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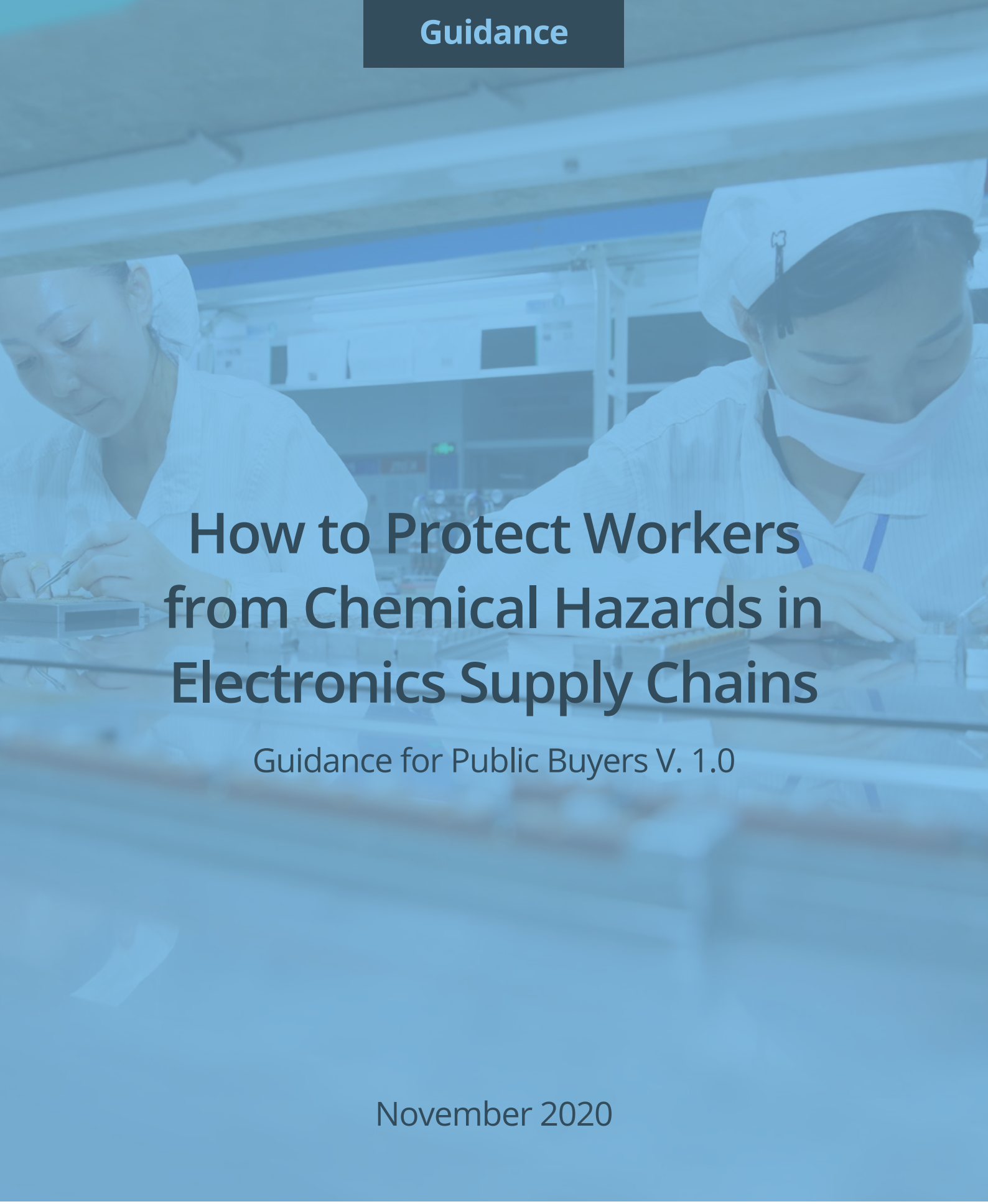
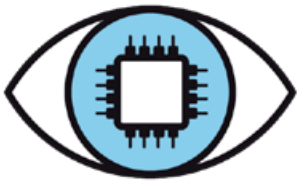


How to Protect Workers from Chemical Hazards in Electronics Supply Chains

Guidance for Public Buyers V. 1.0

November 2020

electronics watch



Electronics Watch is an independent monitoring organisation that helps public sector organisations work together, and collaborate with civil society monitors in production regions, to protect the rights of workers in their electronics supply chains.

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This Guidance is the product of extensive collaboration among occupational health and safety experts and advocates, and Electronics Watch affiliates and monitoring partners. Affiliates described the resources and tools they would need to address chemical hazards in their supply chains. Monitoring partners reported the impact of chemical hazards they see among workers in their communities and shared ideas on how workers are best protected. Experts helped to focus the Guidance on a set of 28 chemicals of concern relevant to the public procurement process and define the actions necessary to protect workers from harm.

We especially acknowledge the work of Mamta Khanna for her research and guidance throughout the project, and Brian Martin for his exhaustive research and expert guidance to develop the chemicals of concern (Annex 1). Amanda Hawes helped us gain insight into occupational exposure limits for chemicals (Annex 4) and Ted Smith and Garrett Brown provided valuable critical insight, guidance and research which helped shape the final product. Thanks also to Michel Dedeo and the Healthy Building Network for helping us navigate and make use of the Pharos database. These individuals are not responsible for any mistakes or shortcomings of this Guidance.

We are keenly aware of the challenge to protect workers from chemical harm in the electronics industry. This Guidance represents a first effort to help public buyers build effective demand for safer workplaces in their supply chains. We invite industry experts and others who feel they can contribute to this effort to help us develop and improve the Guidance for future iterations.

make ICT fair

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of Electronics Watch and can in no way be taken to reflect the views of the European Union.

Contents

1. Executive Summary

This Guidance offers practical steps that public buyers can take to help protect the health and safety of workers who make the electronic products they buy. Many of these workers—at all tiers of the supply chain—handle toxic chemicals, such as solvents, adhesives, resins and etchants that can cause illness and even death after prolonged exposure with inadequate industrial hygiene. This is an acute problem for public buyers who have a special responsibility to protect the health, safety and wellbeing of the people in their jurisdictions, but should not exercise this responsibility at the expense of the health, safety and wellbeing of people in different parts of the world who make vital equipment for public administrations.

We propose a two-fold public procurement strategy to help protect workers from chemical hazards. First, we have developed a list of 28 chemicals of concern (Annex 1) which include 12 chemicals that should be immediately discontinued in favour of safer alternatives and 16 chemicals that may have no feasible alternatives in certain applications but should be used with caution, that is, with adequate industrial hygiene measures. Public buyers can use this list of chemicals of concern in pre-award measures, such as selection and award criteria, to screen out the worst offenders and reward suppliers who improve chemical safety in the manufacturing process. This Guidance includes several possible contract clauses and options for verification.

'The right to know' is the cornerstone ensuring protection of workers from toxic exposures at work.

Second, measures that promote workers' own ability to advocate for their own safety are also vital. 'The right to know' is the cornerstone ensuring protection of workers from toxic exposures at work. Workers have a right to know about the effects of exposure to chemicals and the right to protect themselves from exposure at work. Public buyers can introduce 'the right to know' and other basic principles of industrial hygiene, including the precautionary principle, in their own

strategic planning and in pre-tender market engagement. They can then incorporate such principles in post-award contract performance conditions or award criteria, such as those suggested in this Guidance.

We hope that public buyers will use this Guidance to create demand for a safer work environment in their electronics supply chains for the benefit of workers globally. We invite expert collaboration to build on this effort to update and improve the results in future iterations of this Guidance.

2. Introduction

Workers are unquestionably among the most vulnerable to toxic exposures. They are exposed the first and the most. Among workers, there are those that are even more vulnerable and less likely to be adequately protected, such as those working in certain sectors, those living in poverty and workers of reproductive age, whose children also bear the burden of exposure to toxic substances. Occupational exposures not only harm workers themselves but can also have devastating impacts on their children.

--United Nations Special Rapporteur on human rights and hazardous substances and wastes[1]

The electronic industry uses thousands of chemicals in the materials and component manufacturing and assembling of products such as desktops, laptops, mobile phones, servers, printers, and other ICT equipment. Many of these chemicals are toxic to human health and should not be used or should only be used with extensive industrial hygiene measures to protect workers and the environment. Unfortunately, such measures are sometimes lacking. Workers are then exposed to toxic substances and their vapours causing illness and even death.

One step in protecting workers is to identify and eliminate those chemicals that pose the highest risk to worker because of their toxicity, the dosage used, and the duration of workers exposure. For some of these chemicals safer alternatives already exists. When there are no safer alternatives available industry should implement

consistent and effective industrial hygiene measures. This Guidance identifies some of these chemicals that pose critical risks to workers and that should be a priority for replacement or effective industrial hygiene. We suggest steps public buyers can take to accelerate these industry measures and protect the health of workers in their electronics supply chains.

We have selected 12 chemical substances that can and should be immediately discontinued in favour of safer alternatives. One chemical is commonly used and at present has no completely feasible safer alternative. This chemical, n-methyl pyrrolidone, has received much scrutiny by NGOs, regulatory agencies, and manufacturers, and should be limited to only those applications where no feasible safer alternative has been found. We have selected another 16 chemicals that may have no feasible alternatives in certain applications but should be used with carefully engineered human and environmental controls. Safer substitutes should be used when and as they are found. Public buyers can demand the complete discontinuation of the 12 chemicals (the “12 chemicals to be discontinued” in this

Guidance) in their supply chains, and insist that the 16 chemicals (the "16 chemicals to be used with caution" in this Guidance) are indeed used only with adequate industrial hygiene in their supply chains. They can award companies with contracts in part according to their compliance with these demands.

We have selected 12 chemicals that should be immediately discontinued in favour of safer alternatives and 16 chemicals that should be used with caution.

A list-based approach to control chemical substances in electronics supply chains is not alone sufficient to protect workers. First, the problem is vast with thousands of chemicals used and new chemicals frequently introduced into manufacturing processes without public disclosure. Therefore, any list of high-risk chemicals will only address a small part of the problem. Second, manufacturers face many challenges in managing function, yields, costs, and quality and may resist safer alternatives or stricter industrial hygiene measures because of cost, inconvenience, or, simply, misguided intentions. Third, many chemicals used in electronics manufacturing supply chains are shielded as proprietary even when processes used in making materials, components, and assemblies are relatively standardized. Thus, top-down measures to evaluate chemical hazards and protect workers are hampered by lack of transparency of chemical inventories, usage and their impact on human health.

Measures that promote workers' own ability to advocate for their own safety are also vital. 'The right to know' is the cornerstone ensuring protection of workers from toxic exposures at work. Workers have a right to know about the effects of exposure to chemicals and the right to protect themselves from exposure at work.[2] This Guidance further suggests that workers should be able to participate in the monitoring and evaluation of health risks in their own workplaces and that companies should be prepared to remediate adverse health impacts based on the precautionary principle. The Guidance recommends steps that public buyers can take to achieve these goals in the procurement process.

Methodology

In order to define the list of chemicals of concern for this Guidance, we turned first to Pharos—a database that provides hazard, use, and exposure information for more than 160,000 chemicals—and collected a subset of data of chemicals linked to electronics manufacturing. We then sorted this list using the Pharos six endpoints (health risk) scores for carcinogenicity, mutagenicity and genotoxicity, reproductive toxicity, developmental toxicity, endocrine activity, and multiple risks. We also included chemicals with a high risk for eye and skin irritation.

This filtering resulted in a subset of several hundred chemicals. We then used internet search results to screen for chemicals reported to be used in materials, components, or assemblies in electronics. We further refined the list by identifying those chemicals used in assemblies and manufacturing of products of interest to public buyers and within scope for Electronics Watch monitoring; that is, desktops, notebooks, tablets, smartphones, small servers, printers and multifunctional devices. We also included chemicals used in the manufacturing of the following high value components: batteries, printed circuit boards, displays, hard disk drives and storage. In order to create a practical list for this initial effort, we excluded semiconductor manufacturing which uses hundreds of chemicals. Finally, we further refined the list by consulting with experts on the probability of actual current use of the chemicals. We also noted if the chemicals were regulated under REACH and if the chemicals have been categorised under the Candidate List of Substances of Very High Concern (see Annex 1).

--> We invite expert collaboration to build on this effort.

Any effort to identify chemical hazards in the process of electronics manufacturing is hampered by lack of transparency in chemical inventories and usage. Our work necessarily relies on public domain information; better industry transparency would help to refine the results. Chemical inventories, chemical usage, and industrial hygiene and environmental controls are all pertinent to improving worker safety, and electronics manufacturers should work toward the goal of full disclosure of this information. Improved transparency and collaboration

will help improve chemical management systems, resulting in improved worker health and reduced costs to manufacturers. We invite expert collaboration to build on this effort, update and improve the results.

The Responsibility and Potential of Public Procurement

Just like private sector supply chains, public procurement supply chains of electronics products are linked to chemical hazards for workers. This is an especially acute problem for the public sector. Public authorities have a special responsibility to protect the health, safety and wellbeing of the people in their jurisdictions. But they should not exercise this responsibility at the expense of the health, safety and wellbeing of people in different parts of the world who make vital equipment for public administrations, and sometimes life-saving medical technologies for far-away hospitals. This is not just a moral imperative. As the Covid-19 pandemic has made clear, the health and well-being of people globally are interdependent, and, ultimately, we cannot protect ourselves without protecting others. In concrete terms, occupational health and safety in global supply chains has now become a prerequisite for resilient global supply chains.

Fortunately, there are many steps public buyers can take during the procurement process both before and after issuing awards to help

protect the health and safety of workers who make the products they buy. They can screen out the worst offenders, reward suppliers who improve chemical safety in the manufacturing process, and work to eliminate hazardous chemicals when workers report that they are suffering adverse health effects. This Guidance offers practical steps public buyers can take to achieve these goals.

Box 1. What is the Problem?

Researchers and civil society organisations in countries where electronics manufacturing takes place have for many years reported that workers handle many hundreds of chemicals that are toxic to the skin, respiratory system, reproductive system, and the central nervous system. Some common concerns include:

- Workers do not know the chemicals they work with or sometimes they know only the commercial name. For example, what some workers call “banana oil” is an industrial solvent used to clean phone screens containing n-hexane which causes damage to the nervous system.
- Workers are not aware of the hazards of the chemicals they work with so they cannot take adequate measures to protect themselves. This limits their freedom to choose safer employment.
- Most of the electronics production workforce are women of child-bearing age. Exposure to toxins can cause reproductive and developmental health impacts to children who have been exposed *in utero*.
- Occupational Health and Safety standards are significantly weaker than environmental standards for the same toxins and are thus not health protective enough. This means that a worker has less protection from the same chemical than a consumer of the product even though they may work in factories where there is extensive exposure to the toxic materials.

- High production targets can result in long working hours, resulting in long periods of exposure to hazardous chemicals, fumes, and radiation.
- Precarious forms of employment such as temporary contracts, traineeships, apprentices and internships, or employment through third party agencies deprives workers of the security and stability to speak up about their health concerns.
- Workers within these supply chains are often migrant populations who move across geographical areas, across multiple employers, exposed to a number of chemicals along the way, with no means to monitor their health and well-being over time.
- Sometimes the training workers receive on how to handle chemicals safely is inadequate. Workers handle chemicals that are deadly in nature and do not understand their toxicity or how to protect themselves.

3. How Public Buyers Can Protect Workers

Safe and healthy working conditions have been explicitly recognized as a human right since 1966, with the adoption of the International Covenant on Economic, Social and Cultural Rights. They are a fundamental aspect of the human right to just and favourable conditions of work. The right to safe and healthy work encompasses many other interrelated and interdependent human rights, including the rights to life, health, bodily (physical) integrity and security of the person. These are indivisible from the rights to information, meaningful participation and the freedoms of expression, assembly and association, as well as the right to an effective remedy.

--"Principles on human rights and the protection of workers from exposure to toxic substances," Report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes, September 2019

Public buyers can protect workers' health in their electronics supply chains by creating demand for less harmful chemicals, better industrial hygiene, and a voice for workers to monitor and report on the impact of chemicals they handle. Some demands can and should be met immediately and can be mandatory contract obligations. Other demands will help to accelerate improvements in the industry. In these cases, public buyers can provide incentive through non-mandatory award criteria or by establishing time-bound commitments for contractors and their suppliers to meet certain benchmarks towards safer working environments.

Public buyers can develop and express demands for worker protection against chemical hazards during pre-tender planning, through pre-award and post-award measures, and during contract management.

Box 2. Stages of Public Procurement

1. **Pre-tender planning:** process to assess need, conduct risk assessments, and set goals to decide which goods and services to buy and when, and under what conditions.
2. **Pre-award measures:** requirements that take effect before the award of the contract and provide a basis for awarding the contract. These measures include exclusion grounds, technical specifications, selection criteria, and award criteria.
3. **Post-award measures:** requirements that take effect after the contract is awarded and are evaluated during the term of the contract. These are contract performance conditions, which is the basis for the Electronics Watch model to protect workers' rights in public buyer supply chains.
4. **Contract management:** the management of the performance of contracts where requirements are monitored and results evaluated. Contract management includes regular communication with suppliers as well as monitoring compliance with the terms of conditions through desk audits, supplier self-assessment, social audits, and, for Electronics Watch affiliates, worker-driven monitoring. The aim is effective contract performance, including compliance with contract performance conditions related to worker rights and safe working conditions.

3.1 Pre-Tender Planning

The pre-tender planning stage includes assessing risks, need and timescales for procurement. It is vital to the procurement process as it will define the specific requirements of selection and award criteria, and contract performance conditions, and will help define a procurement strategy linked to wider organisational goals and risks.

A good first step is to assess the risk of chemical hazards in the electronics supply chain of the products you are planning to procure

and setting a goal to mitigate and prevent those risks in your procurement. Annex 1 of this Guidance provides a list of chemicals of concern that should be a priority for elimination, safer substitution, or improved industrial hygiene. It connects these chemicals to manufacturing functions and electronic equipment and components in which they are used. Members of Electronics Watch's Advisory Panel on Occupational Health and Safety are also available to consult with affiliates to evaluate risk, and identify opportunities to mitigate risk, through the procurement process.

Members of Electronics Watch's Advisory Panel on Occupational Health and Safety are available to consult with affiliates to evaluate risk, and identify opportunities to mitigate risk, through the procurement process.

Next you can set strategic goals to mitigate and prevent adverse impact of chemical hazards for workers in your electronics supply chain, depending on your organisational priorities, volume of procurement, and experience with suppliers. For example, this Guidance allows you to focus on chemicals used in assembly or components manufacturing or both. You can choose to focus only on certain products initially and expand your scope over time. You can employ pre-award or post-award measures or both. You can focus on the elimination of chemical hazards, better industrial hygiene, chemical transparency, a stronger worker voice to protect themselves against chemical hazards, or you can introduce measures that seek to achieve all these objectives.

Next you should advertise your intention to tender electronics procurement in line with your goals and priorities to protect workers in your supply chain from chemical hazards. Prior Information Notices (PIN) can be advertised 12 months before actual procurement begins.[3] Through PIN you can announce your goals, for example, to seek demonstrable reduction of harmful chemicals based on the precautionary principle, and other verifiable measures that protect the health of workers in your electronics supply chains. Annex 1 can support you to develop the PIN to identify the chemicals of concern, and the products that you could prioritise.

You can also request Information from potential bidders about their plans to improve worker health through the reduction of hazardous

chemicals, improvement of industrial hygiene, strengthening worker voices, and other measures. For example, you can ask companies how they are implementing the Hierarchy of Controls to protect worker health in high risk facilities, and which hazardous chemicals they are eliminating or phasing out.

If you are procuring through resellers, this advanced notice allows time for the information to cascade into global supply chains to brands, manufacturers and suppliers, and for them to research and help prepare the bid.

Through effective engagement with potential suppliers prior to tendering you can:

- Identify potential bidders and/or solutions (e.g., safer chemicals).
- Create market capacity to meet the requirements and inform the design of the procurement and contract.


Focus on the elimination of chemical hazards, better industrial hygiene, chemical transparency, and a strong worker voice.

3.2 Pre-Award Measures

Pre-award measures and post-award measures should be viewed as tools in a single toolbox. By using them together, public buyers can compensate for their respective limitations. Coupling mandatory minimum requirements in the form of pre-selection criteria with more challenging post- award measures allows public buyers to ensure a level playing field for suppliers and reward those who are already implementing human rights protections.

--Danish Institute of Human Rights Toolkit (2020)

Exclusion grounds

Consider introducing exclusion grounds for contractors who have been found responsible by courts or other official bodies of serious human rights abuses, including jeopardizing the health and lives of workers by unnecessary and deliberate exposure to known toxic chemicals over an extended period without proper industrial hygiene.

The Public Procurement Directive 2014/24/EU allows contracting authorities to exclude companies from tendering for not meeting certain conditions. The 2014 Directives make it mandatory for contracting authorities to exclude a potential bidder where it is aware that it has been convicted for child labour or human trafficking offences. In addition, contracting authorities may at their own discretion exclude companies that have been convicted of breaching environmental, social and labour law.[4]

Selection criteria

Selection criteria stipulate minimum standards, capacities, and experience a potential contractor must have to be considered in a procurement. Selection criteria should be Yes/ No, or Pass/ Fail questions, hence buyers should carefully consider the criteria so as to not limit the market too far. If you are unsure whether or not the market can meet selection criteria, you can use the same criteria as non-mandatory award criteria.

Chemical substitution

The contractor ensures that none of the 12 chemicals to be discontinued are used in the factories linked to the subject matter of the contract.

Verification options

- The contractor states which of 12 chemicals to be discontinued have been eliminated and which ones are used instead and why those chemicals are less toxic.
- Confirmation from independent union.
- Confirmation from independent audit.

Health and safety due diligence

The contractor routinely and periodically identifies chemical hazards risks in its supply chain through measures such as:

- A supplier self-assessment questionnaire, that includes a focus on chemical hazards, including the 12 chemicals to be discontinued and the 16 chemicals to be used with caution.
- Review of supplier audit findings and reports from NGOs and other external sources with attention to the 12 chemicals to be discontinued and the 16 chemicals to be used with caution.

Verification

- The contractor's written detailed description of its health and safety due diligence system.

Award criteria

Unlike selection criteria, award criteria are not mandatory; however, contractors that satisfy more award criteria have a better chance of being awarded the contract. In order to reward good practices, using a scoring scale instead of binary questions (yes or no) may be helpful. Thus, award criteria can be a tool to reward progress on worker health and safety related to hazardous chemicals in the electronics

industry and can aspire to goals that are more difficult to meet than selection criteria. Some award criteria can also be reformulated as contract performance conditions.

Chemical substitution and industrial hygiene

The contractor ensures that the 12 chemicals to be discontinued are not used in factories linked to the subject matter of the contract and that safer alternatives are in place. The contractor also ensures that there is adequate industrial hygiene measures for the 16 chemicals to be used with caution in factories linked to the subject matter of the contract.

Verification options

- The contractor states which of the 12 chemicals to be discontinued have been eliminated and which ones are used instead and why those chemicals are less toxic. The contractor also describes the industrial hygiene measures for the 16 chemicals to be used with caution.
- Confirmation from independent union.
- Confirmation from independent audit.
- A timeline for when the criteria will be met for partial credit.

Product redesign to eliminate hazardous chemicals

The contractor ensures products have been redesigned using technological or organisational measures to achieve the same function without the use of the 12 chemicals to be discontinued and with adequate industrial hygiene for 16 chemicals to be used with caution in factories linked to the subject matter of the contract.

Verification options

- Contractor describes the redesign that eliminates the 12 chemicals to be discontinued and ensures adequate industrial hygiene for the 16 chemicals to be used with caution, and names the chemicals used instead of 12 chemicals to be discontinued.
- A timeline for when the criteria will be met for partial credit.

Workers' right to know

The contractor ensures that workers in factories linked to the subject matter of the contract take part in regular trainings on Occupational Health and Safety that address the chemicals they handle, their hazardous properties, and safe handling. The contractor further ensures that Globally Harmonized System compliant safety data sheets, in languages workers understand, are freely and easily available to workers and their representative organisations, for all materials stored, used and discharged in factories linked to the subject matter of the contract.

Verification options

- Training records that show the dates and contents of the trainings.
- Confirmation from independent union.
- Confirmation from independent audit.
- A timeline for when the criteria will be met for partial credit.

Worker participation in health and safety

The contractor ensures participation of workers in an elected occupational health and safety committee that is involved in all levels of health and safety, from identification to remediation of risks, in factories linked to the subject matter of the contract.

Verification options

- Contractor describes the occupational health and safety committees, including members, their roles and functions, how it is elected, how often it meets, and topics addressed during the last year.
- Confirmation from occupational health and safety committee.
- Confirmation from independent union.
- Confirmation from independent audit.
- A timeline for when the criteria will be met for partial credit.

The contractor ensures participation of workers in an elected occupational health and safety committee.

The right of workers to organise unions without interference and to bargain collectively

The contractor ensures an independent union, a collective bargaining agreement, and/or other forms of worker organisation that allows for effective collective dialogue with their employers and influence on health and safety issues in factories linked to the subject matter of the contract.

Verification options

- Collective bargaining agreement.
- Records of health and safety complaints and resolution of complaints, showing worker influence.
- Confirmation from independent union.
- Confirmation from independent audit.
- A timeline for when the criteria will be met for partial credit.

Monitoring the health of workers

The contractor ensures workers undergo regular and thorough health examinations during employment, including blood and urine testing for chemical exposure, and workers receive reports of their health examinations.

Verification options

- Dates of medical examinations and their content during last two years.
- Confirmation from independent union.
- Confirmation from health and safety committee.
- Confirmation from independent audit.
- A timeline for when the criteria will be met for partial credit.

3.3 Post-Award Measures

Contract Performance Conditions

Contract performance conditions are conditions that the contractor must meet after the contract has been awarded. These conditions can be framed positively to reflect commitments to achieve strategic goals of the contract within agreed timelines.

These conditions can be important to ensure remediation of violations of occupational health and safety regulations and reparation for workers who suffer adverse impact. It is also good to couple selection and award criteria with contract performance conditions to ensure contractors can be held accountable for any failure to protect workers from the 12 chemicals to be discontinued and the 16 chemicals to be used with caution.

To be able to enforce contract performance conditions public buyers need to be able to monitor the health and safety and other conditions of workers in factories linked to the subject matter of the contract. This monitoring should be conducted independent of the industry. The European Union Green Public Procurement for Computers and Monitors[5] supports the general principle that

contracting authorities have the right to independent inspections. As Electronics Watch is an independent monitoring organisation, our model includes contract performance conditions to remedy violations.

The following conditions are excerpts from Electronics Watch's Contract Conditions that help public buyers protect workers from chemical hazards in their electronics supply chains.

Transparency of chemical hazards

Upon evidence of a Contractor's breach of the Code, the Contractor shall collaborate with the Affiliate [contracting authority] and Electronics Watch and use reasonable and proportionate endeavours to... obtain and provide to Electronics Watch the inventory of chemicals used and stored and related health and safety and environmental impact monitoring reports for each Factory where there has been an actual or potential breach of the health and safety standards of the Code.

Verification

- List of chemicals used and stored for specific factories.
- Electronics Watch follows up through worker-driven monitoring and expert consultation to ensure lists are complete and accurate.

Effective remedy when harm occurs

Upon evidence of a Contractor's breach of the Code, the Contractor shall collaborate with the Affiliate and Electronics Watch and use reasonable and proportionate endeavours to: obtain access for Monitors to the Factories where there has been a breach; ... obtain and provide to Electronics Watch the Suppliers' full written compliance findings and corrective action plans related to the actual or potential breach; report to the Affiliate and Electronics Watch on the extent to which its trading conditions and its Suppliers' trading conditions adversely affect its compliance with the Code in the specified Factories; comply with, and use reasonable and proportionate endeavours to ensure that its Suppliers comply with, all applicable whistleblowing laws, statutes and regulations in force from time to time in the jurisdiction where the Goods are manufactured.

Verification

- Electronics Watch reports on factory collaboration with independent monitors, effective remedy e.g., elimination of the 12 chemicals to be discontinued, improved industrial hygiene for the 16 chemicals to be used with caution, and effective preventative measures

3.4 Contract Management

While contractors are responsible for complying with contract performance conditions and other terms and conditions to protect the health and safety of workers in public buyer supply chains, it is vital that you monitor their performance. This is part of the contract management process. Because this process takes place over an extended period of time, you will have the opportunity to ensure health and safety violations are remedied and working conditions improve through ongoing dialogue and, if necessary, contract enforcement. As part of the contract management process, you can:

- Request reports on contract conditions that contractors could not meet fully at the time of award, but committed to meet overtime, such as elimination of the 12 chemicals to be discontinued or adequate industrial hygiene for the 16 chemicals to be used with caution.
- Communicate any evidence you have obtained about violations of health and safety regulations in factories linked to the subject matter of contract, and request they use reasonable and proportionate endeavours to investigate and remediate the violations.
- Review progress toward strategic goals, established during pre-tender planning.

You can strengthen the contract management process if you understand some basic principles of worker protection from hazardous chemicals: the precautionary principle, the hierarchy of controls, and occupational exposure limits. Each one of these principles is explained in the Annexes to this Guidance.

For example, if you advertised your intention to tender electronics procurement in line with the precautionary principle you can apply

this principle in the contract management process. The precautionary principle requires companies to take health protective action when credible threats of harm exist, even though some uncertainty may remain. It places the burden of proof on companies to demonstrate a healthy work environment rather than on workers to prove an unhealthy work environment.

Box 3. Applying the Precautionary Principle in Contract Management

In the electronics industry it is notoriously difficult for workers to prove that exposure to certain chemicals in the workplace cause them harm. The human toll of semiconductor manufacturing, for example, is known since at least the early 1980s. Scientists have linked miscarriages to twice the expected rate, various aggressive forms of cancer and other lethal diseases with semiconductor factories in the US, UK, South Korea, Taiwan, and Japan.[6] Chemicals that were banned in the United States 25 years ago are still being used in Asian semiconductor factories today. This is affecting not only the workers on the shop floor but also their children. It has taken workers years to get their illnesses recognized as work-related and to receive compensation.

So, how would you apply the precautionary principle in your contract management process? Here is an example.

You have learned about an electronics factory in your supply chain where workers routinely handle methyl ethyl ketone (MEK) and toluene, chemicals that cause teratogenic effects (cause pregnancy complications such as preterm labour, spontaneous abortions or miscarriages) and affect the development of the foetus. In addition, they cause damage to the central nervous system and to kidneys in the case of toluene. Some workers in this factory have experienced miscarriages and others have reported respiratory problems, also linked to the chemicals. They may not be able to prove that these adverse health impacts are work-

related. However, the combination of scientific knowledge on the risks associated with the chemicals and workers' own reports of adverse health impacts consistent with the scientific understanding of risks should be enough to trigger the precautionary principle. Thus, even if companies report that they cannot confirm that workers' ill health is work-related, you can now seek to protect workers from possible adverse health effects from these chemicals.

Toluene is one of the12 chemicals to be discontinued in this Guidance and should be immediately eliminated. Methyl ethyl ketone is among the hundreds of chemicals that are not included as a chemical of concern in this Guidance—simply because we had to limit the number of chemicals that public buyers can reasonably focus on during the pre-award stage of the procurement process—but it is still hazardous to workers' health. Electronics Watch can advise affiliates on best course of action: elimination or effective industrial hygiene.

Annex 1: Chemicals of Concern

Below is a table of chemicals of concern that workers use in the manufacturing of common electronic products and components. It includes 12 chemicals to be discontinued and an additional 16 chemicals to be used with caution. This is far from a comprehensive list of hazardous chemicals in the electronics industry. Rather, the list is designed to help public buyers create demand for a safer work environment in their supply chains. We invite expert collaboration to build on this effort to update and improve the results.

Nine of the chemicals of concern overlap with the first round of "priority chemicals" that the Clean Electronics Production Network (CEPN) has developed. CEPN is a multi-stakeholder network addressing complex workplace health and safety challenges, with the goal of moving toward zero exposure of workers to toxic chemicals in electronics manufacturing. Their first round of nine Priority Chemicals – manufacturing process chemicals prioritized for elimination or substitution in electronics manufacturing – is focused on solvents used in manufacturing cleaning products. Additional rounds of Priority Chemicals will be identified in the future.

CEPN's priority chemicals:

- 1-Bromopropane (CAS #106-94-5)
- Benzene (CAS #71-43-2)
- Dichloromethane (Methylene Chloride) (CAS #75-09-2)
- Methanol (CAS #67-56-1)
- n-Hexane (CAS #110-54-3)
- N-Methyl-Pyrrolidone (NMP) (CAS #872-50-4) – Exempted Conditional Use for photoresist stripping
- Tetrachloroethylene (CAS #127-18-4)
- Toluene (CAS #108-88-3)
- Trichloroethylene (CAS #79-01-6)

Key

CASRN: Chemical Abstracts Service Registry Number, a unique identifier number for chemical substances.

Green Screen Score: The GreenScreen protocol establishes a four-step benchmark system with Benchmark 1 indicating a Chemical of High Concern and Benchmark 4 indicating an ideal Chemical of Low Concern. Chemicals must undergo a full GreenScreen assessment before they are given a Benchmark score. Chemicals in this Guidance have the following scores:

- BM-1 Benchmark 1: Avoid—Chemical of High Concern
- LT-1 Likely Benchmark 1: An LT-1 score is based on clear agreement among authoritative lists that the substance is a Chemical of High Concern and may be considered equivalent to a GreenScreen Benchmark 1.
- LT-P1 Possible Benchmark 1: Frequently this means that the chemical appears on a list that does not translate directly to a single Benchmark score and Benchmark-1 is included in the range of possible Benchmark scores.
- LT-UNK ("unknown"): The chemical is present on a GreenScreen Specified List but there is insufficient information to classify the hazard as LT-1 or LT-P1. The LT-UNK score or the absence of a chemical on hazard lists does not mean it is safe. It may mean the chemical has not been reviewed by the body publishing the list or that the chemical has not yet been well tested.

IH (Industrial Hygiene): The network of controls in place to protect workers from injury and illness. Examples include exhaust fans with exhaust scrubbers, protective eyewear, clothing, and shoes. Some companies employ Certified Industrial Hygienists to determine exposure limits and other hazards, and to devise IH measures.

PPE (Personal Protective Equipment): A subset of IH measures, commonly used along with other IH measures to emphasize the need for some personal protection beyond other industrial controls. An example would be workers using respirators along with exhaust hoods.

REACH (EC 1907/2006): This is an overarching chemicals management framework enacted in the EU and in effect since 2006. REACH stands for Registration, Evaluation, Authorization and restriction of Chemicals. It regulates chemicals included in products rather than those workers handle during the manufacturing process though, as the table below shows, there is overlap. Its provisions are underpinned by the precautionary principle.

SVHC: Substance of Very High Concern under REACH. These substances are known to be harmful to human beings and may be subject to authorization. Substances of Very High Concern must be disclosed to purchasers if present at rates higher than 0.1%.

12 chemicals to be discontinued

16 chemicals to be used with caution

CASRN	Chemical Name	Recommendation	GS Score	REACH	Application	Battery	Printed Circuit Board Assembly	Displays and related	HDD/Storage	Notebook	Desktop/AIO	Smartphone	Tablet	Small Server	Printer/MFD
127-18-4	Tetrachloroethylene	Discontinue use and replace with safer alternative.	BM-1	Yes	Solvent					■	■	■	■	■	■
108-88-3	Toluene		BM-1	Yes	Solvent					■	■	■	■	■	■
71-43-2	Benzene		BM-1	Yes	Solvent					■	■	■	■	■	■
75-09-2	Dichloromethane		LT-1	Yes	Solvent						■			■	■
106-94-5	1-Bromopropane		BM-1	Yes (SVHC)	Solvent		■	■		■	■			■	■
25637-99-4	Hexabromocyclodo-decane		LT-1	Yes (SVHC)	Ingredient in resins and plastics									■	
71-55-6	Methylchloroform		LT-P1	Yes	Solvent		■			■	■	■	■	■	■
110-54-3	n-Hexane		BM-1	Yes	Solvent			■		■	■	■	■	■	■
110-82-7	Cyclohexane		LT-P1	Yes (SVHC)	Solvent			■		■	■	■	■	■	■
79-01-6	Trichlorethylene		LT-1	Yes (SVHC)	Solvent			■		■	■	■	■	■	■
67-56-1	Methyl alcohol		BM-1	Yes	Solvent		■	■		■	■	■	■	■	■
872-50-4	n-methyl Pyrrolidone	Use only as photoresist developer where alternatives not feasible. Use with proper IH and environmental controls.	BM-1	Yes (SVHC)	Photoresist developer and solvent		■	■	■	■	■	■	■	■	■
141-78-6	Ethyl Acetate	Use with proper IH and environmental controls. Replace with safer alternatives where feasible.	LT-UNK	Yes	Solvent		■								
1310-65-2	Lithium Hydroxide		LT-P1	Yes	Solvent	■									
156-60-5	trans-1,2-Dichloro-ethylene	Ensure purity. Use with proper IH and environmental controls. Replace with safer alternatives where feasible.	LT-P1	Yes	Solvent		■	■		■	■	■	■	■	■
7664-93-9	Sulfuric acid	Use with proper IH and environmental controls. Replace with safer alternatives where feasible.	LT-P1	Yes	Solvent		■	■		■	■	■	■	■	■
67-64-1	Acetone		LT-P1	Yes	Solvent			■		■	■	■	■	■	■
106-89-8	Epichlorohydrin		LT-1	Yes	Adhesives and ingredient in resins			■		■	■	■	■	■	■
7440-50-8	Copper dust / powder / fume		LT-P1	Yes	Material in electronic components		■			■	■	■	■	■	■
7440-48-4	Cobalt		LT-1	Yes	Material in batteries, and magnets	■	■			■	■	■	■	■	■
513-78-0	Cadmium Carbonate		LT-1	Yes (SVHC)	Material in batteries and displays	■		■		■	■	■	■	■	
1313-13-9	Manganese dioxide		LT-P1	Yes	Material in batteries	■									
1307-96-6	Cobaltous Oxide		LT-1	Yes	Material in batteries	■									
10043-35-3	Boric Acid		LT-1	Yes (SVHC)	Etchant			■		■	■	■	■	■	■
7681-49-4	Sodium Fluoride		LT-P1	Yes	Ingredient in flux		■			■	■	■	■	■	■
7705-08-0	Ferric Chloride		LT-P1	Yes	Etchant		■								
7440-02-0	Nickel		LT-1	Yes	Plating	■	■		■	■	■			■	
7440-47-3	Chromium		LT-P1	Yes	Pigment and coating				■	■	■			■	■

Annex 2: The Precautionary Principle

The precautionary principle requires companies to take action when credible threats of harm exist, even though some uncertainty may remain.[6] It aims at prevention, based on early detection of potentially dangerous processes, and detecting harmful processes at the start. This is particularly important where there is the potential for serious and irreversible health effects such as developmental damage, cancer, or life-long illness such as asthma. The principle aims at prevention of harm based on early detection of potentially dangerous conditions. It shifts the burden of proof from workers to prove a work-related harm to companies to prove the absence of harm.

The precautionary principle is included in Article 191 of the Treaty on the Functioning of the European Union. It is also embedded as Principle 7 in the UN Global Compact, a set of ten principles for businesses to conduct themselves sustainably and responsibly. Principle 7 directs companies to exercise prevention measures, taking early action before damage occurs, as this is the most effective approach.

The precautionary principle has four central components; [7]

1. Taking preventive action in the face of uncertainty;
2. Shifting the burden of proof to the proponents of an activity;
3. Exploring a wide range of alternatives to possibly harmful actions; and,
4. Increasing public participation in decision making.

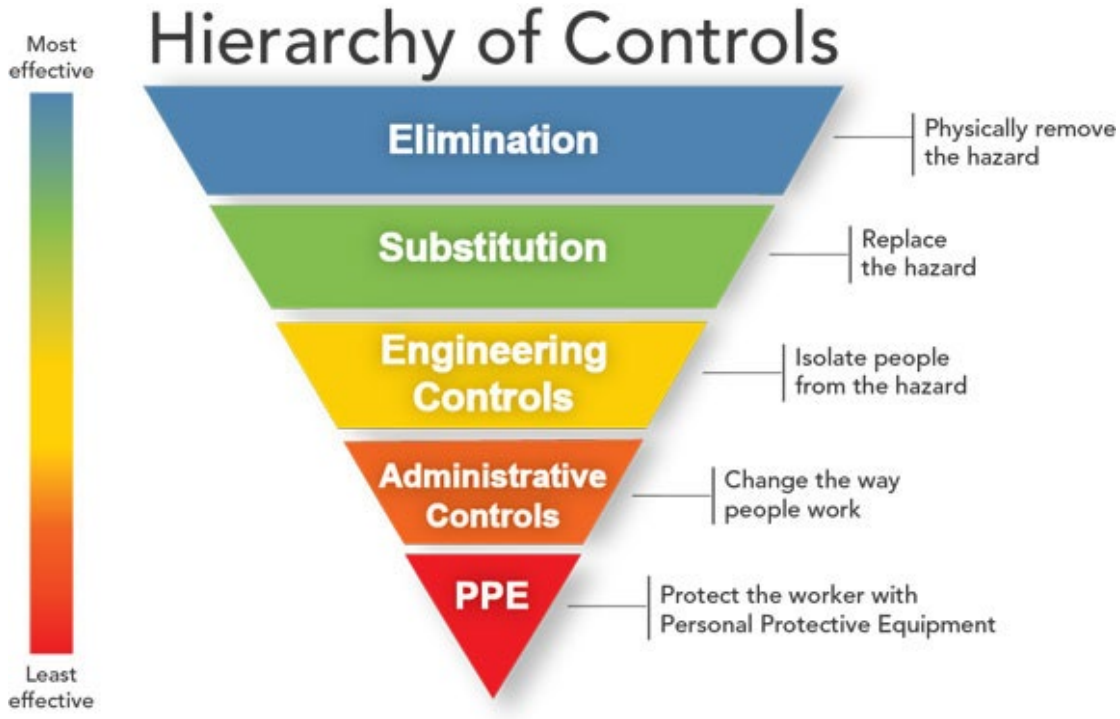
Public procurement tip:

By creating demand for a precautionary approach, public buyers can provide incentive to brands and manufacturers to systematically identify hazardous exposures in the workplace, a first step in phasing out problematic chemicals.

Annex 3: The Hierarchy of Controls

For any situation in which workers are exposed to toxic chemicals there is a Hierarchy of Controls in which the control methods at the top of the hierarchy (the top of the inverted triangle below) are more effective and protective than those at the bottom.

Following this hierarchy leads to the implementation of safer systems, where the risk of illness is substantially reduced. However, employers often do not follow the hierarchy of controls because the methods at the top may be more expensive than those at the bottom. Some employers rely on the least effective control measures—personal protective equipment—in lieu of more effective controls higher on the hierarchy, such as elimination, substitution, or the use of engineering controls.



Elimination of the hazard from the workplace through designing out problematic materials and processes. This is a fundamental step in keeping workers and communities safe from chemical hazards.

Substitution of hazardous chemicals with demonstrably less hazardous products and processes.

Engineering controls, such as increasing ventilation to dilute and capture airborne exposures or automating those processes where hazards cannot be removed.

Administrative controls, such as limiting the time any given worker is exposed to potentially hazardous exposures.

Personal protective equipment, such as gloves, respirators, and eye protection. This is the least protective method but is the most frequently used by employers as an easy solution to hazard elimination.

Public procurement tip:

During contract management you can use the Hierarchy of Controls to evaluate the steps contractors report taking to protect the health of workers in your supply chains and to suggest more effective methods if necessary.

Annex 4: Occupational Exposure Limits

Occupational Exposure Limits (OEL) are a measure for minimising worker exposure to hazardous substances in the workplace. Adhering to OELs is the traditional way to manage worker exposures in the workplace. Such limits are set taking into account the available information on the hazards of a substance, particularly with respect to carcinogenicity, mutagenicity, reproductive toxicity, and with respect to the acute effects of exposure.[8] The units for these air concentration measurements are parts-per-million (PPM) or (micrograms/m3).

The EU's Chemical Agency (ECHA) uses OELs to regulate allowable exposure levels. Other organisations use different measures that correspond to OELs. Governing bodies such as the United States' Occupational Safety and Health Association (OSHA), CalOSHA (California Occupational Safety and Health Administration), and other state-run United States occupational health agencies refer to Permissible Exposure Limits (PEL). Organisations such as the National Institute of Occupational Safety and Health uses Recommended Exposure Limits (REL), and the American Conference of Governmental Industrial Hygienists (ACGIH) uses Threshold Limit Values (TLV). A common way to interpret OEL values between different organisations is to use and reference the most conservative value. The most conservative value is usually the lowest or most health protective value.

However, OELs are not sufficient to protect worker health for several reasons:

- Electronics manufacturing uses thousands of chemicals, and only a fraction of them have any OELs, PELS or TLVS. This is not because the remainder have been proven safe at all levels but because they have not been studied sufficiently for an OEL, PEL or TLV to be proposed.

- Governing bodies such as OSHA have recognized that their PELs are outdated and inadequate for ensuring protection of workers.[9]
- They are also routinely less health protective than environmental exposure limits. Environmental standards are consistently higher than workplace standards. Yet, toxic chemicals that are unsafe for the community (final consumers) would be equally or more hazardous for workers who assemble and manufacture the products and are exposed to these chemicals for extended periods of time.
- A single factory may use and store multiple toxic chemicals. Thus, OEL, PELs and TLVs designed to protect workers against exposure of a single chemical rather than combinations of chemicals are not sufficiently health protective given the routine use of multiple chemicals. A chemical that is relatively safe to use on its own at a certain concentration under proper conditions may not be safe in the same concentration when workers are exposed to mixtures.
- Finally, a large portion of the electronics production workforce consists of women of child-bearing age. But the OELs rarely account for the heightened vulnerability of pregnant women. A developing foetus is especially vulnerable to toxic chemical harm secondary to the mother's exposure even if she experiences no apparent adverse impact.

Public procurement tip:

It is useful to understand the limits of the standard OELs for the contract management process. Workers may experience adverse health impacts even when a factory complies with the relevant OELs. In such a situation you should seek to apply the precautionary principle and suggest that more health protective measures (see Hierarchy of Controls) are put in place.

Endnotes

1 Baskut Tuncak, Opening Remarks, 24th October 2019, United Nations Special Rapporteur on human rights and hazardous substances and wastes, 42nd Session of the U.N. Human Rights Council.

2 See, for example, "Principle 8 – Every worker has the right to know, including to know their rights" in Principles on human rights and the protection of workers from exposure to toxic substances, Report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes (2019), https://documents-dds-ny.un.org/doc/UNDOC/GEN/G19/217/70/PDF/G1921770.pdf?OpenElement. Similarly, the American Public Health Association, states: "Right-to-know is a key chemical safety principle. Workers have a need and right to know about the identities and hazards of chemicals they are exposed to when working. Community residents have a right to know about chemicals they may be exposed to from manufacturing facilities, water, food, products, and wastes." American Public Health Association, "Improving Occupational and Environmental Health in the Global Electronics Industry" (2012), https://apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2014/07/21/08/43/improving-occupational-and-environmental-health-in-the-global-electronics-industry.

3 Official Journal of the European Union (2014) Article 48, Prior Information Notice, Directive 2014/24/EU Of the European Parliament and of the Council https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0024&rid=3

4 This includes EU and national law, collective agreements and a list of international conventions set out in Annex X of Directive 2014/24/EU. The Annex contains the eight fundamental conventions of the International Labour Organisation and four environmental conventions relating to hazardous waste, persistent organic pollutants, hazardous chemicals and

pesticides, and the protection of the ozone layer. Depending on the national transposition of the 2014 Directives, contracting authorities may also be able to or be obliged to impose the same conditions on major subcontractors. See Procura+ Manual, https://procuraplus.org/manual/, p. 54.

5 European Union Green Public Procurement Criteria for Computers and Monitors (2016) Pg. 7. https://ec.europa.eu/environment/gpp/pdf/EU_GPP_criteria_for_computers_and_monitors.pdf

6 EU Legislation Communication (COM(2000) (final) on the precautionary principle (2000) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al32042

7 Kriebel, Tickner, et al., (September 2001) "The Precautionary Principle in Environmental Science", Environmental Health Perspectives, Pg. 871, Volume 109, Number 9.

8 Occupational exposure limits, https://echa.europa.eu/oel

9 US Department of Labor, Occupational Safety and Health Administration, https://www.osha.gov/dsg/annotated-pels/