect to such risk."

"(b) LAWS ADMINISTERED BY THE ADMINISTRATOR.—(1) The Administrator shall coordinate actions taken under this Act with actions taken under other Federal laws administered in whole or in part by the Administrator. If the Administrator determines 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 actions taken under the authorities contained in such other Federal laws, the Administrator shall use such authorities to protect against such risk unless the Administrator determines, in the Administrator's discretion, that it is in the public interest to protect against such risk by actions taken under this Act. This subsection shall not be construed to relieve the Administrator of any requirement imposed on the Administrator by such other Federal laws.

"(2) In making a determination under paragraph (1) that it is in the public interest for the Administrator to take an action under this title with respect to a chemical substance or mixture rather than under another law administered in whole or in part by the Administrator, the Administrator shall consider, based on information reasonably available to the Administrator, all relevant aspects of the risk described in paragraph (1) and a comparison of the estimated costs and efficiencies of the actions to be taken under this title and an action to be taken under such other law to protect against such risk."

If this statutory language were not sufficient to express the limitations on EPA's authority, the legislative history leaves no doubt. The House Energy and Commerce Committee Report states: "H.R. 2576 reinforces TSCA's original purpose of filling gaps in Federal law that

otherwise did not protect against the unreasonable risks presented by chemicals," and further clarifies that "while section 5 makes no amendment to TSCA section 9(a), the Committee believes that the Administrator should respect the experience of, and defer to other agencies that have relevant responsibility such as the Department of Labor in cases involving occupational safety."[143]

It was clear from the outset that TSCA is to be used only when other statutes fail to provide a remedy for unreasonable risks. Representative James Broyhill of North Carolina indicated that "it was the intent of the conferees that the Toxic Substance [Control] Act not be used, when another act is sufficient to regulate a particular risk."[144] EPA applied this statutory directive in determining that the risk from 4,4' methylenedianiline (MDA) could be prevented or reduced to a significant extent under the Occupational Safety and Health Act, and referring the matter for action by OSHA.[145] And in an analysis of TSCA § 9, EPA's Acting General Counsel concluded that "Congress expected EPA – particularly where the Occupational Safety and Health Act was concerned – to err on the side of making referrals rather than withholding them."[146]

Indeed, TSCA § 9 was strengthened by the Lautenberg Act, as evidenced by two colloquies on the floor of the House of Representatives with specific reference to TCE. First:

> "Mr. SHIMKUS. Mr. Speaker, I yield 2 minutes to the gentlewoman from Tennessee (Mrs. *Blackburn*), the vice chair of the full committee.
>
> Mrs. BLACKBURN. Mr. Speaker, I do rise in support of the amendments to H.R. 2576, and I congratulate Chairman *Shimkus* on the wonderful job he has done. Mr. Speaker, I yield to the gentleman from Illinois (Mr. *Shimkus*) for the purpose of a brief colloquy to clarify one important element of the legislation.
>
> Mr. Chairman, it is my understanding that this bill reemphasizes Congress' intent to avoid duplicative regulation through the TSCA law. It does so by carrying over two important EPA constraints in section 9 of the existing law while adding a new, important provision that would be found as new section, 9(b)(2).

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[143] H. Rep. No. 114-176 (114th Cong., 1st Sess.) at 28.

[144] 122 Cong. Rec. H11344 (Sept. 28, 1976).

[145] 50 Fed. Reg. 27674 (July 5, 1985).

[146] Memorandum to Lee M. Thomas from Gerald H. Yamada, June 7, 1985, p. 2. *See also* TSCA § 2(c): "INTENT OF CONGRESS.—It is the intent of Congress that the Administrator shall carry out this Act in a reasonable and prudent manner, and that the Administrator shall consider the environmental, economic, and social impact of any action the Administrator takes or proposes as provided to take under this Act."

It is my understanding that, as a unified whole, this language, old and new, limits the EPA's ability to promulgate a rule under section 6 of TSCA to restrict or eliminate the use of a chemical when the Agency either already regulates that chemical through a different statute under its own control and that authority sufficiently protects against a risk of injury to human health or the environment, or a different agency already regulates that chemical in a manner that also sufficiently protects against the risk identified by EPA.

Would the chairman please confirm my understanding of section 9?

Mr. SHIMKUS. Will the gentlewoman yield?

Mrs. BLACKBURN. I yield to the gentleman from Illinois.

Mr. SHIMKUS. The gentlewoman is correct in her understanding.

Mrs. BLACKBURN. I thank the chairman. The changes you have worked hard to preserve in this negotiated bill are important. As the EPA's early-stage efforts to regulate methylene chloride and TCE under TSCA statute section 6 illustrate, they are also timely.

EPA simply has to account for why a new regulation for methylene chloride and TCE under TSCA is necessary since its own existing regulatory framework already appropriately addresses risk to human health. New section 9(b)(2) will force the Agency to do just that.

I thank the chairman for his good work."[147]

Second:

"Mr. PITTENGER. Mr. Speaker, I thank the chairman for this very sensible legislation. I appreciate his efforts in leading a bipartisan effort to reform U.S. chemical safety law that is decades in the making.

I particularly thank him for securing amendments to section 9 of the TSCA law that remain in the negotiated text. These amendments reemphasize and strengthen Congress' intent that TSCA serve as an authority of last resort for the regulation of a chemical when another authority under EPA's jurisdiction, or another Federal agency, already regulates the chemical and the risk identified by EPA.

[147] 162 Cong. Rec. H3028 (May 24, 2016).

> As a unified whole, TSCA now makes clear that EPA may not promulgate a rule under section 6 of TSCA to restrict or eliminate the use of a chemical when:
>
> Number one, the agency either already regulates that chemical through a different statute under its own control, like the Clean Air Act, and that authority sufficiently protects against a risk of injury to human health or the environment; or
>
> Number two, a different agency already regulates that chemical in a manner that also sufficiently protects against the risk already identified by EPA.
>
> Mr. Speaker, in light of yet another regulatory overreach in the rulemaking at EPA, the new amendments to section 9 of TSCA are a welcome reform with the intent that it will help restrain the agency's unnecessary activities. These are commonsense, but important, protections given what EPA is likely to pursue."[148]

These colloquies make clear the ongoing Congressional intent that TSCA not be used when either EPA or another agency has taken steps to address the risks identified.

B. The instant proposal fails to take into account existing regulation of TCE, as required by TSCA § 9

As noted above, OSHA has regulated occupational exposure to TCE for many years. OSHA should be given an opportunity to consider whether a lower workplace limit would be appropriate. Otherwise, if EPA were to go forward with regulation under TSCA, there would be a potential for conflicting and overlapping regulation. OSHA's existing limits would remain in place, regardless of EPA's action, and OSHA's enforcement of its own standards is mandatory (subject to prosecutorial discretion). OSHA may not, however, enforce an EPA regulation under the general duty clause of the OSH Act, even if the EPA regulation afforded greater protection, as long as an OSHA standard on the same substance is in effect.

It is also significant that EPA is not authorized to establish ambient concentration limits under TSCA § 6.[149] EPA thus cannot limit employee exposure directly, but could only do so indirectly, *e.g.,* by controlling the amount of substance used in a product or prohibiting a particular use of the substance under § 6. This is potentially much more burdensome

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[148] *Id.*

[149] H. Rep. No. 1341, 94th Cong., 2d Sess. 34 (1976), *reprinted in* House Committee on Interstate and Foreign Commerce, *Legislative History of the Toxic Substances Control Act*, at 441 (1976).

economically than ambient standards, which permit each employer subject to the standards to achieve the necessary reduction in exposure in the most cost-effective manner. Yet TSCA § 6(c)(2) requires EPA carefully to consider the cost-effectiveness of a proposed regulatory action against at least one alternative, and Executive Order 13563 requires agencies to achieve their objectives by using the least costly regulatory alternative.[150] Here, the most cost-effective alternatives have not been chosen.

In light of the foregoing, considerations of avoiding unnecessary duplication and utilizing established expertise weigh in favor of invoking the Administrator's referral authority under TSCA § 9(a) even if EPA were to proceed under TSCA. If EPA were to identify a category of exposure deemed to present a risk that is unreasonable, these considerations indicate that referral under § 9(a) would be the appropriate course.[151] Yet there is no evidence that EPA has submitted to OSHA "a report which describes such risk and includes in such description a specification of the activity or combination of activities which the Administrator has reason to believe so presents such risk and includes in such description a specification of the activity or combination of activities which the Administrator has reason to believe so presents such risk." The non-

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[150] Improving Regulation and Regulatory Review, 76 Fed. Reg. 3821-3823 (January 21, 2011). In pertinent part, E.O. 13563 states:

> "This order is supplemental to and reaffirms the principles, structures, and definitions governing contemporary regulatory review that were established in Executive Order 12866 of September 30, 1993. As stated in that Executive Order and to the extent permitted by law, each agency must, among other things: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor its regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public."

[151] As noted above, § 9(a) provides that if the Administrator has reasonable basis to conclude that an unreasonable risk of injury is presented, and he determines, in his discretion, that the risk may be prevented or sufficiently reduced by action under another federal statute not administered by EPA, then the Administrator shall submit a report to that agency describing the risk. In the report, the Administrator shall request that the agency determine if the risk can be prevented or sufficiently reduced by action under the law administered by that agency; if so, the other agency is to issue an order declaring whether the risk described in the Administrator's report is presented, and is to respond to the Administrator regarding its prevention or reduction. The Administrator may set a time (of not less than 90 days) within which the response is to be made. The other agency must publish its response in the Federal Register. If the other agency decides that the risk described is not presented, or within 90 days of publication in the Federal Register initiates action to protect against the risk, EPA may not take any action under § 6 of TSCA.

existent report obviously did not "include a detailed statement of the information on which it is based" and was not "published in the Federal Register," as required.

Had the required report been issued, in the case of OSHA it presumably would have identified how OSHA's authority over the workplace was insufficient to address the risks posed by TCE. A letter from the Assistant Secretary of Labor for Occupational Safety and Health (undated but apparently issued on April 4, 2016) identifying limits on OSHA's authority to regulate hazardous substances was issued in connection with a previous unrelated rulemaking, but it does not come close to meeting the requirements of TSCA for EPA action in this case. The April 2016 letter identifies no such gap specific to use of TCE in any particular workplace, rather it simply recites how OSHA's authority does not extend to self-employed workers, military personnel, and consumer uses. But those are limitations that were imposed by Congress and have existed since the Occupational Safety and Health Act was enacted. Those limitations apply to every use of every toxic substance. Congress cannot have meant, in enacting "gap-filling" legislation, to open the door to EPA assuming all authority over the use of hazardous substances in the workplace.

Finally, EPA has not taken into account its own extensive regulation of TCE use under the Clean Air Act (CAA), as required under TSCA § 9(b). The 1990 CAA Amendments created a comprehensive program to regulate sources of HAPs such as TCE. CAA § 112(d) provides that EPA shall "promulgate standards . . . to provide an ample margin of safety to protect public health in accordance with this section." Further, CAA § 112(f)(2) provides "if standards promulgated pursuant to subsection (d) and applicable to a category or subcategory of sources emitting a pollutant (or pollutants) classified as a known, probable or possible human carcinogen do not reduce lifetime excess cancer risks to the individual most exposed to emissions from a source in the category or subcategory to less than one in one million, the Administrator shall promulgate standards under this subsection for such source category." Pursuant to these authorities EPA has already adopted standards applicable to many sources of TCE emissions that specifically regulate the risk now identified in the proposed rule.

One such program for TCE under § 112 is the National Emission Standards for Halogenated Solvent Cleaning (the "Degreasing NESHAP"),[152] which requires batch vapor

[152] 40 C.F.R. Part 63, Subpart T.

solvent cleaning machines and inline solvent cleaning machines to meet emission standards reflecting the application of maximum achievable control technology (MACT) and generally available control technology (GACT) for major and area sources, respectively. The rule imposes specific caps on emissions of several halogenated solvents, including TCE. Under CAA § 112, these standards must ensure an "ample margin of safety to protect public health." Thus, if the risk of concern about TCE from degreasing was significant, EPA should adopt more protective standards under the Clean Air Act. The Degreasing NESHAP and similar regulations adopted under § 112 properly take into account small business considerations and provide an "ample margin of safety to protect public health," and are already in effect for major use sectors where EPA now proposes further to eliminate TCE use.

The existence of a comprehensive regulatory framework for TCE uses under the Clean Air Act has two important implications for any consideration of TSCA § 6 rulemaking for the same sectors. First, it means that regulation under TSCA § 6 is precluded under TSCA § 9(b) unless EPA can make a determination "that it is in the public interest to protect against such risk by actions taken under this Act," where sponsors of the Lautenberg Act have stated the view, with regard to TCE, that EPA's "own existing regulatory framework already appropriately addresses risk to human health."[153] Second, it is remarkable that EPA has not drawn on use and exposure information from these regulated uses to inform the instant proposal. Analyses conducted by the EPA Air Office and data collected under the various NESHAPs applicable to TCE would provide information that is missing from the meager Alternatives Assessment in the record.

XI. FENCELINE ANALYSIS

The preamble includes, under the heading "TSCA Section 6(c)(2) Considerations," a detailed discussion of general population exposure to TCE from air and water pathways. It indicates that:

> "As mentioned in Unit II.D., EPA has separately conducted a screening approach to assess whether there may be potential risks to the general population from these exposure pathways. The screening approach was developed in order to allow EPA to determine—with confidence—situations which present no unreasonable risk to fenceline communities or where further investigation would be needed to develop a more-refined estimate of risk. The fenceline technical support memos for the

[153] 162 Cong. Rec. H3028 (May 24, 2016).

> ambient air pathway and the water pathway provide the Agency with a quantitative assessment of exposure. For TCE, the results from applying this screening approach did not allow EPA to rule out unreasonable risk to fenceline communities."[154]

For the reasons detailed in § 3 above, HSIA disagrees vehemently that the near-background concentrations of TCE in fenceline communities have any public health impact whatsoever. Nevertheless, the preamble states that "EPA. . . does not intend to revisit the air or water pathways for TCE as part of a supplemental risk evaluation."[155] In any event, under TSCA § 9 should there be any such risk other statutory authorities administered by EPA are the appropriate vehicle for EPA to take additional regulatory action identified as necessary to protect against such risk. As noted in the preceding section, these are precisely the authorities that Congress provided should additional action be needed; TSCA is intended to fill gaps, not supplant all other environmental laws applicable to toxic chemicals.

EPA also seeks comment on whether it should require ambient air monitoring at fenceline locations or facility emissions source monitoring to demonstrate compliance with the proposed requirement that engineering controls implemented as part of a WCPP/ECEL under this rule would not result in the ventilation of more TCE outside:

> "EPA requests comment on whether industry anticipates increased releases of TCE to outdoor air associated with the implementation of the WCPP. EPA requests comment on whether owners and operators should be required to attest in their exposure control plan that engineering controls selected do not increase emissions of TCE to ambient air outside of the workplace and document in their exposure control plan whether additional equipment was installed to capture emissions of TCE to ambient air. EPA requests comment on how such a requirement could impact the availability, feasibility, or cost of engineering controls as a means to reduce workplace exposures to or below the proposed ECEL. EPA is also soliciting comment on the frequency and nature of air monitoring EPA should consider including as requirements in the final rule."[156]

No purpose would be served by requiring an attestation regarding increased releases of TCE to ambient air outside of the workplace associated with implementation of the WCPP/ECEL. Moreover, given the difficulty of distinguishing between background levels of

[154] 88 Fed. Reg., at 74768.

[155] *Id.*, at 74769.

[156] *Id.* at 74778.

TCE and emissions from facilities, HSIA submits that ambient air monitoring at fenceline locations or facility emissions source monitoring, are unnecessary and that the cost would exceed any benefit, particularly in light of the recognized limitations to the fenceline analysis.

XII. THE ELEMENTS ADDED BY EPA IN ITS REVISED RISK DETERMINATION ARE INCONSISTENT WITH TSCA

EPA published a draft Revised Risk Determination for TCE in 2022,[157] in which it announced its intent to implement two changes to the approach taken in the 2020 Risk Evaluation: (i) EPA stated it would make a revised risk determination of unreasonable risk for TCE as a whole chemical, instead of making risk determinations for each of TCE's conditions of use; and (ii) EPA stated it would no longer assume that all workers wear PPE when conducting risk evaluations. HSIA commented that the proposed whole chemical approach and decision no longer to assume the use of PPE are inconsistent with the requirements of TSCA and EPA's implementing regulations, are not within the scope of EPA's discretion, and fail to provide the public with an accurate picture of the risks presented by a chemical substance under the substance's actual conditions of use. HSIA urged EPA to withdraw its proposed revision to the TCE risk determination, to continue to make condition-of-use specific risk determinations for TCE and other chemical substances, and to continue to include reasonable assumptions regarding the use of PPE for each condition of use.[158]

Those comments are all relevant and in the docket. In light of EPA's justification of its unreasonable risk findings by unrealistic exposure scenarios, it warrants repeating that TSCA § 3(4) defines the term "conditions of use" as "the circumstances, as determined by the Administrator, under which a chemical substance is intended, known, or reasonably foreseen to be manufactured, processed, distributed in commerce, used, or disposed of." The structure of the definition makes clear that "circumstances" includes aspects of the context in which a chemical substance is manufactured, imported, processed, distributed in commerce, used, or disposed of, including whether workers wear PPE. EPA's proposal no longer to assume the use of PPE is contrary to TSCA because it effectively eliminates "circumstances" from the definition of conditions of use. The use of PPE is a circumstance that "is intended, known, or reasonably

[157] 87 Fed. Reg. 40520 (July 7, 2022).

[158] EPA-HQ-OPPT-2016-0737-0139.

foreseen." PPE use therefore belongs as a component of the conditions of use that EPA must consider in its risk evaluations.

As noted above, in the 2020 Risk Evaluation EPA generally assumed compliance with OSHA requirements for protection of workers. EPA explained that existing OSHA regulations for worker protection and hazard communication will result in use of appropriate PPE, and that reasonable evidence supported the assumption that workers were complying with OSHA's requirements. EPA also acknowledged that it could not presume, in the absence of supporting information, a lack of compliance with OSHA's existing regulatory programs. Nevertheless, EPA based its decisions on unreasonable risk to workers on high-end exposure estimates, in order to account for the uncertainties related to whether or not workers are using PPE. EPA's Revised Risk Determination does not explain why the prior findings that OSHA requirements will result in appropriate PPE use are no longer supported. Without supporting record evidence or analysis, EPA's decision no longer to assume the use of PPE is clearly inconsistent with TSCA requirements.

Further, EPA departed from the scope of its TCE risk evaluation in its proposed TCE rule. EPA acknowledges that it is "not proposing to incorporate the descriptions of known, intended, or reasonably foreseen conditions of use in Unit III.B.1.a. through e. into the regulatory text as definitions because these conditions of use represent those evaluated in the 2020 Risk Evaluation for TCE, whereas the regulatory text applies to all consumer and industrial/commercial uses."[159] As noted above, EPA should continue to make condition-of-use specific risk determinations for TCE and other chemical substances. The regulatory text should not apply to uses that were not evaluated in the 2020 Risk Evaluation or the Revised Risk Determination. If, however, EPA chooses to proceed with "whole chemical" unreasonable risk determinations, EPA should incorporate descriptions of conditions of use such as those in Unit III.B.1.a through e. into the regulatory text as definitions.

XIII. DISTRIBUTION IN COMMERCE

EPA should confirm the no unreasonable risk determination and order under TSCA § 6(i)(l) for distribution of TCE in commerce.[160] Because distribution in commerce does not pose

[159] 88 Fed. Reg. at 74729.

[160] For some reason, distribution is missing from the list of allowable conditions of use in the proposed rule. As noted, it was deemed to present "no unreasonable risk" in the Revised Risk Determination. Although the Revised

an unreasonable risk, risk management regulation is not necessary to prevent such unreasonable risk. Additionally, the proposed rule requires a WCPP to prevent unreasonable risk in any ongoing upstream or downstream use following distribution in commerce, therefore negating any need to regulate distribution in commerce to address upstream or downstream activities.[161] EPA should clarify that distribution in commerce in compliance with regulations for transportation of TCE does not pose an unreasonable risk so that additional regulation is not necessary. It can do so by eliminating "Distribution in commerce" from proposed 40 CFR § 751.305(a).

XIV. EXPORT

In general, TSCA imposes import certification and export notification requirements which will be triggered by the rule. Those who import TCE would be required to certify compliance that the chemical shipment complies with all applicable rules and orders under TSCA by filing with Customs and Border Protection a statement to that effect.

Exporters of TCE must first submit a written notice to EPA providing basic information on the exporting and importing parties, which is then forwarded to the importing party's government. "Domestic manufacture," defined as "refer[ing] to making or producing of a chemical substance within the United States (including manufacturing for export),"[162] is allowed pursuant to a WCPP, and as noted above compliance with a WCPP means that unreasonable risk has been eliminated. On the other hand, the preamble states "As the manufacture and processing of TCE presents an unreasonable risk to health in the United States, the manufacture and processing of TCE for export would also be prohibited or restricted in accordance with TSCA section 12(a)(2)."[163] EPA should clarify that TCE is only restricted from export if the manufacturing condition of use is not in accordance with a WCPP.

Such clarification is important, and the following factors should be considered:

Risk Determination (EPA-HQ-OPPT-2016-0737-0147, at 2) states that distribution in commerce does "not drive EPA's unreasonable risk determination for TCE," it was not included in the Revised Risk Determination under the whole chemical approach.

[161] Of course, this is not to concede that either the upstream or downstream uses pose an unreasonable risk, or that EPA has the authority to regulate upstream activities which do not pose an unreasonable risk.

[162] 88 Fed. Reg. at 74726.

[163] 88 Fed. Reg. at 74732. TSCA § 12(a)(2) states that the exclusion in (1) "shall not apply to any chemical substance, mixture, or article if the Administrator finds that the substance, mixture, or article presents an unreasonable risk of injury to health within the United States."

1. EPA's memorandum *Existing Chemical Exposure Limit (ECEL) for Occupational Use of Trichloroethylene,* EPA-HQ-OPPT-2020-0642-0128 (Feb. 22, 2021), states "[t]he 8-hour ECEL is the concentration that EPA determined would indicate no unreasonable risk of injury to human health from chronic inhalation exposures in an occupational setting for the endpoints that are the basis for the TSCA unreasonable risk determination."
2. As "including manufacturing for export" is part of the preamble's "domestic manufacture" description,[164] proposed § 751.305 should expressly allow manufacturing for export as long as exposure is at or below the ECEL.
3. If TSCA § 12(a)(2) is read as an automatic blanket export prohibition, then EPA's "whole chemical" unreasonable risk determinations would unduly burden international trade.
4. The Economic Analysis does not address the loss of the export market.

EPA should clarify throughout the preamble and as appropriate in the proposed rule that domestic manufacturing in accordance with the WCPP includes export. If EPA does intend to prohibit export of TCE, it should reconsider for the reasons set forth above. There is no basis for banning such exports where (i) no other country has adopted or even considered a limit within 9000-fold of the proposed ECEL, and (ii) TCE manufacture in the United States is in compliance with a WCPP. Moreover, the Economic Analysis is totally silent on the economic impact of such a ban. In this and other ways, the proposal is a self-inflicted wound on US manufacturing competitiveness.

[164] *Id. at* 74726.