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Toxics Use Reduction: beyond analysis to action

Linking public health, occupational health and safety, environmental sustainability and new or better employment: a position paper

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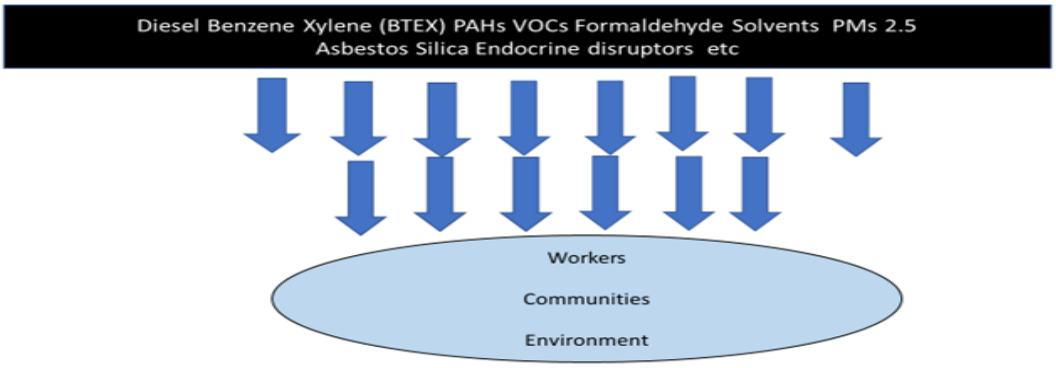
TUR is a "planning tool" for more efficient industrial operations that would produce less waste. Toxics use reduction involves in-plant changes that reduce, avoid, or eliminate the use of toxic chemicals or the generation of hazardous waste, emissions (to air or land), and by-products per unit of product manufactured (Source: TURI).

INTRODUCTION

What are toxics?

"Toxic"" has its origins in Greek and Latin words relating to archery – toxon for bow and toxikon for poisons on arrows shot from bows. Now toxic means poisonous and usually refers to hazardous substances although we should also not forget there can be ''toxic'' work practices and "toxic work organisations" due to bad management that can damage mental health through for example stress, overwork, and shift systems. So, these toxic substances or 'toxins', usually chemicals, now rain down like arrows on workers, their communities and the environment. Effective efforts to remove or reduce them at source in workplaces and wider environments will be a major contribution to both occupational health and safety and public health.



Toxics use reduction (TUR) would therefore seem at first sight to be an approach everyone would support if it was technically possible. It should be part of a policy that contributes to environmental justice and workplace democracy, the green new deal and sustainability. Employers, workers, communities, environmental groups, local and central government should all be in favour of such policies. However, if the costs, time, and resources of reducing or removing toxic substances are viewed as high or too high or too difficult by employers and if the human and economic costs of continuing to use such substances are paid by workers, communities, and the environment and not by employers, then there may be resistance to TUR. The problems may be further compounded by limited or absent regulation, inspection and monitoring of toxic substances and the proper enforcement of laws to control them. Further problems may emerge because of the failure or inability to record the harms done by toxic substances. This may lead to arguments that TUR is not needed.

Some of the most dangerous and toxic substances that workers and the wider world face are of course a range of air pollutants and carbon. Global climate change is caused by dangerous substances. Linking worker occupational health and safety to concerns about global climate change and air pollution is therefore vital. Exposure to hazardous substances in workplaces must be added to exposures from the wider environment (and vice versa), the importance of mixtures and the effects of very low-level exposures for example to endocrine disruptors on risk estimates.

To fully assess the toxics use reduction decisions needed, it is therefore necessary to have more information about the life cycle analysis – detailing the life of a chemicals from extraction, production, use, incidental pollution, contamination, and disposal - of the chemical used. In addition, the cumulative exposures of an employee to that chemical beyond the workplace and from other sources over their lifetime is needed to inform TUR decisions. This may not always be possible or assessments may be incomplete but an incomplete assessment is better than no assessment at all and there are tools and data bases that will help to make such an assessment possible.

Tools such as hazard, risk and body mapping for example will help to identify and prioritise hazardous substances and strategies for choosing what to target in TUR. We should consider more fully how the science has changed in the last decade and concentrate more fully on chemical hazard identification as well as risk assessment with for example mixtures and multiple hazardous substance exposures from a range of sources, exposome calculations and cumulative health impact assessments. Pre-natal exposures need to be factored into hazardous assessments for more effective TUR decisions. There is often little detailed consideration of cumulative health impacts or complex interactions involving many toxic substances (Solomon 2016).

The exposome concept developed in 2005 (Shaffer 2017) to look at total environmental exposures from pre-natal stages and onwards during a lifetime may also prove a useful additional tool. These hazards should now as a matter of course be an integral part of risk assessments but often they are not or are marginalized in policy-making and standard setting. These shortcomings are again powerful arguments for adopting toxics use reduction strategies as the first approach to risk removal and risk reduction.

When we look at TUR, we therefore need to assess the risks from all the exposures to toxic substances that we have within the workplace, directly and indirectly, and from the wider environment. This is an argument for using TUR in wider society as well as workplace TUR. Air pollution for example may occur as the result of a particular process or task but the load of pollutants may then be added to by air pollution from elsewhere in the workplace, from materials used in the building, from pollutants generated by other workplaces and from the wider environment such as fumes from transport and energy sources. There is now a very short window globally to controls some toxic hazards that are major contributors to climate change as well as air pollution.

The workplace focus should be on the hazard and its removal first, then the risk and then mitigation. Yet UK practices if not policies, regulation and enforcement appear to be operating back to front. This has often meant still greater emphasis being placed on individuals to safeguard themselves from chemical hazards rather than the adoption by employers of toxics use reduction through less hazardous substitutes. These issues are explored in more detail later in the paper against the background of toxics use reduction success stories for example in engineering, services, construction materials and printing.

Critiques of TUR

These have been widely debated since the early development of TUR in Massachusetts because of the perceived lack of information on what risk was with regard to toxic substances and how it could be measured. In 1993, the pros and cons of TUR were described. The cons included the arguments (1) that laws already existed that would deal with the issue and no new regulations were needed (2) that there were benefits to be gained from toxic chemicals such as BTEX and these could not be replaced or not easily (3) TUR would be an unnecessarily intrusive government intervention (4) few or no known less hazardous substitutes exist (Laden and Gray 1993).

These counter-arguments continue to be put often as part of bigger neo-liberal arguments about freeing up markets for manufacturers, the spurious belief that markets would naturally safeguard public health and worker health and safety, the need for deregulation and red tape, accusations of risk aversion and chemophobia. At the time, all these arguments were refuted. The tragedy of the gas leak at the Union Carbide plant in Bhopal and the refusal of the plant's new owners, Dow Chemicals to accept liability for tens of thousands of deaths, cases of disease and birth defects in children is a lesson that neo-liberal supporters continue to ignore. The foreseeable and preventable failures in such cases as Bhopal and indeed Grenfell are brutal reminders about hazardous materials and flawed safety systems, compounded by a refusal to listen to expert, community, and worker warnings.

Since the 1990s even more evidence has been gathered on substitution including EU REACH impacts and other initiatives, on the need for effective public health measures to reduce the impacts of hazardous substances and the greater damage many are known to do not only to workers but to the public at large and the environment. Global climate change research and evidence of air pollution and plastics pollution have added further and huge drivers to the need for toxics use reduction.

Why do we need to reduce or remove exposure to toxic substances?

Hazards for toxic substances include occupational cancer to chronic respiratory diseases, adverse reproductive and developmental effects, immunotoxicity , neurological diseases, mental health impacts, and cardio-vascular diseases. Calculating the risks presented by the toxic substances individually, in combination and in inter-actions with a variety of other materials and exposures is highly complex. That is why removal or reduction of the number of toxic substances in the workplace is a far easier task than assessing the complex risks and identifying illnesses caused by exposures. The International Agency for Research on Cancer suggests that globally 7 to 19% of all cancers may be due to toxic environmental exposures but relatively few of these will be recorded in the UK even in 2019. There are still huge problems with the lack of comprehensive chemical toxicity assessments.

In the 2000s, it was estimated in the USA that even with chemicals used in high volumes, only around 10% had partial hazard assessments available and none had complete hazard assessments. In the late 1990s USEPA found that 43% of high-volume chemicals used had no toxicity information available at all. Only 7% had a full set of basic toxicity information available and since that time evidence indicates the data gap has not been closing significantly but new threats to public health have emerged (Applegate and Bauer 2006).

A widely used metal that has been with us for centuries, lead for example, illustrates the problems still faced in controlling toxic substances in the workplace often with wider environmental impacts. The acute neurological effects of lead were gradually recognized in the workplace and some regulations introduced. Then reproductive threats to pregnant women were recognized and women employees were excluded from the workplace. Sometime later the reproductive hazards to men were recognized. More problems have emerged in the last thirty years with environmental and occupational 'low level, long term' exposure linked to blood pressure and heart disease, kidney function and low birth weights. It has been estimated that about 5000 GB workers a year have lead above 10 micrograms per decilitre in blood (µg/dl) throughout the 2000s. Action levels for employees are set at 50 µg/dl and at 25 µg/dl for women of childbearing age. In some states in the USA all elevated blood lead levels of more than 25 ug/dl adult, and more than 10 ug/dl for children under fifteen years of age have to be reported to the state authority within two days. Regulatory agents are told when more than 25 µg/dl are recorded. Since 1991, evidence has existed that children's physical and mental development can be affected at blood lead levels of <10 µg/dl. California State considers " current science strongly indicates that worker blood lead levels should not exceed 5 to 10 µg/dl over a working lifetime" The USA Environmental Protection Agency additionally considers lead a probable human carcinogen. So we have a hazardous substance with significant potentially serious risks still present in many Scottish workplaces.

With the introduction of REACH provisions in 2007 and the application of regulations such as COSHH 2002 and in various earlier forms, some occupational health and safety practitioners consider the health threats from chemicals is well under control but evidence indicates otherwise. The European Chemical Agency (ECHA) plays a role in assessing threats from existing chemicals but resources and staff are limited, the task is huge and the EU is often hamstrung by hostile governments and vested interests and unable to act. In addition , post-Brexit UK deviations from and weakening of REACH seem likely when deregulatory governments are in office.

This is why bodies like WHO and the European Environment Agency support the application of the precautionary principle to chemicals where risks of long-term health damage to workers and the public have been flagged. This is a safety first and 'balance of probabilities' approach espoused for good reason by many in public health as the lead case study demonstrates. It is a major plank of TUR. Yet scientists may value the null hypothesis approach more highly, seek proof of safety 'beyond reasonable doubt' and protect their rights to innovate first and count societal costs afterwards. Industry too is hostile to the principle because it may stifle innovation and smacks of too much market intervention. Regulators are often directed by government to respond to economic development and industry interest as a priority. A 'wait and see' philosophy then emerges but history shows that for many long-term occupationally and environmentally-caused diseases this simply does not work.

Governments, their agencies, and professionals generally argue they are for goodness and against sin. Exposing workers and the public to toxic substances where there are alternatives would be viewed as sinful and the idea of toxics use reduction would be viewed as goodness. In theory everyone supports the reduction of toxic substances, processes, and work systems. In practice, for reasons including those of profitability and externalisation of costs, production, and ignorance, those in power, whether at Government or workplace level do not take action or their actions are limited and harmful to workers, the public and often the wider environment. This is the problem we face across the UK.

The State of Play in figures on the burden of disease related to toxic substances

An ETUC report estimated 500,000 work-related cancer deaths 2014-19 (the period in office of the current European Commission and Parliament) across Europe, part of a total of 900,000-1 million work-related deaths over the same period in EU member states. 200,000 people are estimated to die every year in the European Union because of workplace diseases, illnesses, and injuries. Hazards Campaign estimate 18,000 work-related cancer deaths each year, 6,000 work-related deaths from respiratory illnesses/obstructive lung diseases, 6000 deaths from other work-related diseases including restrictive lung diseases & neurological logical diseases and other lung diseases. Just these 3 groupings alone from dangerous substances produce a work-related annual deaths figure of 30,000 in GB.

The HSE Health and Work Strategy estimated 1.3 million people who worked in 2015/16 were suffering from an illness they believed was caused or made worse by work. HSE also estimated there are 13 000 deaths a year linked to past exposures to hazardous substances at work. New cases of work-related illness resulting from current working conditions (excluding long-latency illness) led to costs of around £9.3 billion in 2014/15.

Past working conditions also continue to cause high costs today, and HSE estimates that new cases of work-related cancer, caused largely by past exposures to carcinogens at work, resulted in costs of around £12.3 billion in 2010.

Some toxic substance controls get tougher it is true although there are regular efforts to weaken or ignore such standards as we have seen with chromium VI used in paints and engineering and the herbicide glyphosate in the last 12 months. Whilst some standards may get tougher, we also find out more about dangerous substances. There are currently well over 80,000 commercial chemicals available around the world although of course not all are used widely or in great quantities and not all are toxic. More than 700 new chemicals also come on to the North American market each year. Wendy Chavkin coined the phrase ‘double jeopardy’ for women exposed to hazards at work and at home. Most of us now face at least quintuple exposures to chemicals – at work, at home, in the air, in water and in food – far more than half a century ago.

What exactly is Toxics Use Reduction and what models exist already?

Massachusetts along with Oregon have had the longest involvement with TUR through legislation. The former has conducted a great deal of research and evaluation on the policy and practice of TUR, following the passage of the 1989 Act. In 1989, the Toxics Use Reduction Act in Massachusetts was introduced, following negotiations between industry and environmental groups "to promote safer and cleaner production that enhances the economic viability of Massachusetts firms". The term is widely used and at one level is self-explanatory and could include reducing toxics use in workplaces as well as the wider environment with all that entails for improved public health. The state views TUR as a "planning tool" for more efficient industrial operations that would produce less waste and considers the tool involves in-plant changes to "reduce, avoid, or eliminate the use of toxic chemicals or the generation of hazardous waste, emissions (to air or land), and by-products per unit of product manufactured". The Toxics Use Reduction Institute (TURI) at the University of Massachusetts, Lowell, which supports TURA initiatives and work in the mid-2000s used the following definition : "Toxics use reduction (TUR) is a fundamental form of pollution prevention that focuses on the use of toxic chemicals and the generation of wastes in the manufacturing process. It does not focus on the management or treatment of wastes once they are produced". TUR is effectively a "planning tool" for more efficient industrial operations that would produce less waste. Toxics use reduction involves in-plant changes that reduce, avoid, or eliminate the use of toxic chemicals or the generation of hazardous waste, emissions (to air or land), and by-products per unit of product manufactured.

TURA targeted objectives included establishing a state-wide goal of reducing toxic waste generated by fifty percent (50%) by the year 1997 using toxics use reduction as the means of meeting this goal. To do so, they chose a TUR approach to obtain compliance with laws and regulations dealing with 'toxics production and use, hazardous waste, industrial hygiene, worker safety, public exposure to toxics, or releases of toxics into the environment and for minimizing the risks associated with the use of toxic or hazardous substances and the production of toxic or hazardous substances or hazardous wastes'.

This joins up rather than duplicates a number of important strands for action that in the UK would include COSHH, HASAWA, the extant EU directives on OSH, and REACH in so far as it will remain in force. For workers and communities, the TURA aim of enhancing and strengthening the enforcement of existing environmental laws and regulations would be welcome in the UK.

TURA/TURI additionally aimed to sustain, safeguard, and promote the competitive advantage of businesses, large and small, while advancing innovation in toxics use reduction and management. This should appeal to employers in the UK who would report quantities of toxic chemicals used, generated as by-products waste) and shipped in or as product. They would then receive support, training, and information on how to prepare a Toxics Use Reduction Plan, in which they examine how and why toxic chemicals are used at their facility and evaluate what their options are. Under TURA , there were about 500 companies (2018/19) required to report annually on toxic chemicals used and toxic by-products generated (https://turadata.turi.org/). Between 1990 and 2016, companies in Massachusetts reduced toxic chemical use by 66%, by-product production by 72% and onsite releases by 92%. 1400 chemicals are now covered by the reporting A firm must manufacture or process 25,000 pounds per year of a listed chemical or must use 10,000 pounds per year of a listed chemical for registration under TURA but much of the data, evaluations and training materials generated by TURA are openly and freely available on the web for anyone in the UK to access and are not restricted to registrants.

TURI have for example supported small business and community grant programmes and educational work dealing with safer cleaning and disinfection, toxic substances in products marketed for black women, and safer alternatives for artificial turf (www.turi.org) .

Toxics use reduction is the best method for protecting public health and the environment from hazardous pollutants. This method will and has decreased risk of major accidents from transportation and storage, protected workers from dangerous workplace exposures and created products which are safer for our, the consumer's, use.

What should TUR do in the UK and why?

The approach should be based on a problem-solving approach. It can utilise occupational health and safety laws and regulations underpinned by what is technically feasible and practical. However, existing laws and regulations do not always ensure a TUR approach because of a lack of monitoring, inspection, regulation, and the necessary information to allow companies to plan for TUR. COSHH does not always removes hazards at source. REACH may reduce hazards through restriction or removal but there are significant gaps in the current assessment of many chemicals and post-Brexit it is unclear in the middle term how REACH will apply. In contrast TUR is strategic and fits into sunsetting and just transition policies using citizen/worker science and participatory action research. TUR also both helps to implement and complements environmental policies and green jobs, control of work and jobs, alternative economic strategies & plans, sustainability, and climate change.

TUR needs to adopt a well thought out, carefully researched goal setting policy as applies in Massachusetts and in Sweden where the emphasis is on action not just analysis but actions that are thoroughly well researched and evaluated. There are major economic benefit by simple TUR actions such as water for solvent and others linked to developing cutting edge technologies . Restricting 4 phthalates (EDCs) in Denmark has been estimated to save 1 million kroners a year. Across the EU, phasing out EDCs saves around 31 billion euros in health-related costs each year in EU, including reproductive & fertility problems; genital malformation; cancers; behavioural disorders; obesity & diabetes (HEAL 2019).

The problem-solving approach in TUR is quite separate from a problem-shifting approach that has too often dominated much of UK past policy, either directly or indirectly. Problem shifting can have unforeseen consequences. Sometimes risks may be shifted from the manufacturer/supplier/employer to worker, community, or public health more widely. Problem shifting is based on a safe worker not safe workplace approach and may result in moving risks from one frying pan to another if not from the frying pan into the fire. For example risks to consumers from pests and diseases could lead to fumigation in ports so consumer risks drop but worker exposure increases. Nanotechnology in drugs, cosmetics & clothes may benefit pharmaceutical companies, manufacturers, patients, and consumers but increase risks for workers in these industries, the wider environment and public health. Shifting and reducing some risks from some groups of workers such as production workers by using different materials and systems may increase risks for maintenance workers, cleaners, and distribution workers. In agriculture, moving from acutely neurotoxic veterinary pesticides to less well researched pesticides where human effects were not thoroughly researched may damage the environment as well as workers later in life. TUR options existed for almost all of the above either through removal or reduction of the hazard and related risks.

The term ‘regrettable substitutes’ has been used for failures to investigate alternative products properly when dealing with toxic substances. Substituting trichloroethylene with n-hexane did not remove risks and better alternatives and engineering solutions were available. Substituting BPS for BPA was case of out of one frying pan into another. Substituting solvents for water in some cleaning processes was often an economically expensive as well as a hazardous step. Insulation ‘improvements’ as the Grenfell Towers tragedy has revealed which ignore or downplay assessments of both flammability and toxicity of cladding materials and are based on the cheaper options available put occupiers & emergency workers at risk. Effective and early TUR policies in such circumstances could have prevented catastrophic failures down the line. The problems of contaminated air in planes and reports of aerotoxic poisoning in air crew, cabin crew and passengers is connected to recycled air from engines that saves airlines money and it is argued reduces fuel consumption and environmental impacts of flying. A TUR solution would be to redesign ventilation systems so there is no possibility of contaminated air reaching aircrew or passengers.

Green Chemistry and TUR

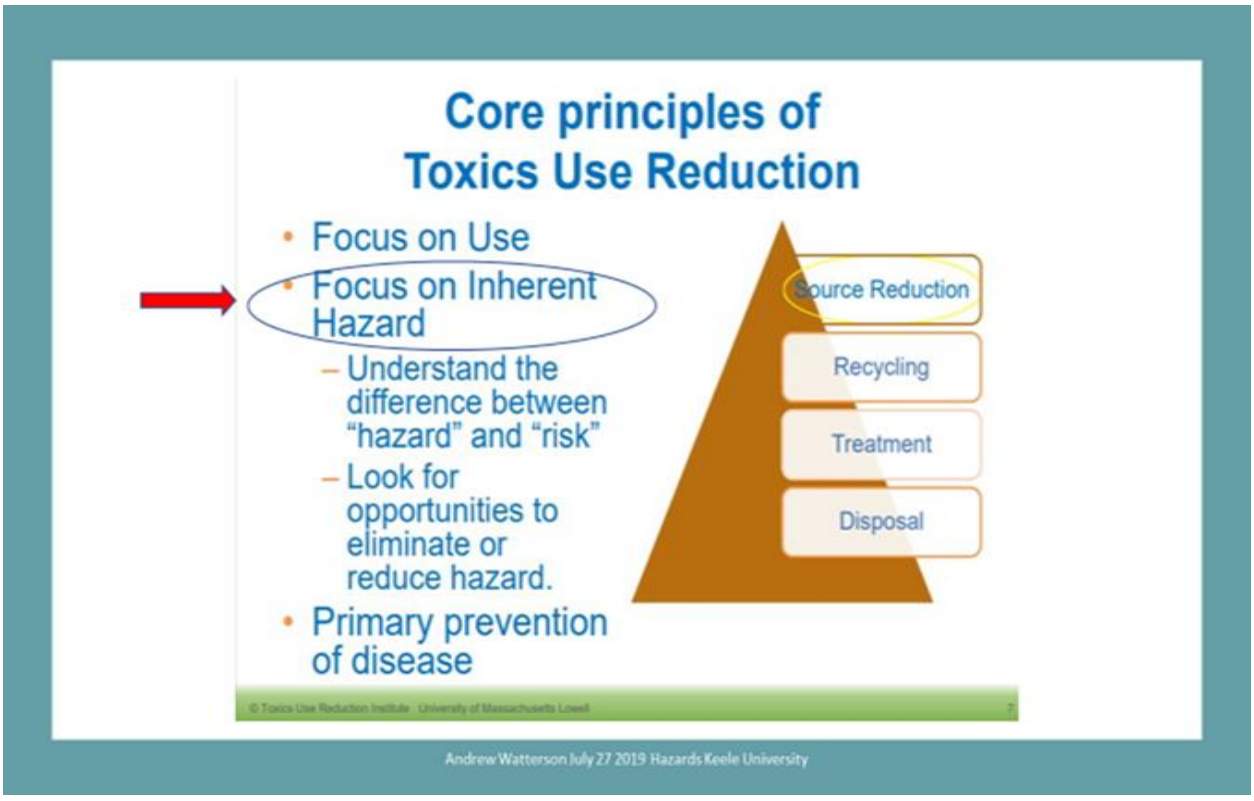
It could be argued that ‘green chemistry’ has always been an important strand of occupational health and safety and toxics use reduction, It dates back over a hundred years to Thomas Legge’s work on various forms of lead, and Alice Hamilton’s work with her colleagues on other metals although the term would not have been used then. With the huge expansion of chemical production since the 1970s, the importance of green chemistry has increased significantly.

In 1990, the US Pollution Prevention Act of 1990 effectively started the green chemistry movement. The US EPA defines green chemistry as “the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances (USEPA nd) ”. Examples of how it works are widely available although not always fully evaluated (Harvard 2011). The benefits of green chemistry for business following some initial investment linked to pollution prevention were highlighted by Rachel Massey from the Massachusetts TURI. These included lower costs for waste disposal, raw materials, worker protection or liability coverage; increased production efficiency; reduced sick days and more (Massey 2017) .

The key principles of green chemistry developed by Paul Anastas and John C. Warner include a variety of elements. Prevent waste rather than clean it up afterwards. Incorporate as much of the materials used in the process into the final product (called atom economy). Design safer chemicals, products, and processes. Increase energy efficiency. Use renewable raw materials. Design products to break down safely at the end of their function. Choose substances that minimize the potential for accidents (Columbia 2014). Such principles can encapsulate occupational and environmental health concerns. These include green/blue work and worker objectives, linked to addressing threats posed by climate change and a lack of sustainable production but also worker health and safety which in practice is often neglected if not ignored in new developments. In 2014, the green chemistry world was mooting the possibility of super-fast computers running on computer chips made from chicken feathers and clothing made of a new kind of spandex, 70 percent of which is made from glucose derived from corn. Both have been partially achieved although the implications for workers of producing such materials does not appear to have been fully explored.

How to research toxics use reduction and what tools you might need?

Developing a TUR strategy and identifying better methods or materials for use in a workplace will often but not always require a good deal of research as well as careful thought and planning if it is to work well and avoid regrettable substitutes. However, there is no need always to re-invent TUR wheels when searching for relevant information.



Data bases already exist that may make your task easier as a worker, manager, or regulator.

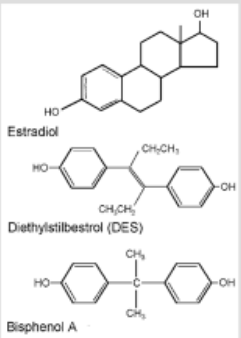
In addition to such basic sources as those made available by regulators and under COSHH as well as European sources still accessible through the European Chemicals Agency (ECHA), there are some data bases especially useful for trade union safety representatives and other workers.

These exist on the TURI web sites, on Chemhat and on Subs port. Each data base may cover different ground or provide different types of information so all three are worth searching. As an illustration of what is available on the various data bases, the endocrine disruptors BPA BPS are used. Endocrine disruptors present major occupational health and environmental health problems at very low levels but actions to control, reduce exposures and remove them have been limited.

Case Study – Endocrine disruptors especially BPA and BPS

The most common endocrine disruptors

- PCBs and dioxins. Found in: Pesticides. ...
- Flame retardants. Found in: Plastics, paint, furniture, electronics, food. ...
- Dioxins. Found in: Meat. ...
- Phytoestrogens. Found in: Soy & other foods. ...
- Pesticides. Found in: Food, water, soil. ...
- Perfluorinated chemicals. ...
- Phthalates. ...
- BPA (bisphenol A)



The 1940's led to a push for synthetic hormones

Vandenberg 2018

Endocrine disruptors are chemicals that may interfere with the body's endocrine system and produce adverse developmental, reproductive, neurological, and immune effects in both humans and wildlife. Examples like **diethylstilbestrol** (the synthetic oestrogen DES) have had known hazards attached to them for decades and DES was introduced in 1948

NIH National Institute of Environmental Health Sciences
Your Environment. Your Health.

The hazards of some of the chemicals are listed along with information about the substitutes available.

SUBS PORT on BPS – no entry but information on BPA

(SUBSPORT is a European substitution e-tool to reduce the risks of hazardous chemicals safely operated by EASHW)

SUBS PORT
Substitution Support Portal

MOVING TOWARDS SAFER ALTERNATIVES

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BPS as a substitute for BPA. www.ChemHat.org source

Bisphenol s

CAS: 80-09-1

Stronger effect / evidence — Weaker effect / evidence

How can this chemical affect my health?

Acute (Short Term) Effects Data sources

Irritates the Eyes – Can cause irritation or serious damage to the eye.

Irritates the Skin – Can cause irritation or serious damage to the skin.

Toxic to Humans & Animals – Can be fatal on contact, ingestion or inhalation for humans and other mammals.

Chronic (Long Term) Effects Data sources

Reproductive Harm – Can disrupt the male or female reproductive systems, changing sexual development, behavior or functions, decreasing fertility, or resulting in loss of the fetus during pregnancy.

Endocrine Disruption – Can interfere with hormone communication between cells which controls metabolism, development, growth, reproduction and behavior (the endocrine system).

Birth Defects – Can cause harm to the developing child including birth defects, low birth weight and biological or behavioral problems that appear as the child grows.

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TURI

TOXICS USE REDUCTION INSTITUTE

UMASS LOWELL

BPA/BPS used in Cash Register Thermal Printing, Receipts:
Hazards:-
- Developers: Bisphenol A (BPA), BPS
- Leuco dyes
- Stabilizers: phenols

Safer alternatives to thermal cash receipts:
- Electronic (email) receipt

Check out this TURI funded public service video and related resources at https://www.bpa-free.me/

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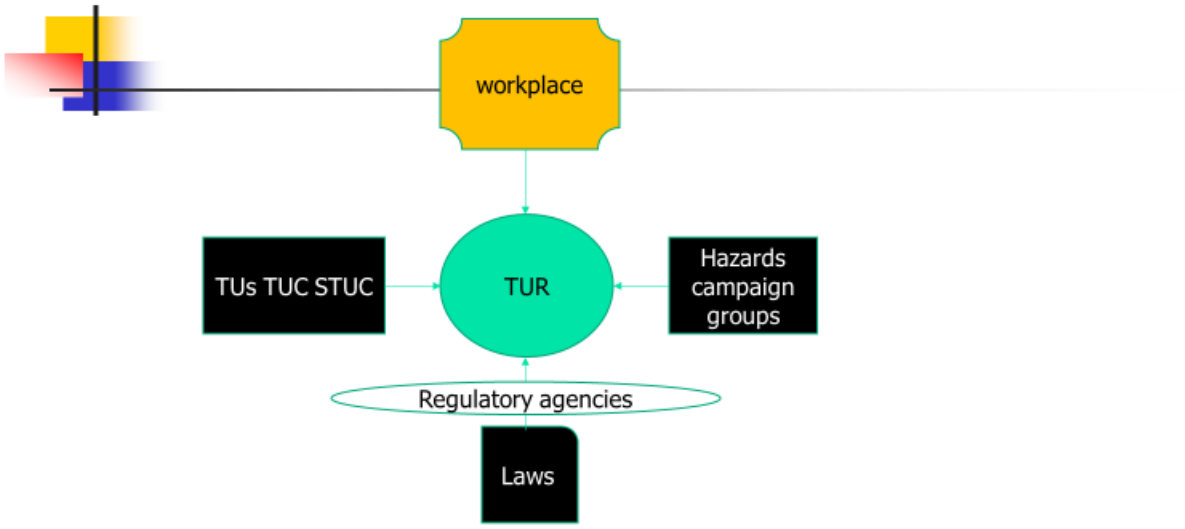
As the TURI example shows, it may be possible to remove hazards completely without changing to other chemicals by rethinking what is required. Similar solutions have emerged for example by switching to water-based paints rather than solvent-based paints: the problems of paint chemicals are not entirely removed but greatly reduced. Similarly questioning the use of nanomaterials to keep socks 'fresh' or using chemicals to keep rooms 'fresh' may lead to decisions to dispense with the chemicals all together.

The role of trade unions, worker representatives, environmental groups, employers and communities in TUR

Trade union safety representatives, environmental groups and possibly communities and residents can have a critical role in influencing and working with employers to address the use, production, or disposal of toxic substances in a workplace or on a site. The Blue Green Alliance in the USA has successfully brought together trade unions and environmental groups to press for TUR-type strategies that produce healthy and safe jobs, a clean environment locally and sustainable products and processes (https://www.bluegreenalliance.org/).

The TUC and its health and safety newsletter, Risks, have explored and promoted toxics use reduction as a way to reduce or remove hazardous substances from the workplace (https://www.tuc.org.uk/). Unions like Unite have also flagged toxics use reduction with members in regional health and safety events. Groups such as the Hazards Campaign, Scottish Hazards have promoted toxics use reduction through articles, training aids and workshops over several decades most recently at their online conference Towards a Greener World and Workplace (The Massachusetts Toxics Use Reduction Act (TURI) (scottishhazards.org.uk)). The UK Hazards magazine provided major coverage of TUR initiatives, campaigns, and tools on a regular basis. (http://www.hazards.org/toxicsusereduction.htm).



Trade unions can work up their own site-specific, company or sectoral TUR strategies and put together data bases on chemicals used in their work and alternatives available. The TUC and STUC could provide additional support if it viewed TUR as an important and integral part of the Green New Deal and Just Transition/Sunsetting agendas that links green jobs with sustainability and climate change targets.

They could also lobby for TUR through calls for a range of other interventions: new laws, regulations, funding, support from staff in existing agencies (HSE, NHS, NHSS, PHE, HPS, EA, Sepa) etc. In Scotland groups like Scottish Hazards are exploring links with Just and Green Recovery Scotland https://foe.scot/just-and-green-recovery-scotland/ that may be means to carry forward more TUR work.

The TURI data bases already available provide a good foundation for doing this in several sectors, public and private, along with the Subs port and ChemHat data bases and other sources freely available on the web such as within ECHA . They can draw too on laws and regulations currently in force in the UK – HASAWA 1974, CPL-related regs, Management Regs, COSHH and SRSC Regulations etc - both to obtain information on risk assessments, SDSs, gather more specific details and get time to analyse their findings. Bodies such as PAN, HEAL, Health Care with Harm can provide information on particular hazards or employment sectors. Similarly groups such as WWF, FOE, Greenpeace labs and, in the US, Green Chemistry labs have a wide range of relevant information for TUR.

What happened and is happening in Scotland in toxics use reduction

TUR presents policy, principle, and organisational challenges across the UK but perhaps less so in Scotland where its size could lead to closer and more effective co-operation among enforcers . Joint Competent Authorities (JCAs) already exist between HSE and Sepa in Scotland.

HSE

Occupational health and safety remains reserved to Westminster. This effectively constrains certain policies and regulatory initiatives in Scotland and is a partial barrier to the development of an effective toxics use reduction structure, strategy and practice based on bringing together workplace, environmental and health bodies in the country. HSE in Scotland has in the past flagged up the general policy and practice on occupational ill health and its priorities for dealing with carcinogens and other causes of occupational diseases but it has been primarily reactive. This comes in its reiteration of the Control of Hazardous Substances Regulations 2002 hierarchy approach to hazards – removal, substitutions, enclosure, PPE etc. It has further noted its approach incorporates an 'understanding of barriers that stop people protecting themselves, triggers that will stimulate behaviour change, the most effective targeting of messages'. This does not resonate well with an active TUR approach. http://www.parliament.scot/S4_EconomyEnergyandTourismCommittee/Inquiries/HSE.pdf.

Toxics use reduction, however, does not depend on a focus on individuals or on related behavioural change approaches but emphasises instead structural drivers for employers and government, based on research and regulation, and only then backed up by information, advice, and support. HSE work does contain much on reducing toxic exposures and it has been involved in EU projects for example in the print industry that focus on reducing toxics' use. HSL also researches toxics. Yet HSE does not use or appear to recognise the value of toxics use reduction strategies per se, the details of which can easily and transparently be audited and assessed for risks, costs, and benefits. Cuts to HSE budgets and the break down in the tripartite nature of the HSE, along with UK Government policy, will undoubtedly have contributed further barriers to TUR adoption in recent years.

PHASS

The Partnership on Health and Safety in Scotland brings together many key players in health and safety in Scotland, including the Scottish Government, Public Health Scotland's Health and Work team (previously Healthy Working Lives) enforcers, business, unions, the third sector. https://www.hse.gov.uk/scotland/partnership.htm PHASS has attempted to create tripartite input in Scotland as health and safety and the HSE are reserved matters. Recent additional efforts have been made to increase the profile and effective activity of PHASS. These efforts have increased during the pandemic. PHASS may therefore be one of several possible vehicles through which to argue for a Scottish TUR strategy.

NHS Scotland (NHSS)

The Chief Medical officer (CMO) who advises the Scottish Government on public health and hcolleagues have a major role to play in protecting Scotland's population from health harms due to environmental exposures. The CMO is "responsible for improving the mental and physical wellbeing of people in Scotland" https://www.gov.scot/about/how-government-is-run/directorates/chief-medical-officer/. This includes a key role in continuing reductions in the incidence of coronary heart disease and stroke which may all have their origins in environmental factors directly and indirectly . On such issues as air pollution, the NHS should be the key driver for change but its powers are limited even if its advice is not. On the hazards of diesel, on particulate matter(PM) especially PM2.5s, across the UK the toll taken by such toxic substances in terms of mortality and morbidity has only recently been recognised by health bodies as an urgent priority for action.

Within Scotland's health boards, there are public health departments that advise on regional and local issues . However, their staffing expertise and resources means they may sometimes lack the knowledge and time to offer detailed advice on toxics use reduction. This became clear when various health boards were asked to advise on plans for fracking and coal bed methane applications. They also do not have a statutory and enforcement role in this field but HSE, SEPA and local authorities do.

TUR should form a part of NHSS work at the very least for toxic substances in the health sector but it remains an apparently untapped and unresponsive resource to date.

Health Protection Scotland (HPS)

Health Protection Scotland (HPS) aims " to work in partnership with others, to protect the Scottish population (5 million) from being exposed to infectious and environmental hazards which damage their health and to limit any impact on health when such exposures cannot be avoided. Its remit is to strengthen, coordinate and assure national health protection activity by carrying out surveillance, providing expert advice, ensuring an effective response to incidents, developing good practice and a competent workforce, and taking forward a portfolio of research" https://ecdc.europa.eu/en/health-protection-scotland-epiet. Currently HPS is the national surveillance centre for communicable diseases and health problems associated with environmental hazards https://www.hps.scot.nhs.uk/data/. However, it is currently difficult to identify any systematic policy towards dangerous substances and their reduction or removal within HPS as the organisation effectively appears to have a reactive role to hazards and has limited staff and resources to change policy on such things as TUR. When its web pages are searched using key words, there is for example a significant emphasis on cancer but not carcinogens.

This does not reflect the range of work done by HPS but does confirm its primarily NHS disease rather than disease prevention orientation.

Public Health Scotland

There are concerns that the new Public Health Scotland three-year strategy says very little about health and work. Yet occupational health and safety is integral to each of its four focus areas: Covid-19; poverty and children: mental health; and communities and place. Scottish Hazards and others have called on PHS to ensure that health and work becomes an important part of PHS activity as the strategy is further developed.

SEPA

SEPA's role is to protect "the environment and human health is wide-ranging, including environmental regulation, mitigating and adapting to climate change, monitoring and reporting on the state of our environment, raising awareness of environmental issues, engaging with the public through citizen science projects, and resolving environmental harms" https://www.sepa.org.uk/about-us/. In this context it could be argued toxics use reduction is built into its work across all sectors of the economy. Unlike some of the other agencies discussed in this paper, its collaboration with HSE and overlap on such subjects and regulations as the control of major industrial hazards is clearly acknowledged in its web pages. So SEPA in terms of its role, its current activities, its expertise, and its resources is in many respects effectively the 'lead body' in Scotland on addressing toxics use. SEPA's inspections, regulatory and enforcement work will therefore undoubtedly directly affect worker health as well as the wider public health. The downside is that the agency has a 'better regulation' approach often geared more to risk management not hazard removal and appears in several areas to be strongly influenced by industry groups, corporate thinking and corporate bodies at board and policy level.

Local government environmental health departments

These departments contain staff responsible for enforcing occupational health and safety legislation - as well as environmental health and food safety laws - in certain sectors of the economy such as shops, warehouses, offices, and small businesses. They have a major role in monitoring and controlling local air, soil, and water pollution from toxic substances. Their health and safety activity during the Covid pandemic looks to have been greater than that of the HSE. Local authorities and their environmental health and other enforcement officers therefore look ideally placed to adopt and advocate TUR in their own organisations and in the many small businesses that they cover.

Where we stand now on reducing toxics in the UK and beyond.

The UK House of Commons Environment Committee Report on Toxic Chemicals in Everyday Life which emerged in July 2019 provides an analysis that is both problematic and promising for developing toxics TUR across the country. It could have provided a blueprint for TUR but does not. There is no specific mention of TUR in the whole document. It believes: " Chemicals are pervasive in modern society and contribute to improved health and quality of life globally." In fact, only some chemicals contribute to improved health and quality of life. Other chemicals have damaged human health of workers, communities, and the wider environment whilst their development and use may have profited manufacturers and suppliers. We already know a lot about a variety of chemicals and their human and wildlife impacts as well as there being large areas of ignorance.

So, the priority should be toxics use reduction, a hazards-based approach before a risk-based one and then biomonitoring but this report's priorities look back to front in several places in terms of shaping a chemicals strategy .

Where there are important contributions central to toxics use reduction in the evidence for example with Michael Depledge's focus on the ''do no harm" approach and indoor and outdoor exposures and Michael Warhurst's on groups of chemicals, their ideas do not seem to be fully taken on board in the report. There is too much emphasis on biomonitoring and too little on policy and actions for achieving a reduction of toxics across the board in everyday life starting with the workplace and the makers of toxic substances. Researchers always want more research but we know enough to act on many concerns already. No specific mention is made of the need for sunsetting or just transition. No mention is made of environmental justice in terms of who is exposed most to everyday chemicals and where and this principle should be a major driver in effective TUR policy and practice. Reference to the exposome and cumulative health impact assessments are missing. With all toxics policies, the first line of action should be on industry cutting or removing toxic substances and the second line only on what people can do to reduce body burden – upstream and downstream approaches are missing in the report. However there are important points raised about the value of green chemistry discussed earlier in this paper because it could underpin parts of a TUR strategy .

The Scottish parliament recognised International Workers Memorial Day 2019 and noted that year's theme was "Dangerous substances, get them out of the workplace", which focuses on workers' exposure to carcinogens and contained a strong TUR strand. This came through a motion by SNP MSP Bill Kidd which gained cross-party support https://www.parliament.scot/parliamentarybusiness/28877.aspx?SearchType=Advance&ReferenceNumbers=S5M-16795. How, if at all, this will translate into action on carcinogens and a detailed strategy of toxics use reduction is unclear.

Actions by the Scottish Government on a low carbon economy and support for 'green jobs" also benefit toxics reduction by cutting air pollution and contributing to slowing global climate change. Extreme conditions due to climate change such as high temperatures increase the physiological effects on humans of some toxic substances directly and indirectly.

The Scottish Just Transition Commission – just transition having been advocated by trade unions for decades- should also contribute to toxics use reduction https://www.gov.scot/groups/just-transition-commission/. However, just transition is about more than simply supporting a low-carbon, inclusive economy but needs to address wider chemical and materials usage including inorganic chemicals. The Commission, currently with a two-year life span, is simply not a substitute for a properly worked out and supported general toxic use reduction strategy. Scottish Government departments covering Health, Trade , Environment, Transport (diesel), industry, planning, Energy etc should be central to a coherent and workable TUR structure and strategy.

Elsewhere, in the US, TURA aided by TURI continues to support workplaces to reduce toxic use and produce invaluable material that can often be used in a UK context. Hence safety reps and employers do not need to duplicate some of the specific chemical and sectoral research already done by TURI and available globally. For example, TURI has material on supply chains in electronics, wire and cable work, aerospace and military work that could be used in the UK to advance TUR immediately. It has case studies covering TUR in companies and sites and processes dealing with industrial cleaning , energy conservation, water conservation, waste reduction, VOC Reduction, process efficiency, metal finish/plating, coatings, printing, life sciences, microbreweries, food and beverage, car repair and many more topics. TURI's policy program assesses, develops, and evaluates initiatives that reduce toxins used in industry and communities. This is the type of organisation that is needed in the UK to act as a catalyst for TUR with benefits for all workers and employers, government and the public, the local community and the wider environment.

USEPA still continues to advocate green chemistry and toxics use reduction despite the hostility of President Trump to regulations including those on environmental and workplace hazards. Since 2012 and up to 2017, US facilities reported 2,226 green chemistry activities for 147 TRI chemicals and chemical categories. Green chemistry activities were reported most frequently for lead and lead compounds, methanol, toluene, copper and copper compounds, chromium and chromium compounds, and ammonia.

The sectors reporting the highest number of green chemistry activities were chemical manufacturing, fabricated metals, and computers and electronics. Chemical manufacturers used green chemistry to reduce or eliminate their use of TRI solvent and reagent chemicals, such as methanol, toluene, and ammonia. For example: A pharmaceutical manufacturing facility scaled up a process to increase product yields. The facility also modified a process for production qualification to reduce raw material needs and toluene waste generated per pound of product produced. Fabricated metal producers applied green chemistry techniques to reduce their usage of metals including lead, copper, and chromium. For example, a metal coating and engraving facility increased their use of chromium-free treatment chemicals. Computer and electronic products manufacturers reduced or eliminated their use of lead, such as lead found in solder. For example to meet European restrictions on lead in electronics, an electronics manufacturer redesigned its printed circuit assemblies to use lead-free solder.

Other ‘TUR’ models exist that rely on detailed assessments of substances not quick fixes unsupported by evidence. Demark introduced a toxics policy in 2017 based on targeting toxics and co-ordinating a strategic policy with a relatively well resourced and staffed organization. There were three key prongs to the policy: knowledge generation, information, and regulation. Information already existed from a range of sources on chemical products.

In addition a Centre for Substitution was created in the Danish system with specialist centres that could provide additional information on particular chemical hazards such as the National Allergy Research Centre. This knowledge generation was then fed into information for consumers along with information in the EU from REACH sources and classification, labelling and packaging data. This information is then used in assessing registrations, generating regulatory action and research, and even supporting international agreements. However, it appears to operate most effectively at a macro level and be policy-orientated and policy-driven.

In contrast the TURI approach, although influential at state level, provides practical advice, information, and solutions in workplaces immediately useful to workers and employers.

Moving the Toxics Use Reduction agenda forward

Opportunities exist at many different levels to introduce or adopt more effective TUR policies through governments, employers, trade unions and non-governmental organisations. Some sort of framework and legal structure is currently possible in Scotland, Northern Ireland, and Wales along the lines of the Massachusetts TURA. Such a measure would include registration of toxics substances with regard to large consumers of chemicals, preparation of TUR plans in large and small workplaces linked to training, technical support and advice from the TURI/TURA type body set up by the appropriate regulations. As the US experience has shown over almost a quarter of a century, this would be a cost-effective initiative beneficial to employers, workers, local communities, and the environment.

Scottish Hazards are calling for a Scottish Toxics Use Reduction Strategy in their Manifesto for the 2021 Scottish parliament Elections, 'A Manifesto for Fairer, Healthier, Safer and Greener Workplaces' (https://www.scottishhazards.org.uk/2021-manifesto/our-manifesto-for-fairer-healthier-safer-and-greener-workplaces/) . They advocate a Toxics Use Reduction Strategy underpinned by legislation and an institute modelled on the successful one established at University of Massachusetts, Lowell. It would support businesses, trade unions, local authorities, and communities to develop plans for reducing toxic use.

In taking this forward, there are crucial roles for government, enforcers, employers, and trade unions. Toxic use reduction should have a greater part to play in the 'greening the workplace agenda' to encourage youngers workers, many of whom have a greater awareness of environmental issues, to become active in trade unions. Trade unions can give an effective voice to workers on green issues and toxic use reduction plans could easily be developed and agreed between trade unions and employers. Scotland does not of course need TUR legislation or an institute for this to begin immediately. The health and safety structures should already exist in unionised workplaces and the reduction of toxins is clearly a health and safety issue by elimination or substitution: far more effective than provision of Personal Protective Equipment.

In Scotland, the initiative could and should complement other national and international activities for example the Scottish Fair Work Initiative (Fair Work should be toxics free work], the ILO Decent Work and Sustainable Development Agenda, and Just Transition Commission. Currently there are a range of initiatives in workplaces that would fit into a TUR model but they are often hidden, fragmented and may prove short-lived.

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