TRANSITIONING TO A CIRCULAR ECONOMY THROUGH CHEMICAL AND WASTE MANAGEMENT

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"If we are to build forward better from the COVID-19 pandemic towards a green economy, we must ramp-up global efforts to minimize the negative impact of chemicals and waste. Part of the solution lies in circular economy approaches. This will offer new opportunities to decarbonize our economies."

— Achim Steiner, UNDP Administrator, Berlin Forum on Chemicals and Sustainability, 2021.

Foreword

By Pradeep Kurukulasuriya

As a society, we are beginning to understand that we urgently need to reduce our ecological footprint by changing the way we produce and consume goods and resources. As the world starts to slowly recover from the devastating effects of the COVID-19 pandemic, we have an opportunity to transform our relationship with the environment. The pandemic has shown us that we need to learn to manage our shared natural resources more efficiently and reconsider how we produce and use chemicals and dispose of toxic waste and pollutants.

For too long, the world has employed a linear “take-make-dispose” development model. Our recovery efforts must therefore recognize the interdependencies between human and environmental health and aim to build resilience towards other equally devastating risks that are looming on the horizon, including biodiversity loss, widening inequality and climate change. Together we need to strive towards a circular future, one that combines economic development with safeguarding natural resources and the environment.

The presence of hazardous chemicals in products makes the transformation to circularity more challenging. The world needs to move to a circular economic model in which waste is either eliminated or substantially reduced. To protect ecosystems and biodiversity and restore nature, a green economy must be built into all recovery efforts. This will also bring other concrete benefits, such as new green jobs, reductions in inequalities and more resilient communities.

This publication describes UNDP’s interventions in chemicals and waste management and highlights priority supply chains in our efforts to achieve circularity. We hope that this new publication will inspire our partners to work together to achieve this vision of a world in which we use our planet’s resources more efficiently and produce and consume goods and resources and dispose of our waste more sustainably.

Pradeep Kurukulasuriya
Director – Nature, Climate and Energy
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Preface

By Xiaofang Zhou

Chemicals play an essential role in modern society. Thousands of chemicals are a part of both our daily lives and key economic and social sectors. Without chemicals, the well-being of humanity and society could not be sustained.

Unfortunately, many of these chemicals are also toxic, persist in the environment and can harm human health. Unsound management of chemicals and waste can damage the main natural resources that humans and wildlife depend on, including water, air and soil. They can also threaten food security. For example, WHO estimates that in 2019, at least 2 million people died due to the unsound management of chemicals and waste. The global impact of some of the most harmful chemicals—including persistent organic pollutants, ozone-depleting substances, lead, and mercury—are controlled by international environmental conventions such as the Montreal Protocol, the Stockholm Convention, the Basel Convention and the Minamata Convention.

UNDP recognizes the challenges to managing chemicals and waste and the intrinsic link between this and the broader vision of resource efficiency and the circular economy and is supporting governments and other stakeholders negotiate a new global framework on the sound management of chemicals and waste beyond 2020. This framework will emphasize the transition to a circular economy, one which eliminates waste and pollution and keeps products and materials in use for longer periods. The benefits of this transition are direct, such as through savings in the health care sector, and indirect, such as from the reduced environmental impacts of production and consumption.

UNDP will continue to actively promote the best available techniques, environmental practices, and green chemical chemistry principles to support developing countries in transitioning to a circular economy through chemical and waste management. Nonetheless, a circular economy cannot be achieved without key partners, including local and national governments, businesses and other private-sector partners, local communities, non-governmental organizations, civil society organizations and other UN and development agencies. Each of these stakeholders will play a critical role in achieving sustainable development through circular economy approaches.

Xiaofang Zhou
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Introduction

Chemicals are an essential part of modern society with positive impacts on employment, economic growth, health, environment and the climate. However, if they are not managed properly, they can adversely affect human health and the environment.

Nearly 140,000 industrial chemicals are marketed worldwide, meaning that hazardous chemicals, products containing them, their hazardous wastes and related pollutants continue to be released and disposed of in ever-larger quantities (UNEP, 2019a).

Since 2000, the global production capacity of the chemical industry has almost doubled, going from about 1.2 to 2.3 billion tons, with growth the most rapid in emerging and developing economies. This growth is driven by industrialization, urbanization and the rise of chemical-intensive sectors such as construction, agriculture and food processing, plastics, textiles, mining and electronics. This situation creates both opportunities and risks, given the hazards and dangers of many chemicals on the market and the lack of proper chemical and waste management frameworks in many countries (UNEP, 2019a).

Most products contain a large variety of chemicals. The use of chemicals of concern can create serious health and environmental impacts during the manufacturing, use and disposal of products. This use also makes it very difficult, if not impossible, to recycle products and their materials. To move from the current unsustainable, linear take-make-dispose production and consumption system to a circular economy, chemicals of concern must be phased out.

The sound management of chemicals and waste has important gender implications. Men, women and children are exposed to chemicals in different ways, and this exposure causes different biological responses. For example, in agricultural communities in developing countries, men may be at higher risk of direct exposure to chemical pesticides during their application, while women (and sometimes children) may be more likely to be indirectly exposed during planting and harvesting (UNDP, 2016a). Moreover, in many developing countries, men and women also have unequal access to decision-making, information, health, education or criminal justice systems and may face distinct constraints in their efforts to improve their environment and living conditions. Women, men and youth can also play varying roles in making decisions regarding pollution prevention, waste management, exposure to chemicals and building a safer environment for communities (UNDP, 2017).

The sound management of chemicals and waste is an important component of UNDP's efforts to achieve sustainable, inclusive, resilient human development and the Sustainable Development Goals (SDGs), while shifting to a circular economy that eliminates waste and pollution, maintains the use of products and materials for longer periods and regenerates natural systems.

1. UNDP's strategy, approach and interventions in chemicals and waste management

A gender-responsive approach to chemicals and waste management is essential to achieving the 2030 Sustainable Development Agenda. It is also an important component of UNDP's green recovery efforts. With thousands of industrial chemicals being marketed worldwide, and new chemicals becoming more complex, it is increasingly clear that we need a robust life-cycle management system for chemicals and waste and a systematic approach towards a circular economy.

A circular economy eliminates waste and pollution, keeps products and materials in use and regenerates natural systems. Circular economy approaches can also be leveraged to achieve the SDGs. Research has shown that the circular economy contributes to achieving the following SDGs: SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 8 (decent work and economic growth), SDG 12 (responsible consumption and production), SDG 13 (climate action) and SDG 15 (life on land), among others (Schröder, Anggraeni and Weber, 2018).

One of the key prerequisites for achieving circularity is phasing out the production and use of chemicals of concern in all economic sectors and ensuring that they are no longer used in the manufacturing of consumer products. This will ensure the re-use of materials and compliance with waste hierarchy principles. Nevertheless, the phasing out of chemicals of concern should go beyond replacing chemicals with safer alternatives and improving the management of chemical and waste stockpiles. Although such interventions are important in the short term, the focus should be redirected towards the redesign of products, production processes, services and consumption, so that none of these requires chemicals of concern, and pollution and waste are designed out entirely.

The supply chains that stand to benefit the most from greening efforts to achieve circularity include those for agriculture, textiles, e-products, plastics, construction, secondary metals and waste management since they are resource-intensive and use a large variety of chemicals of concern.

A shift to a circular economy in these sectors will also bring about the generation of greener, safer, fairer jobs, which will be performed by retrained and higher-skilled workers. It also provides opportunities for the creation of new jobs for vulnerable and marginalized groups (e.g. informal waste pickers, garment workers) through the re-use and recycling of waste, textiles and other materials. The transition would thus result in an upscaling of national workforces and ensure workers whose jobs were associated with high-emitting sectors are not left behind.

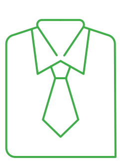
Furthermore, UNDP's gender equality strategy 2018–2021 emphasizes the mainstreaming of gender considerations into all its activities, including chemicals and waste management. It aims to make the views and concerns of both men and women an important component of the design, implementation, monitoring and evaluation of policies and programmes on chemicals and waste so that men and women benefit equally from these outcomes and gender equality is achieved within sound chemicals and waste management.

In aiming towards circularity, UNDP's interventions in the area of chemicals and waste management directly support the implementation of the Montreal Protocol; the Basel, Minamata, Rotterdam and Stockholm conventions as well as the Strategic Approach to International Chemicals Management (SAICM).

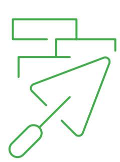
UNDP supports governments, businesses, local communities and non-governmental organizations (NGOs) through the following gender-response interventions:

- **Strengthen policy, regulatory and financial incentives** to phase out chemicals of concern, design out pollution and waste generation, increase the circular use of materials, ensure compliance with waste hierarchy principles and improve residual waste management. These interventions will also facilitate the mainstreaming of chemicals and waste management into national development planning and budgeting processes.
- **Support life cycle assessments and cost-benefit analyses** to make a comprehensive, long-term economic case for circularity and identify chemicals and waste-related interventions to support change.

Efforts will focus first on resource intense sectors such as

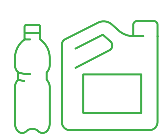


TEXTILES



CONSTRUCTION

ELECTRONICS



PLASTICS

- **Support the identification of "hotspot" sectors of unsustainable consumption and production and associated circular economy opportunities,** which form the basis for enhanced Nationally Determined Contribution (NDC) strategies.
- **Promote product innovation and redesign** by building the capacity of designers, manufacturers and producers to enable them to design circular products which i) have a long lifespan (by increasing durability, reusability, repairability, refurbishment, recyclability); ii) by phasing out chemicals of concern; iii) by introducing sustainable or alternative non-plastic packaging; iv) by changing existing business models from product ownership to services (e.g. chemical leasing, product rental).
- **Support process innovation and redesign** by building the capacity of manufacturers and producers to introduce cleaner production principles (e.g. best available technologies, reducing resource use, improving efficiency, designing out chemicals of concern, reducing pollution and waste generation).
- **Raise consumer awareness around sustainable purchasing practices** by increasing consumer demand for greener, safer, healthier services and products; support green public procurement initiatives; support systems for improved product labelling and supply chain transparency and share best practices, and so on.
- **Improve waste management and recycling systems by improving systems** for waste segregation, recycling (including reverse logistics) and waste collection and management systems to increase re-use and recycling rates, reduce waste leaks into the environment, and minimize the release of greenhouse gases (GHG) and persistent organic pollutants (POPs). This component is not intended to minimize the importance of waste reduction and redesign, which remain priority interventions.

2. Sustainable and green chemistry

Since 2000, the global production of the chemical industry has nearly doubled, going from about 1.2 to 2.3 billion tons, driven by industrialization, urbanization and the rise of chemical-intensive industry sectors such as construction, agriculture and food processing and electronics, mainly in emerging and developing economies (UNEP, 2019a).

Chemicals are an integral part of modern society and have positive impacts on employment, economic growth, health, environment and climate. However, if not managed properly, they can harm human health and the environment, particularly in development settings where adequate systems to manage chemicals and waste soundly are often absent or not fully operational.

It is becoming increasingly clear that to achieve the 2030 Sustainable Development Agenda, we need to access the benefits that chemicals, materials, products, design and production processes provide our society without harming human health and the environment. For this to occur, continuous innovations in the field of chemistry are vital.

Green and Sustainability Chemistry are concepts that aim for innovations in the design, manufacture and use of efficient, effective, safe and more environmentally benign chemical products and processes.

Green chemistry was described by Anatas and Warner in 1998 as “the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacturing and application of chemical products.” The authors proposed 12 principles of green chemistry, which included waste prevention, the design of safer chemicals and products, the design of less hazardous chemical syntheses, safer solvents and auxiliaries, reduce derivatives and design for degradation (Anastas and Warner, 1998: 29–56).

The OECD has defined sustainable chemistry as “a scientific concept that seeks to improve the efficiency with which natural resources are used to meet human needs for chemical products and services.”[1]

Innovations in green and sustainable chemistry could help advance sustainable product design, foster sustainable and resilient supply chains, reduce pollution, enhance resource efficiency, improve environmental health and safety and increase the re-use and recyclability of products to foster a circular economy (UNEP, 2020). Green and sustainable chemistry innovation has the potential to drive sustainability in important sectors of the economy, including (but not limited to) sectors such as energy, transport, agriculture and food, textile, tourism, construction, health and industry.

To support a shift from more traditional forms of chemistry and encourage governments, businesses and NGOs to invest in and advocate for green and sustainable chemistry, UNDP supports the following gender-responsive interventions at the national and global levels:

- **Support policy approaches and principles, regulatory action and standard-setting:** assist governments in developing and introducing policies and regulatory measures that stimulate chemical substitution and green and sustainable chemistry innovation (e.g. the identification of chemicals of concern and setting explicit limits on selected uses and substitution goals), in conjunction with products standards, hazard- and risk-based taxation, user charges, bans or restrictions, among others.
- **Promote research and education programmes:** guide governments in supporting research and development programmes on green and sustainable chemistry and the systematic introduction of this into teaching curricula, research, and support for start-ups (e.g. through incubators).
- **Support innovation through green and sustainable chemistry award programmes or competitions:** organize national-level award programmes or competitions that provide credible recognition of green and sustainable chemistry innovations.
- **Promote sustainable design approaches, design thinking and product design:** support manufacturers in introducing life cycle assessments (LCA) throughout the value chain and set innovation targets for the design and scale-up of safer, more sustainable products, production processes and services to improve resource efficiency (e.g. sustainable materials management), phase out the use of chemicals of concern and lower the impact of products and processes, including at the end of life.
- **Raise awareness and empower consumers:** engage with civil society organizations at the community level to build knowledge for consumers and help create consumer demand for green and sustainable chemicals and products.

[1] “Sustainable chemistry”, OECD, www.oecd.org/chemicalsafety/risk-management/sustainablechemistry.htm.

3. Sustainable production and consumption interventions that achieve circularity

The world's reliance on natural resources has continued to accelerate in the past two decades. Between 2010 and 2017, per-capita global domestic materials consumption rose by 7%, going from 10.8 to 11.7 tonnes, with increases in all regions except North America and Africa.[2]

According to the latest projections, the global population could grow to around 8.5 billion in 2030 and 9.7 billion in 2050. The equivalent of almost three planets would be required to provide the natural resources needed to sustain current lifestyles.[3]

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[2] Sustainable Development Goal 12: Ensure sustainable consumption and production patterns, www.un.org/sustainabledevelopment/sustainable-consumption-production.

[3] IDEM.

The well-being of humanity, the environment and the functioning of the economy ultimately depend on whether we manage the planet's finite natural resources responsibly. The 2030 Agenda for Sustainable Development recognizes that the most pressing issue for developing and transition economies is poverty alleviation. Sustainable consumption and production (SCP) can play a key role in achieving a circular economy and meeting human development needs while minimizing the negative impact of development on nature.

A key aspect of implementing the circular economy is making products reusable through lifespan extension activities along the value chain. For this to happen, manufacturers need to redesign their production strategies and processes as well as current business models to produce more durable, repairable, recyclable products. Moreover, raising consumer awareness and engagement is essential to transforming consumption patterns and encouraging behavioural change to increase demand for reused or reusable products and temporary access rather than ownership (e.g. through leasing, renting or sharing). Creating a circular economy implies a strong shift towards SCP patterns (UNEP, 2017).

The core of SCP is doing more and better with less. It is also about decoupling economic growth from environmental degradation while delivering socioeconomic gains, increasing resource efficiency and promoting sustainable lifestyles to ensure human well-being within the physical limits of the planet. Transitioning to SCP can also lead to employment generation and stimulate innovation while simultaneously protecting existing sources of income (UNEP, 2012).

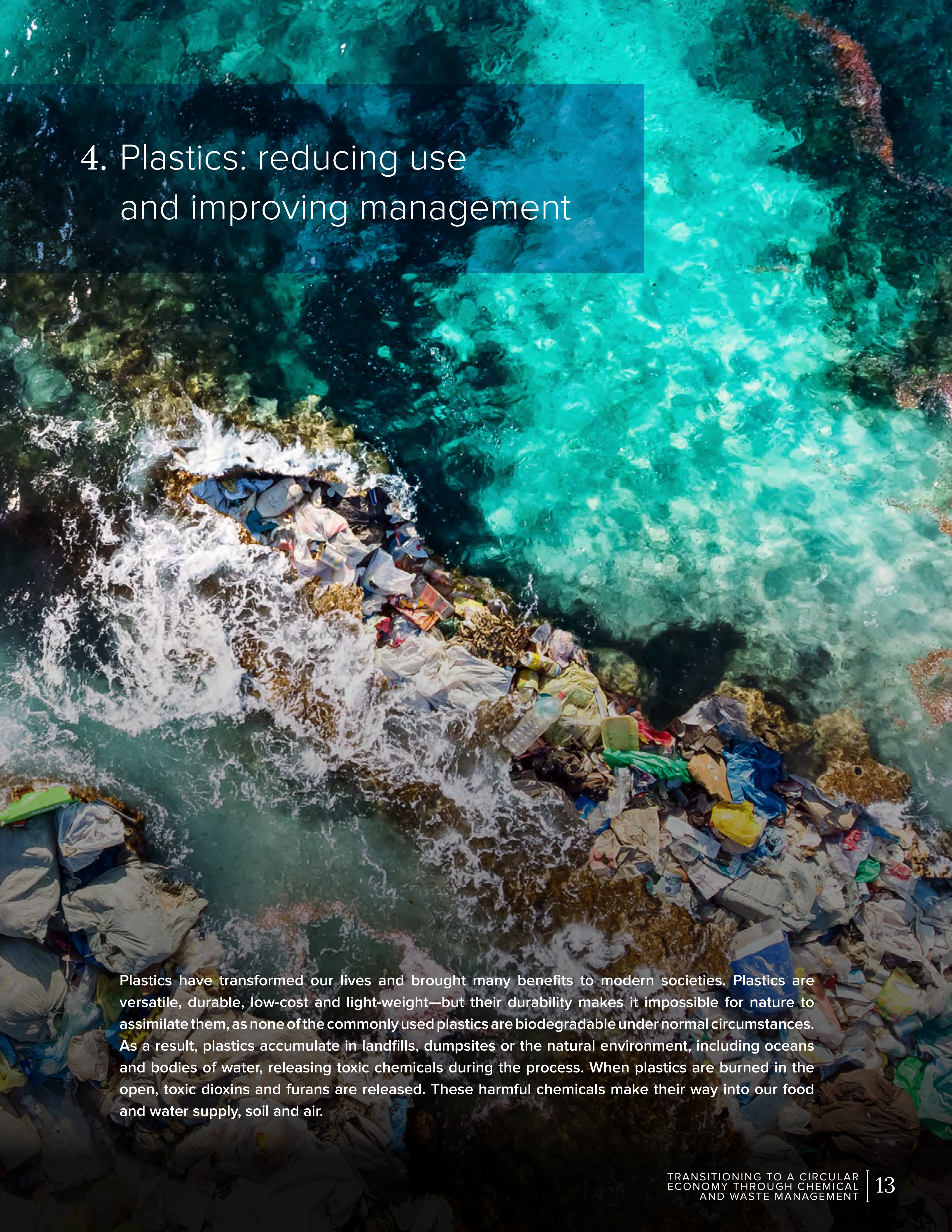
SCP solutions include (but are not limited to): supply chain management, resource efficiency along the value chain, cleaner production, life-cycle thinking, eco-innovation, eco-labelling and waste management and re-use.

UNDP supports governments, businesses and NGOs through the following gender-responsive interventions in the implementation of SCP solutions at the national and global levels:

- **Support policy approaches and principles, regulatory action and standard-setting**: assist governments in developing and introducing policies and regulatory measures that encourage companies to design production processes and produce goods and services that require lower energy and natural resource inputs throughout the value chain; support sustainable lifestyles (mobility, housing, food and leisure); remove technological and institutional barriers to innovation in resource productivity; create favourable conditions for investment in technology; introduce green labels or standards to make it easier for consumers to make sustainable choices; and use financial incentives (e.g., taxation and subsidy reduction) to reflect resource use in the pricing of products and services.

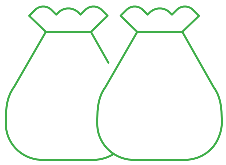
- **Promote sustainable design approaches (Design for Sustainability—D4S):** support designers and producers in applying LCA to analyse impacts throughout the value chain; harness innovation for the design and scale-up of safer, more sustainable products and production processes (using best available technologies and more efficient, cleaner production processes); and provide services to improve resource efficiency (energy, water, materials) in production and product reusability or recyclability, including through sustainable materials management (recycled or renewable content) and by phasing out chemicals of concern to lower the life cycle impact of products and processes.

- **Raise awareness and empower consumers:** support education and awareness-raising among consumers to create demand for sustainable products and promote acceptance of new business models (e.g. services, leasing, renting, sharing); implement conditions or options that make it easy and attractive for consumers to choose sustainable options (e.g. discounts and refunds to incentivize sustainable purchases, easy-to-understand green labels and standards); and support sustainable public procurement to leverage purchasing power.



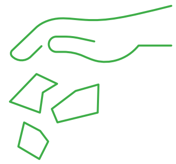
4. Plastics: reducing use and improving management

Plastics have transformed our lives and brought many benefits to modern societies. Plastics are versatile, durable, low-cost and light-weight—but their durability makes it impossible for nature to assimilate them, as none of the commonly used plastics are biodegradable under normal circumstances. As a result, plastics accumulate in landfills, dumpsites or the natural environment, including oceans and bodies of water, releasing toxic chemicals during the process. When plastics are burned in the open, toxic dioxins and furans are released. These harmful chemicals make their way into our food and water supply, soil and air.



75%

OF PLASTIC CUMULATIVELY PRODUCED SINCE 1950 IS WASTE



1/3

OF PLASTIC WASTE IS MISMANAGED AND AT RISK OF POLLUTING THE ENVIRONMENT

>150

MILLION METRIC TONS OF PLASTIC ARE ESTIMATED TO BE IN THE OCEAN

Source: WWF, the Ellen MacArthur Foundation and BCG, 2020. The business case for a UN treaty on plastic pollution.

Since the 1950s, global plastic production has grown by an average of 9% per year and has increased significantly in the last two decades: half of all plastics ever manufactured were made in the last 15 years. Estimates indicate that approximately 8.3 billion tonnes of virgin plastics have been produced to date, which has resulted in 6.3 billion tonnes of plastic waste as of 2015. Of this waste, only 9% has been recycled and 12% incinerated, while 79% has accumulated in landfills or the natural environment. Despite increased global awareness of this issue, it has been predicted that the production of plastic will double again over the next two decades unless trends are reversed (Ellen MacArthur Foundation, 2017b).

The generation of plastic waste leads to dumping in landfills, incineration or, in settings where proper waste management systems are lacking, open dumping, open burning and plastic leakage into the environment and bodies of water.

Waste dumping and the open burning of plastic generate POP emissions, contribute to climate change and lead to impacts on health, such as respiratory illnesses and the spread of infectious and vector-borne diseases (e.g. malaria, dengue). Plastic debris harms marine ecosystems and species externally, mainly by entanglement, while the ingestion of plastics has health implications for many species and those that subsequently consume them. Plastic particles accumulate in marine species, as do toxic contaminants such as dioxins, polychlorinated biphenyls (PCBs) and persistent bioaccumulative toxic substances (PBTs) that are absorbed from plastic marine litter.

The inadequate management of the plastic value chain also has huge economic costs. Global estimates indicate that most plastic packaging is used only once; over 95% of its value, estimated at US$ 80–US$ 120 billion annually, is lost to the economy after its initial use (Jambeck et al., 2015). Furthermore, plastic packaging—which is particularly prone to leakage into the environment—destroys ecosystems, which impacts important economic sectors upon which local communities heavily depend, such as tourism and fisheries.

Addressing the global plastic pollution crisis requires a concerted global approach. The UN Environment Assembly resolution on single-use plastics commits countries to significantly reduce such products by 2030. Along with the adoption of two important decisions to address plastic waste at the Conference of the Parties to the Basel Convention in 2019, they show countries' commitment to pursuing international cooperation and coordination to address the plastic pollution crisis. A new legally binding global agreement on plastic pollution (the Ocean Day Plastic Pollution Declaration[4]) has been called for by the Alliance of Small Island States, which to date has been signed by 79 UN Member States. A UN treaty of this sort could help drive the required change at scale and be instrumental in addressing

[4] Oceans Day Plastic Pollution Declaration, http://plasticdeclaration.aosis.org

the main barriers to achieving a circular economy for plastics, which include fragmentation and lack of scale in voluntary initiatives, misalignment of regulations, lack of data, and structural capability gaps (WWF, the Ellen MacArthur Foundation and BCG, 2020).

Furthermore, local and national governments, businesses, NGOs and consumers have to continue to act now and strive to eliminate unnecessary and problematic plastic, shift to re-use models, dramatically increase recycling levels and stop the leakage of plastics into the environment. A key aspect of pursuing these avenues is assessing current product life cycles and their impact and comparing them with the potential environmental and social benefits, impacts and costs of the proposed changes to determine whether these are indeed the most beneficial option.

UNDP supports governments, businesses, local communities and NGOs in the above-mentioned efforts to tackle plastic pollution and promote circular economy principles through the following gender-responsive interventions:

- **Provide policy, regulatory and institutional assistance** to countries to minimize the impacts of plastic pollution, including banning single-use plastics.
- **Strengthen policy and fiscal incentives:** support the design of bans and restrictions; economic instruments (taxes, subsidies); product standards, certification and labelling requirements; extended producer responsibility (EPR) mechanisms; deposit return schemes and waste management-related regulations.
- **Support plastic life cycle and cost-benefit analyses:** identify interventions that support the shift to a circular economy, while considering all life-cycle stages to assess if alternatives are actually greener and/or more sustainable than current practices (to avoid shifting the burden).
- **Phase out harmful chemicals (e.g. POP flame retardants) from plastic production:** support plastic and product manufacturers in increasing recyclability and identifying and introducing alternatives to harmful chemical additives using green chemistry solutions.
- **Promote product innovation and redesign:** build the capacity of manufacturers in the (re)design of eco-friendly products, sustainable or alternative non-plastic packaging, product recyclability and the phase-out of harmful chemicals used in products.
- **Improve waste management and recycling systems:** improve waste segregation, recycling and waste collection and management systems to increase plastic re-use and recycling rates, reduce plastics leaks into the environment, and minimize GHG and POP emissions.
- **Raise awareness and empower producers and consumers:** increase consumer demand for reducing plastic pollution, improve the labelling of plastics to support recycling and share lessons learned, best practices, best available technologies (BATs) or best environmental practices (BEPs) and case studies.

5. Circularity in the electronics sector

Electrical and electronic products (e-products)[5]—including household items such as kitchen appliances, computers, cell phones and so on—are increasingly integrated into transportation, construction, energy supply, health and security systems, making them hugely important for modern society (Parajuly, 2019).

Over time, e-products have become lighter, smaller and more sophisticated and complex. To make this possible, a wide array of materials is used in their design, including metals, alloys and plastics. At the same time, the lifespan of e-products keeps getting shorter because of technological advances, software compatibility issues, their inability to be repaired or upgraded easily, planned obsolescence by manufacturers or as a result of marketing campaigns enticing consumers to desire the latest models so they do not feel "left behind." As a result, globally approximately 50 million tonnes of e-waste are generated each year (Baldé et al., 2017).

[5] Defined as household or business items that contain circuitry, or electrical components with power or battery supply.

Due to current short lifespans, the environmental impact of e-products has shifted from the use phase (which consumes higher energy over a long period) to the production and material extraction phase. The mining of critical metals (gold, palladium and cobalt) and product manufacturing uses vast amounts of land, water, energy and toxic chemicals which are linked to socioeconomic issues such as dangerous working conditions, human rights issues and conflict (Nkulu et al., 2018).

Hazardous chemicals used in the manufacturing process of e-products (fluorinated greenhouse gases (GHGs), flame retardants, mercury and lead, among others) impact workers' health and lead to a trail of toxicity. In particular, the rudimentary e-waste recycling practices used in informal settings lead to the release of these chemicals including dioxins and furans, which in turn impact human health and cause substantial air, water and soil pollution. At the same time, such recycling practices result in the loss of valuable resources, while less valuable resources are not taken care of properly.

Although e-waste management systems are more advanced in developed countries and can recover base metals such as copper, steel and aluminium efficiently, the recycling rates for critical resources, including rare earth elements, are not very high (Parajuly, 2017). Just 20% of e-waste is documented to be collected and recycled under appropriate conditions, while the remaining 80% is either traded, treated in substandard conditions, discarded or dumped along with municipal waste (Baldé et al., 2017). This means that much of the energy, resources and value embodied in e-products is lost.

The current linear take-make-dispose system through which e-products are manufactured, used and disposed of requires substantial changes for current processes to become sustainable. However, significant opportunities exist in the transition away from the current linear system to a system based on the principles of a circular economy, in which products, components and materials are kept at their maximum utility for as long as possible by either the original users or by flowing to new users who find new value and utility in them. Eventually, when e-products reach their initial end-of-use phase, they are expected to be handled by specialists, who will professionally refurbish products, re-use or remanufacture the valuable components inside, and separate and recycle materials.

UNDP supports governments, businesses, communities and NGOs in their efforts to reduce the environmental impacts of e-products and promote circular economy principles through the following gender-responsive interventions:

- **Provide policy, regulatory and institutional assistance:** support the design of bans or restrictions on the use of hazardous or harmful substances in the manufacturing of e-products; electronic waste management-related regulations, including targets for collection and recycling and guidelines on the handling, processing and disposal of various e-waste streams; product standards, certification and labelling requirements; EPR mechanisms for e-products; economic instruments (taxes, subsidies, etc.) to achieve circularity (phase out harmful chemicals and encourage design for durability, re-use and recyclability).
- **Support e-product life cycle and cost-benefit analyses** to make the economic case for a circular e-product economy and identify interventions to support the transition to a circular economy.

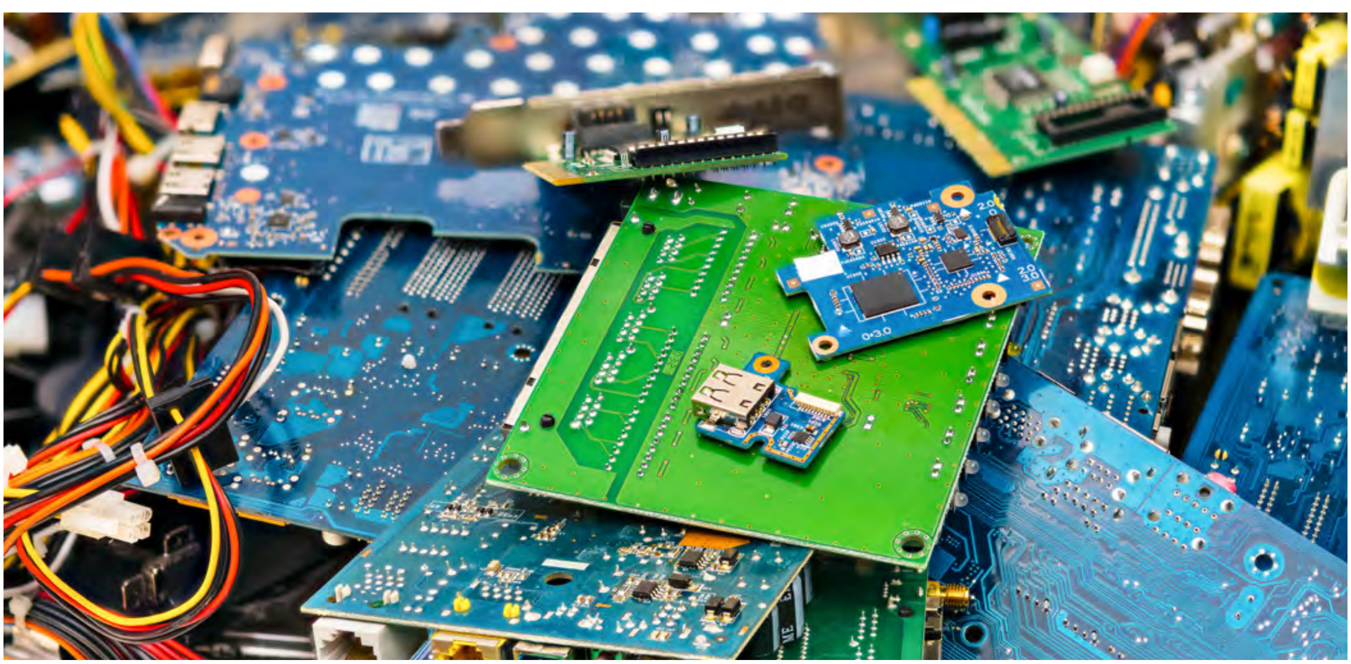
- **Phase out harmful chemicals (e.g. POP flame retardants) from e-product manufacturing** by supporting product manufacturers in identifying and introducing alternatives to harmful chemicals using green and sustainable chemistry solutions, which will allow materials to be kept in use for longer and minimize impacts on human health and the environment.

- **Support circular principles in design processes by building the capacity of manufacturers and producers to improve product design,** with a focus on e-product lifetime extension through improved durability, adaptability, repairability, ease of maintenance, etc.; introduction of recycling-friendly materials and components and sustainable non-plastic packaging; phase-out of harmful chemicals; improved product recyclability and ease of dismantling at end of life to facilitate the recovery of resources and reusable components.

- **Improve collection, waste management and recycling systems and processes:** support companies, governments and municipalities in optimizing e-waste collection systems (e.g. reverse logistics, online to offline solutions and community-based collection) to achieve greater product circularity and resource recovery (e.g. by introducing financial incentives and making it easier for users to return their products to the manufacturer); improve waste segregation, recycling and waste collection and management systems for e-products; introduce BEP and BAT end-of-life resource recovery technologies (increased automation) for disassembly, refurbishment and recycling.

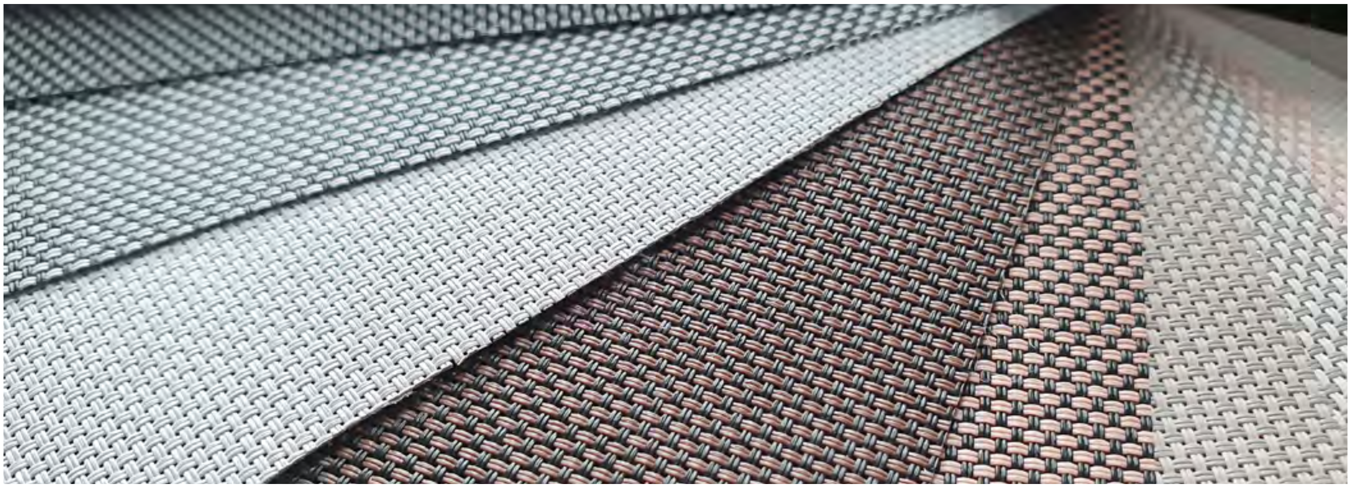
- **Raise awareness and empower producers and consumers:** create consumer awareness and acceptance of new business models (leasing, sharing) in which the manufacturer retains ownership and responsibility for the product, leading to higher rates of recovery and re-use in products (e.g. modems) and raise awareness around the environmental footprints of e-products and the e-waste problem.

GLOBALLY, EACH PERSON GENERATED MORE THAN 6 KG OF E-WASTE ON AVERAGE IN 2016 (BALDÉ ET AL., 2017).



6. Circularity in the textile sector

The textile industry is extremely important globally, providing employment for hundreds of millions of people around the world, especially women, and creating significant economic and export opportunities for developing countries. Textile products (including apparel, industrial textiles and household textiles) are essential to human welfare and play an important role in how people express their cultural and individual identities.



The world is producing and consuming more textiles than ever before. The current textile system operates in an almost completely linear way—another example of a "make—take—dispose" system. More than 500 billion is lost every year due to the underutilization of clothing and the lack of recycling. In this linear system, less than 1% of textiles are recycled back into clothing, with another 12% going into cascaded recycling, where they are used in products such as cleaning cloths, insulation material and mattress stuffing. This linear system leads to substantial and ever-expanding pressure on resources and causes high levels of pollution. Should growth continue as is currently forecast, some 160 million tons will be produced in 2050—more than three times today's amount (Ellen MacArthur Foundation, 2017a).

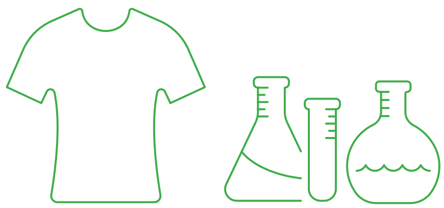
The environmental footprint of the textile industry is enormous—it relies on 98 million tons of non-renewable resources per year. Producing plastic-based fibres (polyester, nylon, acrylic, etc.), which represents 60% of clothing-sector production, uses an estimated 342 million barrels of oil annually. The production of cotton, accounting for 24% of the total, is estimated to use 200,000 tons of pesticides and 8 million tons of fertilizers annually. The climate impact of the global apparel industry is also huge: it emits over 3.3 billion tonnes of GHGs across the value chain per year. In addition, around half a million tons of plastic microfibres are estimated to be released into the ocean from the washing of textiles—this is equivalent to more than 50 billion plastic bottles (Ellen MacArthur Foundation, 2017a).

Textile production is also a chemical-intensive sector, as it uses and releases hazardous chemicals that have significant impacts on human health and the environment all along the supply chain (UNEP, 2019a). On average, producing 1 kg of textiles requires 0.58 kg of chemicals (Ellen MacArthur Foundation, 2017a). A study by the Swedish Chemicals Agency identified approximately 3,500 substances being used in textile production (Posner and Jönsson, 2014). Of the 2,450[6] substances analysed, 750 were found to be hazardous to human health, 299 of which were considered to pose high potential risks to human health (substances that were added intentionally and are expected to remain in the finished articles at relatively high concentrations).

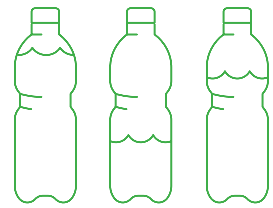
Hazardous chemicals used in textiles, such as per- and polyfluoroalkyl substances (PFASs), affect the health of textile workers, waste workers, farmers and can also jeopardize users, as many remain present in finished articles. Hazardous chemicals from the textile industry leak into the environment through agricultural run-off and the discharge of industrial wastewater, the washing of textiles and the final disposal of them through landfills and incineration, which pollutes the air, water and food sources and leads to the accumulation of toxic substances in humans.

Unfortunately, leveraging existing solutions and best practices will not be enough to achieve a sustainable textile industry. Innovative solutions and new business models are required to shift the take-make-dispose textile system to a circular textile economy, in which

[6] Around 1,000 substances were not analysed due to confidentiality reasons.



THE PRODUCTION OF 1 KILOGRAM OF COTTON GARMENTS USES UP TO 3 KILOGRAMS OF CHEMICALS.



THE EQUIVALENT OF MORE THAN 3 TRILLION PLASTIC BOTTLES IS NEEDED TO PRODUCE PLASTIC-BASED CLOTHES EVERY YEAR.

Source: Ellen MacArthur Foundation, A new textiles economy: Redesigning fashion's future, (2017, http://www.ellenmacarthurfoundation.org/publications).

materials are not lost after use but remain in the economy, circulating as long as possible at the highest value. A circular textile economy will decouple economic activity from the consumption of finite resources, design waste out of the system, regenerate natural systems and support the well-being of all.

To enable a shift to a circular textile economy, UNDP supports the following gender-responsive interventions at the national and global levels:

- **Support policy approaches, regulatory action and standard-setting:** provide targets and strategies for substances of concern, microfibres, durability and recyclability; stimulate chemical substitution (through subsidies, taxes) in conjunction with product standards and eco-design requirements; introduce bans or restrictions on specific substances (or groups of substances with similar properties) and/or the import of products containing them; introduce EPR requirements, recycling and recycled content targets and taxes on landfilling; require reporting and transparency on chemical use; enforce environmental protection laws and protect workers' rights.

- **Promote innovation in textile production processes (through green and sustainable chemistry):** support collaboration between innovators, fibre producers, chemical suppliers, textile mills and brands to develop and demonstrate alternative processes, materials and/or chemicals with the desired properties that avoid using substances of concern.

- **Promote cleaner production processes:** disseminate knowledge on sustainable alternatives, cleaner production (process efficiency, closed-loop processes, resource efficiency and renewable energy), and build the skills and capacity needed to implement sustainable changes.

- **Support transparency and traceability:** support efforts and the implementation of standards that lead to widespread transparency for textiles, their contents and traceability to improve the social and environmental sustainability of textile products, for example in collaboration with global initiatives that seek to increase sustainable sourcing and supply chain management.

- **Raise awareness and empower consumers:** support education and awareness-raising among consumers to better understand the environmental, social and economic impacts of the current textile industry and create demand for sustainable textiles and products and put in place conditions or options that make it easy and attractive for consumers to choose sustainable options (e.g. discounts or refunds to incentivize sustainable purchases and the use of new business models).

Increasing the number of times clothes are worn could be the most powerful way to capture value, reduce pressure on resources and decrease negative impacts. For example, if the number of times a garment is worn were doubled on average, GHG emissions would be 44% lower (Ellen MacArthur Foundation, 2017a).

7. Sustainable agriculture

The use of pesticides has changed agriculture dramatically. Pesticides have significantly increased yields and improved quality in most cultivated crops. But the widespread use of pesticides has also caused harm to human health and the environment, including impacts on water, climate change, and biodiversity[7]. The agriculture sector applies 4.6 million tonnes of pesticides worldwide (Mateo-Sagasta, Zadeh and Turral, 2018) and pesticide production is a global industry worth more than 35 billion per year.

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7 "The Lynchpin of Industrial Ag", Pesticide Action Network, http://www.panna.org/pesticides-big-picture/lynchpin-industrial-ag

Many of the pesticides used by farmers include persistent organic pollutants (POPs) listed under the Stockholm Convention such as endosulfan, dieldrin, DDT and lindane or contain highly hazardous pesticides (HHPs). Although these highly toxic pesticides are either banned or restricted worldwide, some countries continue to produce or use them (Mateo-Sagasta, Zadeh and Turral, 2018). Unfortunately, overuse of these agrochemicals is very common during the farming of a variety of crops, such as cotton, vegetables and rice due to a lack of knowledge on chemicals and appropriate training and risk reduction measures (e.g. use of personal protection equipment, etc.) (FAO, 2016). As farmers experience declining efficacy, they tend to use chemicals at higher concentrations and at greater frequencies, which not only increases potential hazards but can also lead to the development of pest resistance. In the US alone, pesticide resistance was estimated to cost over 10 billion per year in agricultural losses (Gould, Brown and Kuzma, 2018). Finally, the quality of pesticides is sometimes poor because some countries do not regulate them or implement pesticide residue standards effectively (Mateo-Sagasta, Zadeh and Turral, 2018). These problems are compounded by the fact that investment in introducing new chemicals to the market remains high, even though some harmful agrochemicals have been discontinued and others are slowly being phased out (UNEP, 2019a).

Agrochemical waste, including obsolete pesticide stocks and solid waste resulting from production itself, is another pending problem that needs to be addressed in many countries. Large quantities of obsolete stocks of agrochemicals are reported to be scattered around the world, particularly in low- and middle-income countries, leading to potential use and waste management challenges. They are often stored in very poor conditions, that allow leakages and affect soil and ground water quality. The agriculture sector is also a source of plastic waste; estimates place the global demand for agricultural plastics at around 8 million–10 million tonnes (Cassou, 2018).

The current COVID-19 pandemic has focused attention on the issue of food production, security and trade. The resulting economic crisis is limiting food availability, due to disruptions to local and global supply chains, but also to loss in revenues that affect mainly the poor and vulnerable, worsening food security, increasing poverty and threatening the progress that has been made towards achieving the SDGs to date.

A balance needs to be found between good yields and quality while ensuring food security, and environmentally friendly crop production. Although some HHPs remain important to agriculture, in most cases there are feasible alternatives that pose less risk. These may include less hazardous conventional pesticides, biopesticides and non-chemical management approaches such as agroecology and integrated pest management (IPM). IPM is a proven technology and an efficient means of responding to consumer demands of good quality products while at the same time addressing environmental, food safety and security, health and socio-economic issues. IPM is a broad, rational, ecological approach to pest and disease management that combines biological, physical and chemical tools to ensure the protection of the environment while maintaining profitability (Mateo-Sagasta, Zadeh and Turral, 2018). IPM involves making use of all possible resources—not just chemical control—to reduce and prevent the incidence and effects of a given disease or pest[8]. These control options contribute to reducing pests and lead to far less use of chemical pesticides[9].

The mitigation of risks associated with the use of pesticides must also include legal frameworks on their registration, labelling, use, management and trade, as well as proper storage, handling and disposal (which requires training, awareness-raising and capacity-building). Other tools that are essential to achieving the transition include financial tools and instruments to defund the overuse of HHPs and fund the clean-up of stockpiles and contaminated sites. Finally, key stakeholders need to be involved including regulatory authorities, agricultural extension services, public health advisory services

[8] "Integrated pest management", Pesticide Action Network UK, www.pan-uk.org/integrated-pest-management/.

[9] "Conservation Practices that Save: Integrated Pest Management", USDA Natural Resources Conservation Service, www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/energy/conservation/?cid=nrcs143_023640

and poison control centres, farmers' organizations and networks, trade unions and agricultural producers organizations, the private sector (including pesticide manufacturers, importers, distributors and users), civil society, academics, scientists and researchers.

UNDP supports governments, businesses, farming communities and NGOs in their efforts to promote sustainable agricultural practices and manage agrochemicals waste through the following gender-responsive interventions:

- **Strengthen regulatory, policy and investment frameworks:** support governments in developing and introducing policy and investment frameworks that incentivize reductions in the use of harmful agrochemicals and regulatory frameworks that enhance sound management of agricultural chemicals, including legislation to eliminate perverse incentives (e.g. tax exemptions, etc.).
- **Promote sustainable agricultural practices and alternatives:** support pilot activities demonstrating how farmers can increase their income and reduce their use of harmful agrochemicals in priority crops for export and domestic consumption through farming practices that encourage the use of agroecology and IPM approaches, including less toxic options, non-chemical alternatives and cultural procedures.
- **Strengthen capacity in agrochemicals waste management and disposal methods:** provide technical support for governments on removing existing stockpiles of existing POPs or HHPs and build their capacity to sustainably manage or recycle plastic wastes associated with harmful agrochemicals.
- **Raise awareness among key stakeholders:** build the capacity of national extension units, technical advisers, farmers and other key stakeholders involved in crop production to promote sustainable agriculture practices and alternatives to agrochemical inputs.

8. Sustainable mining

Artisanal and small-scale gold mining (ASGM)[10] is an important source of income for millions of people in low and middle-income countries. More than 15 million people (WHO, 2013) worldwide engage in ASGM, of which around 30% are women (Hobson, 2019). Another 100 million people are estimated to be indirectly dependent on ASGM for their livelihoods[11].

[10] Defined as the extraction of gold using rudimentary processing methods.

[11] "The Minamata Convention on Mercury and Artisanal and Small Scale Gold Mining", US Department of State, https://2009-2017.state.gov/e/oes/eqt/chemicalpollution/mercury/245187.htm.

Mercury is often used in ASGM to separate gold from ore by forming an amalgam. The amalgam is subsequently heated, evaporating the mercury from the mixture and leaving the gold. This process is used because mercury is often less expensive than most alternative methods, more accessible, and simpler to use than alternative methods, and thus allows miners to produce gold quickly[12].

However, the environmental and health impacts of mercury use in ASGM are significant. ASGM is the largest global source of anthropogenic mercury releases into the environment accounting for about 38% of the total from sites in over 70 countries (UNEP, 2019b). Mercury is released into the environment during mining and/or processing activities, polluting air, land and soil. The uncontrolled loss of mercury, especially from worst practices like whole ore amalgamation, can travel long distances, contributing to global mercury pollution and contaminating the world's ecosystems and fisheries. The consumption of fish contaminated by mercury exposes people to methyl mercury, an organic form of mercury that bioaccumulates along the food chain. Children are particularly susceptible to the negative developmental effects of this mercury exposure.

Addressing the use of mercury in ASGM has been difficult because much of the ASGM sector is either illegal or informal, and thus lies outside the scope of government regulations. This makes it difficult to organize and educate miners and mining communities on the risks of using mercury. It also makes it challenging to invest in technologies and solutions to reduce and eliminate mercury use. Finally, informality also contributes to the sector's vulnerability to corruption, leaving miners and their communities without legal protection[13].

The ASGM sector is also undercapitalized, particularly in comparison to the large-scale gold mining (LSGM) sector (Macdonald, K.F. et al., 2020). Miners are unable to afford the high initial investments that are needed to switch from using mercury, which is relatively cheap, to low or non-mercury alternatives. In addition to a lack of access to finance, miners' awareness of mercury alternatives is also very low. The barriers to increasing access to finance in the ASGM sector include a lack of awareness of the sector and how to accurately price risk by local financial institutions, lack of data in the sector, lack of formal business skills among miners, lack of clarity on the finance required, and the remoteness of the operations which create market access challenges.

Solutions that reduce the use and release of mercury in ASGM and eliminate the need for mercury already exist but have not been deployed on a large scale yet. These technologies include better preconcentration of gold before amalgamation, decreasing the amount of mercury needed; capture, re-activation, and re-use of mercury; and mercury-free gravity separation technologies. Estimates indicate that if all of these techniques were applied together, they could reduce the global use of mercury in ASGM as much as 90%[14].

Finally, the COVID-19 outbreak has created additional challenges for the ASGM communities. They are highly vulnerable to the coronavirus due to limited access to health care facilities, potential loss of income and livelihood-related risk factors such as underlying occupational health risks and a lack of infrastructure. In addition, food security in many mining communities is an additional concern due to lockdowns, disruptions to gold supply chains, and unstable incomes[15].

[12] "The Minamata Convention on Mercury and Artisanal and Small Scale Gold Mining", US Department of State, https://2009-2017.state.gov/e/oes/eqt/chemicalpollution/mercury/245187.htm

[13] "Formalization: Integrating miners into the formal economy and regulatory system for the benefit of all", Planet GOLD, https://www.planetgold.org/formalization

[14] "The Minamata Convention on Mercury and Artisanal and Small Scale Gold Mining", US Department of State, https://2009-2017.state.gov/e/oes/eqt/chemicalpollution/mercury/245187.htm

[15] "AGC Covid portal", Artisanal Gold, https://www.artisanalgold.org/agc-covid-19-portal

UNDP supports governments, financial institutions and other private sector partners, mining communities and NGOs to promote sustainable mining practices in ASGM through the following gender-responsive interventions:

- **Enhance formalization in the ASGM sector:** support governments in achieving increased formalization in the ASGM sector through integrated, multisectoral approaches that identify opportunities and constraints for the coexistence of ASGM and LSGM, pilot commodity-specific jurisdictional approaches and build the capacity of government institutions to assess, plan and implement sustainable and mercury-free interventions in ASGM zones in target jurisdictions.
- **Promote financial inclusion and responsible supply chains:** support miners to access finance from formal financial institutions, build capacity for financial institutions to procure equipment and invest in miners' business skills, and create opportunities for responsible, transparent supply chains.
- **Enhance uptake of mercury-free technologies:** provide technical support for government institutions to promote reduced mercury use and invest in mining organizations, and support the establishment of assay labs, processing plants and training centres to promote resource-efficient gold mining.
- **Raise awareness among key stakeholders:** increase knowledge of low- and non-mercury alternatives among mining communities and build consumers' public awareness of environmentally friendly and sustainable gold purchasing options.

9. Reducing pollutant releases from the secondary metal industry

The reuse and recycling of metals is a key aspect of the transition to a circular economy. Metals are highly recyclable, and recycled metals (secondary metals) are an excellent substitute for metal produced from virgin mineral resources (primary metals). Furthermore, primary metal production generates a broader range of polluting by-products than secondary metal production. For example, producing metal from scrap generates considerably less GHG emissions than doing so from mineral ores (see Figure 2) (McCarthy and Börkey, 2018). This is significant given that mining and metal production consumed around 7.5% of the global energy supply in 2014[16].

[16] IEA (2016), "Sankey Diagram", www.iea.org/Sankey

FIGURE 1

Final metal production by process

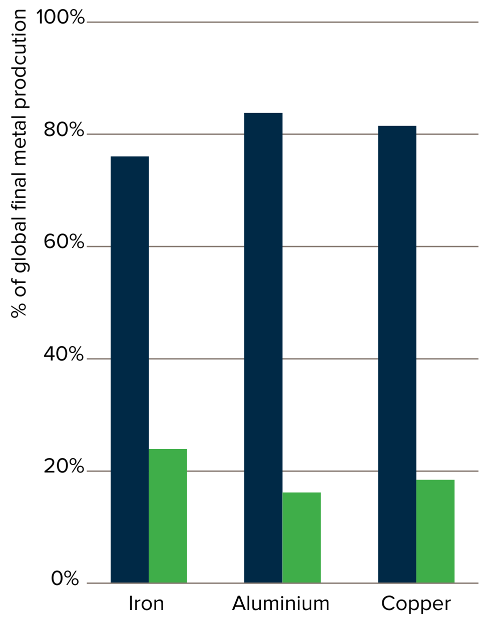
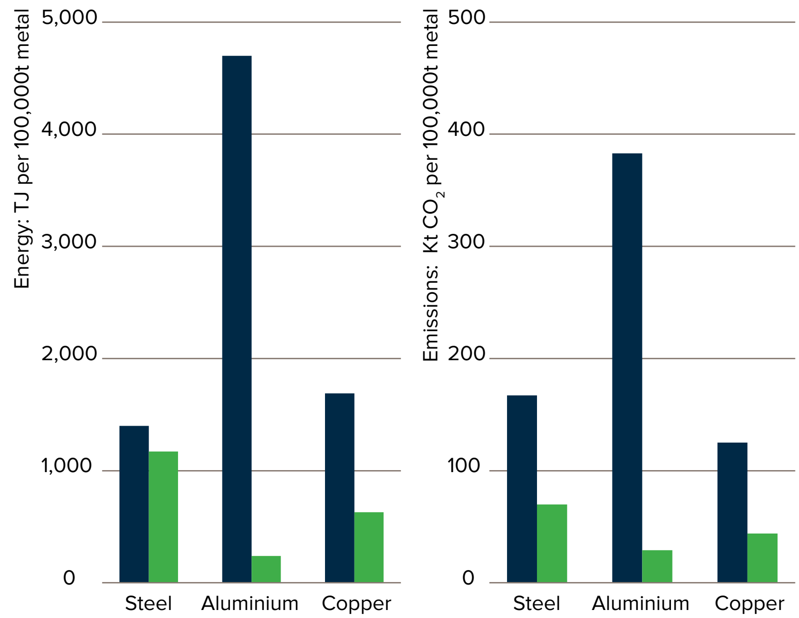


FIGURE 2

Energy input and emission by process



Source: OECD Government Support for Primary and Secondary Metal Production.
www.oecd.org/environment/waste/Policy-Highlights-Government-Support-for-Metal-Production.pdf

The ongoing extraction of metals from virgin mineral resources has resulted in a steadily growing stock of metals concentrated in urban areas. These metals are contained in buildings, infrastructure and machinery and also in consumer goods such as electronics. The flow of scrap metal emerging from in-use stocks is the main source of feedstock for secondary metal production (McCarthy and Börkey, 2018), a process sometimes referred to as "urban mining."

Today, around 20% of the most widely recycled metals (steel, aluminium and copper) are produced using the secondary process (i.e. production from metal scrap), but this share is less than 1% for many other important metals, such as rare elements (see Figure 2) (McCarthy and Börkey, 2018). In the latter case, it is the marginal economic viability of metal recovery and processing that limits secondary production.

If countries aim to achieve a circular economy and increase resource efficiency, considerably more metals will have to be processed by the secondary metal industry. This would require an approach that is both more competitive and cleaner than virgin extraction.

Although the secondary metal industry pollutes less than the larger (for now) primary industry, it is still very energy-intensive and is a source of a wide range of worrying pollutants. These mostly affect air and water as a result of contaminated input materials such as plastic coating, paints, used batteries (for lead production), oils, slags and fly ash from metallurgical or other processes, as well as the subsequent pollutants formed during the drying and melting steps. As a result, the sector is a major source of PCDD/Fs (dioxins/furans) and other unintentional POPs (PCBs, HCBs, PCNs, PeCBz, PBDD/Fs) and also emits particulate matter, heavy metals, nitrogen oxides, carbon monoxide, sulphur dioxide, and volatile organic compounds (VOCs) (Wu, et al., 2020), in the form of metallic fumes, smoke and dust[17]. To achieve a circular economy, the secondary metal industry needs to be cleaned up significantly.

[17] Stockholm Convention on Persistent Organic Pollutants, Toolkit for Identification and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs under Article 5 of the Stockholm Convention on Persistent Organic Pollutants, https://toolkit.pops.int/Publish/Main/II_02_Metals.html

UNDP has extensive experience in the introduction of BATs and BEPs in the secondary copper sector. This is highly relevant to the secondary metal sector as a whole, as there are many similarities and synergies with other secondary non-ferrous metal sectors, such as lead, zinc and aluminium. The areas listed below are those in which UNDP can provide substantial support to its partners:

- **Develop policies and regulations that support the competitiveness of the secondary metal sector:** development of waste management policies—landfill taxes and bans; EPR and take-back schemes; public provision of separated recycling collection; creation and establishment of financial incentives to support domestic recyclers and re-processors.
- **Develop policies and regulations that support cleaner production in the secondary metal sector:** support technical and economic policies on pollutant control in the secondary metal sector; support the development and implementation of emission standards (air, water and soil release limits), industry standards and technical requirements, and environmental protection control standards.
- **Promote cleaner production processes:** Disseminate knowledge and demonstrate best practices on BATs and BEPs for primary and secondary prevention measures such as presorting and precleaning of feed material, effective process control, fume and gas collection, high-efficiency dust removal, afterburners and quenching or thermal post combustion (off-gas treatment) and adsorption through activated carbon or other effective adsorbents; sound management of residues and ashes; and building the skills and capacity needed to implement sustainable changes.

10. Circularity in the construction sector

The construction sector plays a very important role in the global economy. Before the COVID-19 pandemic, the construction sector accounted for around 7.7% of global employment (ILO, 2020), mainly in micro and small enterprises, with projections for 2020 indicating that it would contribute to 13.4% of global gross domestic product (GDP) (Global Construction Perspectives and Oxford Economics, 2015). Construction consumes large quantities of intermediate products (raw materials, chemicals, electrical and electronic equipment, etc.) and related services. Because of its economic importance, the performance of the construction sector can significantly influence the development of the overall economy (EC, 2020b).

The building and construction (B&C) sector is one of the largest end markets for chemicals and is the sector that generates the highest chemical revenue. It uses a wide range of products containing various outputs from the chemical industry, ranging from commodity chemicals such as plastic resins—such as polyvinyl chloride (PVC), polyethylene (PE) and polypropylene (PP)—to specialty chemicals like paints, coatings, adhesives, sealants, advanced polymers and additives. These specialty chemicals are either used as stand-alone formulations, such as paints or adhesives, or are incorporated into other products (e.g. adhesives used in engineered wood products) (UNEP/SAICM/GEF, 2021).

The use of chemicals and chemical products in the B&C sector impacts human and environmental health during the manufacturing of the chemical or products, the building's construction (affecting construction workers), during its use (impacting inhabitants, cleaners and maintenance personnel), refurbishment, the demolition phase and the waste management phase. These impacts are particularly significant when the substances in question are considered chemicals of concern, as construction and demolition waste (C&DW) consequently contains these hazardous components and thus requires costly treatment and disposal to keep communities safe. People currently spend most of their lives in buildings surrounded by materials containing harmful chemicals, which lead to indoor air pollution and make it impossible to create a healthy living environment.

In most countries, C&DW makes up the largest proportion of the total waste generated as a result of the fast pace of urbanization and infrastructure development (UNEP/SAICM/GEF, 2021). The volume and quantity of C&DW waste put enormous pressure on already limited waste management capacity and infrastructure, but the generation of this also means that valuable resources are discarded without being reused or recycled, thus requiring the production of new products that have a major impact on energy, climate change and the environment (EC, 2020b).

To achieve circularity in the construction sector, buildings and infrastructure need to be designed differently, prioritizing resource efficiency (energy, water and materials), durability, flexibility and easy dismantling, disassembly and re-use. Developers should be making consistent use of high-quality reusable, renewable, or recycled construction materials (Ellen MacArthur Foundation, 2016), that do not contain harmful chemicals or products.

In a circular economy, buildings could be regarded as material and product "banks" that make use of safe, high-quality, reusable (prefabricated) building components over their lifespan. At the end of the building's life, they are taken back by product manufacturers and construction companies to be reused, refurbished or recycled for the assembly of other structures. Digitalizing the buildings' components using a materials passport would make maintenance, repair, dismantling and re-use safer and easier (Ellen MacArthur Foundation, 2016).

Improving circular economy practices in the construction sector is key to increasing material re-use and high-quality recycling. Circular economy-inspired actions can help achieve national waste prevention policy objectives and increase both the quantity and the quality of recycling of C&DW while reducing the presence of hazardous materials in this (Wahlström et al., 2020).

UNDP's experience and expertise in the area of chemicals and waste management are very relevant to certain aspects of the construction sector—but less relevant to others. The areas listed below are those in which UNDP can provide substantial support to its partners:

- **Develop policies and regulations that promote re-use and high-quality recycling of buildings and building materials** (EC, 2020a) by minimizing the landfilling of C&DW; phasing out hazardous substances and chemicals of concern from construction materials and products; integrating LCAs into construction policies;

stimulating innovation in circular construction-related materials, design and production facilities; and encouraging quantitative target-setting in waste and construction-related policies and strategies.

- **Phase out chemicals of concern from construction products** by supporting product manufacturers in identifying and introducing alternatives to harmful chemicals, such as by using green and sustainable chemistry solutions.
- **Design for circularity: support the design of construction-related products that can be reused, reassembled, reconfigured and recycled** by supporting local and national product manufacturers and recycling companies in identifying and introducing recycled materials and product designs of high quality and durability which can be easily reused, repaired, recycled or recovered.
- **Support the creation of a competitive market for secondary raw materials** (versus virgin materials) by increasing price competition with virgin alternatives; introduce EPR for construction materials; support the development of standards for secondary raw materials to increase trust in their properties and quality; and increase re-use, recovery and recycling potential of products by improving information-sharing (product labelling and product or building passports).
- **Support the environmentally sound management of C&DW, including waste containing chemicals of concern** (e.g. POPs), by supporting the development of guidelines on the removal of hazardous materials and increased source separation; support the development of new technologies for the efficient and safe removal of hazardous substances in existing construction and materials and the recycling and treatment of hazardous C&DW components; and improve the capacity of the local recycling infrastructure and companies.

11. Waste and resource management

Globally, approximately 2 billion tons of municipal solid waste (MSW) are generated each year. When commercial and industrial waste and C&DW are added, combined waste generation is estimated at between 7 billion and 10 billion tons per year. Although generation rates vary widely within and between countries, per-capita MSW generation is strongly correlated with national income. In high-income countries, waste generation rates are now beginning to stabilize. However, as economies continue to grow rapidly in low- and middle-income countries, per-capita waste generation is expected to continue increasing steadily (UNEP, 2015).

When waste is not managed properly, it can significantly increase public health risks, in particular in communities that are already vulnerable. MSW that is thrown out by households, businesses and markets at random sites without regular collection and safe disposal practices can lead to outbreaks of waterborne diseases such as cholera, typhoid and diarrhoea. Waste piles become breeding sites for insects and other harmful animals that can be vectors of disease, increasing the likelihood of the transmission of malaria and dengue, among others. When not disposed of appropriately, MSW can also block water and sewerage canals and drainage systems, causing flooding (UNEP, 2016b).

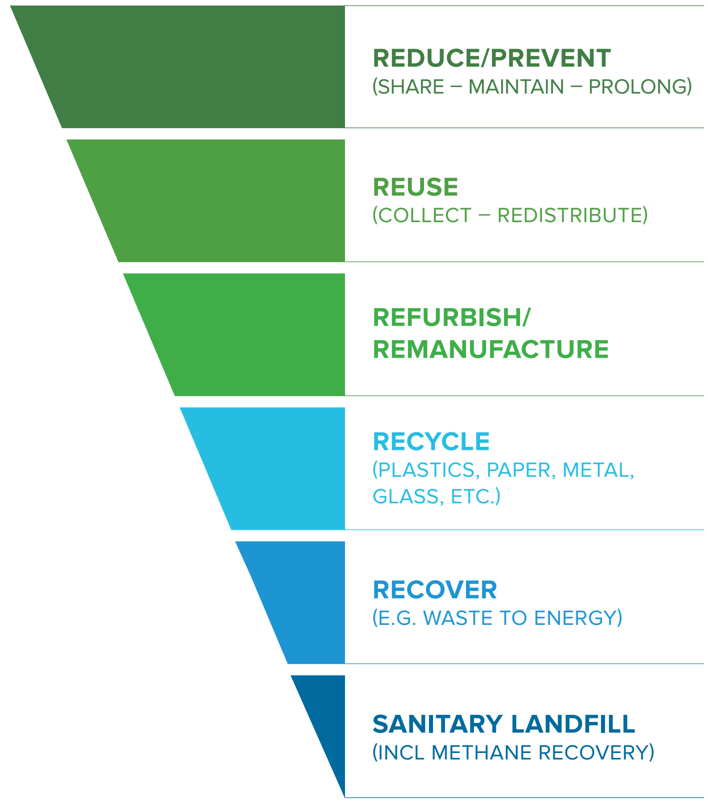
Waste that is disposed of at random sites or non-sanitary dumpsites leads to water and soil contamination and the release of GHGs as it decomposes. The unmanaged dumping of waste in coastal regions or waterways contributes considerably to marine litter, while the open burning of waste releases particulates that cause respiratory diseases as well as dioxins and furans, the latter two among the most harmful chemicals known to humankind and the environment.

When not properly managed, hazardous waste—including plastics, infectious health care waste, obsolete pesticides, PCB-containing electrical equipment and e-waste create significant health and environmental risks, especially when POPs or persistent toxic substances (like mercury and lead) are contained in such wastes and are thus released into the water, soil and air due to inadequate disposal, storage or recycling, open burning or incineration practices.

The health and environmental issues caused by unsound waste management practices are clear, however, estimating the exact economic costs of inaction remains challenging. That said, it is reasonable to conclude that it is probably more inexpensive for society as a whole to resolve waste management issues upfront in an environmentally sound manner rather than to carry on dumping.

To do this, it is essential to move from a linear take-make-dispose system, where waste management is a "last resort" solution, to a circular economy system that focuses on managing resources sustainably and ensures products and materials are used as long as possible and kept at their highest possible value.

WASTE HIERARCHY



Waste prevention should be our top priority, which has substantial benefits as it reduces carbon emissions and the use of natural resources and mitigates impacts on human health and the environment. However, residual waste that continues to be generated until economic sectors have achieved partial or complete circularity will need to be segregated, collected, transported, recycled and disposed of safely to protect human health and the global environment.

There is a shift towards zero waste initiatives to address the challenges of cities in the long run, considering the need for action to tackle climate change. In the future, the level of the waste management system may become a core comparative advantage for a city and demonstrate its commitment to social and environment responsibility and resource efficiency. The roadmap for zero-waste vision is a gradual process guided by a forward-looking strategy leading to action plans based on in-depth analysis and system-based solutions. With the support of professional institutions, communities and stakeholders, city managers could carefully assess the waste management model and infrastructures most applicable to their local conditions, taking into account relevant international and national policies and standards. Sorting the waste at source must be mandatory. All businesses and citizens will need do their part according to the regulations and guidance of the municipalities. We are seeing that circularity principles are well received by the business community and individuals through innovative and effective communication practices. Regulations should be introduced that steer towards more sustainable products on the market, i.e. through more rigorous product standards or the mixing in of a certain percentage of recycled materials in new products. A public private partnership (PPP) business model should be established as needed. Neighbouring cities should coordinate to achieve economic of scale and provide coherent incentives.

As part of its work around the various chemical-related conventions and to prevent the generation of waste, UNDP has been supporting governments, municipalities, businesses and NGOs in addressing the capacity gaps in solid waste management and reducing the use of hazardous chemicals and products containing them in sectors including agriculture, electricity generation and distribution, health care, mining and electronics, among others. More needs to be done to advance the zero-waste vision through enhancing integrated solid waste management systems at the city level, improving planning and governance mechanisms, creating financial instruments for waste reduction and low-carbon infrastructure (composing, recovery, gas-capture, waste-to-energy), improving waste recycling systems, and conducting awareness raising, training and education for behaviour change. Examples of UNDP's gender-responsive interventions in these areas include:

- **Improve municipal solid waste management system:** improve national and local MSWM policies, regulations, guidelines and financial mechanisms for waste management and recycling. Introduce viable model for sustainable waste management at municipal and community levels. Promote the adoption of a zero-waste vision and support the formulation of the strategy with the aim to reduce open burning and dumping, landfilling and incineration. Provide support in building a public and private partnership (PPP) business model in the waste management area. Facilitate the exchange of knowledge and experiences among municipalities through a global platform and network.
- **Develop Financing instruments:** Analyze optimal financing instruments to cover the cost of municipal waste management, focusing on ways to create sustainable business models and public and private partnerships, covering investments in key infrastructure, daily operational costs as well as incentive-related cost arrangements. Legal and financial instruments may be explored to address the financial challenges within the municipal waste management sector, including the introduction of extended producer responsibility (EPR) and the use of economic instruments, such as different forms of taxes and differentiated waste tariffs.
- **Improve waste recycling system:** Improve the waste recycling system to enhance the circularity of materials and reduce waste volume. Formulate mandatory sorting method at household as well as separated collection system for the reuse and recovery of materials and for separating the hazardous wastes. A whole-of-society approach could help improve the participation of communities along with broad awareness efforts, education and training to public, firms and waste workers.
- **Improve Health Care Waste Management (HCWM):** improve national HCWM policies, regulations, guidelines and emission standards; introduce BEP approaches and BATs for the management and treatment of HCWM at the facility level; phase out the use of mercury-containing medical devices; introduce green procurement practices at the government and health care facility (HCF) levels; train HCF workers on sorting waste at its source, as well as safe storage, transport and treatment; and introduce curricula on HCWM into educational facilities.

KEY RESOURCES AND KNOWLEDGE PRODUCTS ON PROJECTS WITH HEALTHCARE WASTE COMPONENTS CAN BE FOUND ON OUR REPOSITORY AT HTTPS://GREENHEALTHCAREWASTE.ORG!

"Circularity is an essential part of a wider transformation of industry towards climate-neutrality and long-term competitiveness. It can deliver substantial material savings throughout value chains and production processes, generate extra value and unlock economic opportunities."

— (European Commission, 2020)

UNDP portfolio

COUNTRY	PROJECT TITLE	GEF GRANT (US $)	SECTOR
Argentina	Environmentally Sound Management of POPs, Mercury and other Hazardous Chemicals	8,930,250	Waste Management
	Environmentally Sound Management and Destruction of PCBs	3,400,000	Waste Management
Belarus	POPs Legacy and Sustainable Chemicals Management Project	8,400,000	Waste Management
Belize	Chemicals and Waste Management Programme	990,000	Plastics, Waste Management
Brazil	Environmentally sound destruction of PCBs	9,660,000	Waste Management
	Establishment of PCB Management and Disposal Program	4,700,000	Waste Management
China	Demonstration of production phase-out of Hg-containing medical thermometers and sphygmomanometers and promoting the application of Hg-free alternatives	16,000,000	Waste Management
	Green Production and Sustainable Development in Secondary Aluminum, Lead, Zinc and Lithium Sectors	15,750,000	Waste Management
	UPOPs Reduction through BAT/BEP and PPP-based Industry Chain Management in Secondary Copper Production Sector	12,600,000	Waste Management
	Phase out of Endosulfan	1,980,000	Sustainable Agriculture
	Improvement of DDT-based production of Dicofol and Introduction of alternative technologies including IPM for leaf mites control	6,000,000	Waste Management
	Alternatives to DDT Usage in Production of Antifouling Paint	10,365,000	Waste Management
	Reduction of POPs and PTS release by environmentally sound management throughout the life cycle of electrical and electronic equipment	11,650,000	E-waste
Colombia	Strengthening national capacity to manage industrial POPs within the framework of national and international guidelines on chemical substances and hazardous waste management	5,187,000	E-waste, Waste Management
	Reducing UPOPs and mercury releases from healthcare waste management, e-waste treatment, scrap processing and biomass burning.	5,800,000	E-waste, Waste Management
	Developing National Capacity for Environmentally Sound Management and Disposal of PCBs	3,400,000	Waste Management
Costa Rica	Integrated Management of PCBs	1,930,000	Waste Management
Ecuador	National Programme for the environmental Sound Management and Life cycle management of Chemical substances	8,490,000	Plastics, Waste Management, ASGM
	Integrated and Environmentally sound PCBs Management	2,000,000	Waste Management
Egypt	Protect human health and the environment from unintentional releases of POPs originating from incineration and open burning of health care- and electronic-waste.	4,100,000	E-waste, Waste Management
Ethiopia	PCB Management in Ethiopia to Meet the 2025 Stockholm Convention Deadline – Phase 1	1,990,000	Waste Management
Gambia	Capacity building for PCBs and U-POPs	1,998,000	Plastics, Waste Management

COUNTRY	PROJECT TITLE	GEF GRANT (US $)	SECTOR
Georgia	Disposal of POPs Pesticides and Initial Steps for Containment of Dumped POPs Pesticides	1,000,000	Waste Management
Ghana	Building for PCB Elimination	2,945,700	Waste Management
Global (Argentina, India, Latvia, Lebanon, Philippines, Senegal, Viet Nam)	Demonstrating and Promoting Best Techniques and Practices for Reducing Health-Care Waste to Avoid Environmental Releases of Dioxins and Mercury	10,326,455	Waste Management
Global (Colombia, Indonesia, Kenya, Peru)	Global Opportunities for Long-term Development (GOLD)	20,910,000	ASGM
Global (Ghana, Honduras, Suriname, Ecuador)	Global Opportunities for Long-term Development (GOLD) – 2nd phase	22,043,300	ASGM
Global (Ecuador, Laos PDR)	Financing Agrochemical Reduction and Management (FARM)	8,000,000	Sustainable Agriculture
Honduras	Environmentally Sound Management of Products and Wastes Containing POPs and Risks Associated with their Final Disposal	3,460,000	Plastics, Waste Management
	Environmental Sound Management of Hg and Hg Containing Products and their wastes in ASGM and Healthcare.	2,600,000	Waste Management, ASGM
	Strengthening National Management Capacities and reduction releases of POPs	2,650,000	Waste Management
Indonesia	Reducing Releases of Polybromodiphenyl Ethers (PBDEs) And Unintentional Persistent Organic Pollutants (UPOPs) Originating from Unsound Waste Management and Recycling Practices and the Manufacturing of Plastics	7,980,000	Plastics, Waste Management, Textiles
Jordan	Reduction/elimination of POPs and other chemical releases through implementation of environmentally sound management of E-Waste, medical waste and priority U-POPs	5,090,000	E-waste, Plastics, Waste Management
	Implementation of Phase I of a comprehensive PCB management system	950,000	Waste Management
Kazakhstan	Design and Execution of a Comprehensive PCB Management Plan	3,300,000	Waste Management
	NIP update, integration of POPs into National planning and promoting sound healthcare waste management	3,400,000	Waste Management
Kenya	Sound Chemicals Management Mainstreaming and UPOPs reduction	4,515,000	Plastics, Waste Management
Kyrgyzstan	Protect Human Health and the Environment from Unintentional Releases of POPs and Mercury from the Unsound Disposal of Healthcare Waste	1,425,000	Waste Management
	Management and Disposal of PCBs	950,000	Waste Management
Latvia	Environmentally Sound Disposal of PCBs and enhancement of POPs health risk management	999,600	Waste Management
Maldives	Eliminating POPs through Sound Management of Chemicals	3,675,000	Waste Management
Mauritius	Sustainable Management of POPs	902,250	Waste Management

COUNTRY	PROJECT TITLE	GEF GRANT (US $)	SECTOR
Mexico	Environmentally Sound Management and Destruction of PCBs: Second Phase	4,800,000	Waste Management
	Environmentally Sound Management and Destruction of PCBs	4,630,000	Waste Management
	Sound Management of POPs Containing Waste	5,720,000	E-waste, Waste Management
Montenegro	Comprehensive Environmentally Sound Management of PCBs	3,500,000	Waste Management
Morocco	Safe PCB Management Programme	2,198,000	Waste Management
Nicaragua	Improved Management and release containment of POPs pesticides	900,000	Waste Management
Nigeria	Environmentally Sound Management and Disposal of PCBs	6,930,000	Plastics, Waste Management
	Less burnt for a clean Earth: Minimization of dioxin emission from open burning sources	4,150,000	Waste Management
Pakistan	Comprehensive Reduction And Elimination Of Persistent Organic Pollutants	5,150,000	Waste Management
Panama	Environmentally sound management of hazardous wastes containing POPs and Mercury	2,730,000	Plastics, Waste Management
Peru	Environmentally sound management of PCBs, Mercury and Toxic Chemicals	4,725,000	Waste Management
Philippines	Reduction of POPs and UPOPs through integrated sound management of chemicals	6,562,500	Green & Sustainable Chemistry, Waste Management, Textiles, Lead
Regional Europe & CIS	Global Programme to demonstrate the viability and removal of barriers that impede Adoption and Successful Implementation of Available, Non-Combustion Technologies for Destroying Persistent Organic Pollutants (POPs)	10,004,040	Waste Management
Regional Africa (Ghana, Madagascar, Tanzania, Zambia)	Reducing UPOPs and Mercury Releases from the Health Sector in Africa	6,453,195	Waste Management
Regional Asia & Pacific (Philippines and Indonesia)	Reducing Environmental and Health Risks to Vulnerable Communities from Lead Contamination from Lead Paint and Recycling of Used Lead Acid Batteries	838,000	Lead
Regional SIDS (Comoros, Mauritius, Seychelles, Maldives)	Implementing Sustainable Low and Non-Chemical Development in SIDS (ISLANDS): Indian Ocean component	13,000,000	Sustainable Production & Consumption/CE, Plastics, Waste Management, Sustainable Agriculture
Rwanda	Supporting a Green Economy - Decoupling Hazardous Waste Generation from Economic Growth	6,300,000	Sustainable Production & Consumption/CE, Plastics, Waste Management, E-waste, Textiles
	Management of PCBs stockpiles and equipment containing PCBs	886,700	Waste Management

COUNTRY	PROJECT TITLE	GEF GRANT (US $)	SECTOR
Sri Lanka	POPs and HCWM	5,040,000	Waste Management
Turkey	POPs Legacy Elimination and POPs Release Reduction Project	6,931,400	Waste Management, Textiles
Uruguay	Development of the National Capacities for the Environmental Sound Management of PCB	954,550	Waste Management
	Environmental Sound Life-Cycle Management of Mercury Containing Products and their Wastes	3,713,400	Waste Management
Viet Nam	Reduce the impact and release of mercury and POPs through lifecycle approach and green labeling	4,600,050	Sustainable Production & Consumption/CE, Waste Management
	Application of Green Chemistry to Support Green Growth and Reduction in the Use and Release of POPs Harmful Chemicals	1,999,800	Green & Sustainable Chemistry
	Building capacity to eliminate POPs pesticides stockpiles	3,957,580	Waste Management
	Environmental Remediation of Dioxin Contaminated Hotspots	4,977,000	Waste Management
	POPS and Sound Harmful Chemicals Management Project	5,100,000	Waste Management

NOTES:

1. Waste management includes PCBs/Obsolete pesticides, MSWM, and HCWM
2. GEF Ozone approvals are not depicted in this table.
3. Enabling activities are not depicted in this table.

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