



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION



CIRCULAR ECONOMY

The Japanese concept of **mottainai** expresses that it is a shame for something to go to waste without having made use of its potential in full — something that happens with regularity in a linear economy.

Something old, something new

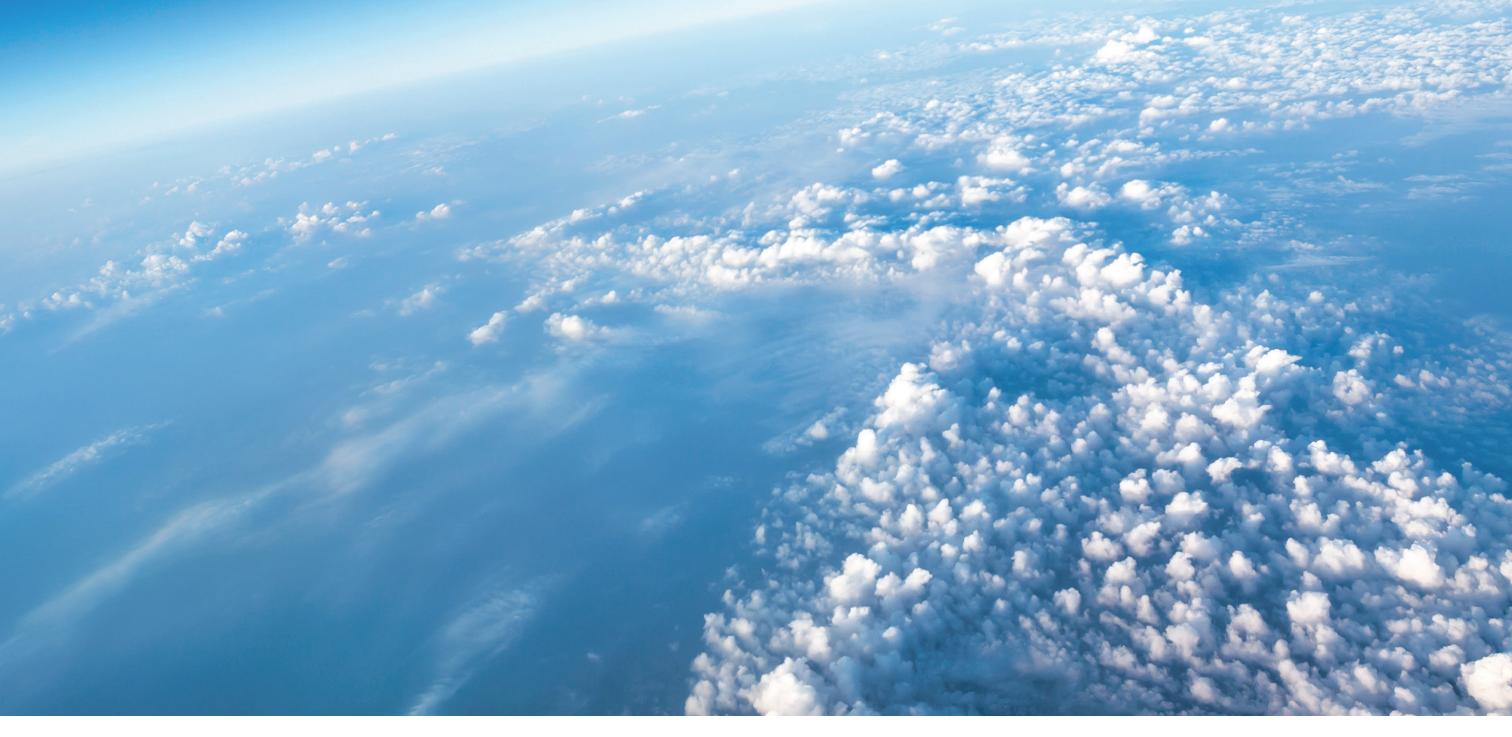


The circular economy is a new way of creating value, and ultimately prosperity. It works by extending product lifespan through improved design and servicing, and relocating waste from the end of the supply chain to the beginning—in effect, **using resources more efficiently by using them over and over, not only once.**

By and large, today's manufacturing takes raw materials from the environment and turns them into new products, which are then disposed into the environment after use. It's a linear process with a beginning and an end. In this system, limited raw materials eventually run out. Waste accumulates, either incurring expenses related to disposal or else polluting—indeed, a 2012 World Bank report estimates that municipal waste generation will double over the next 20 years in low-income countries. On top of that, manufacturing processes are often themselves inefficient, leading to further waste of natural resources.

In a circular economy, however, **products are designed for durability, reuse and recyclability, and materials for new products come from old products.** As much as possible, everything is reused, remanufactured, recycled back into a raw material, used as a source of energy, or as a last resort, disposed of.

For 50 years, UNIDO has worked towards a truly sustainable industry. In doing so, we have moved towards a circular economy. The building blocks of a circular economy do not need to be invented. They already exist.



Governments are encouraging—and, in some cases, requiring—the adoption of circular economy principles and practices that would lead to more resource efficiency and less waste. At the global level, the **Sustainable Development Goals**, adopted by the United Nations Member States in 2015, include many related ambitions.

At the country and **regional level**, in 2008 China was among the first to adopt a circular economy law promoting the recovery of resources from waste. In that same year, the G8 environment ministers agreed on an action plan for the 3Rs: reduce, reuse and recycle. Following on that, the 2015 G7 Summit Leaders' Declaration underscored the need for "sustainable supply chains" that protect workers and the environment.

Then, in late 2015, the European Union adopted an ambitious Circular Economy Package, including goals for food, water and plastics reuse. "The message is that while you are protecting the environment you can boost your economic development and provide new growth and new jobs," said the then European Commissioner for Environment Janez Potočnik in support of the EU Circular Economy Package in 2014.

Indeed, there is a **strong business** case to be made for a circular economy. Nike, Google, and H&M are already implementing aspects of the circular economy in their global business. Dutch technology company Philips refurbishes medical

Inclusive and Sustainable Industrial Development



All 'round the world:

Embracing the circular economy

equipment such as MRI systems. Chilean pump technology company Neptuno Pumps remanufactures energy-efficient pumps from reused and recycled pump material, and its common practice for automotive manufacturers is to use recycled plastics in components under the hood and for vehicles' internal parts. Mexican brewer Cuauhtémoc Moctezuma Heineken México and American computer company Dell, as well as smaller companies such as Serbian rolling-element bearing manufacturer FKL Temerin are also leaders in adopting circular economy principles. By designing products with resource recovery in mind, they can protect themselves from price changes in the raw-materials market by creating a more reliable source of raw materials, as well as maintain longer-lasting relationships with consumers by ensuring contact throughout a product's life cycle.

There are also **efficiency gains**: According to the Ellen MacArthur Foundation, by 2025 about \$1 trillion per year of materials cost savings could be generated from circular business models. National economies, entrepreneurs and employees will benefit, as they form new businesses and create new jobs to fill niches created by the circular economy, through resource recovery and remanufacturing.





INCLUSIVE

The winners' circle

We find this vision of the future compelling, but we also see reason for concern. While the circular economy takes into account two pillars of sustainability—environmental and economic performance—it risks leaving out an essential third pillar: **inclusiveness**. Simply put, the circular economy could cut poorer countries out of the global supply chains they've worked so hard to enter.

How? First, as wealthy countries learn to extend their resource use, they will reduce their dependency on imported raw materials as well as other products manufactured abroad. For example, the Netherlands recently announced that it aims to cut in half its use of primary raw materials from minerals, fossil fuels and metals by 2030, with the ambitious goal of a fully circular economy by 2050.

Second, developing countries—especially least developed countries—may struggle to access the knowledge and new technologies that make the circular economy possible. They will be less able to fill the demand for products that meet increasingly stringent circular economy standards in their export markets, as well as for circular economy services such as reclamation and remanufacturing.

Yet, developing countries stand to also profit immensely from a circular economy. There is a growing need for material, water and energy because of both population growth and increased demand by infrastructure, industry and consumers in developing countries. Circular economy activities have the potential to address a significant share of this need—dampening or, possibly, reversing the rise in resource use by developing countries, and in turn reducing resource depletion, climate change and the pollution of natural areas. In fact, a report from the McKinsey Global Institute estimates that up to 85 per cent of opportunities to improve resource productivity lie in developing countries.

As we think back on 50 years of environmental work at UNIDO, our conviction grows that we can help advance circular economy models, in particular in developing economies. Many of our projects already address various building blocks of a circular economy. Some support cleaner manufacture of products, others help develop safe, easy-to-recycle products with longer lifetimes and still others deal with the recovery or safe disposal of resources at the end of a product's life.

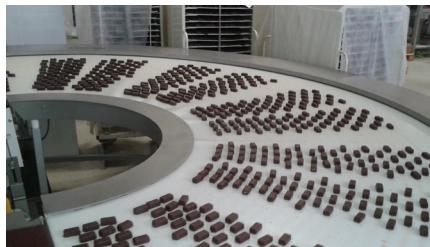


EFFICIENT

Moving in the best circles

A key part of the circular economy is **improving resource efficiency during production.** A major way we do this in UNIDO's Department of Environment is through programmes related to **Resource Efficient and Cleaner Production (RECP).** RECP means applying preventive environmental strategies to processes, products and services to increase efficiency as well as reduce risks to humans and the environment. Thanks to these programmes, individual companies and entire industrial sectors have profited.

One example is our Chemical Leasing programme, where chemicals are leased rather than purchased in a cooperation between chemical producers, suppliers and users. The total use of chemicals is reduced, leading to economic and environmental benefits.



Since 2014, when UNIDO's Resource Efficient and Cleaner Production (RECP) pilot project was launched in the Republic of **Belarus**, more than 30 companies learned how they can cut production-related costs and at the same time reduce adverse environmental impacts. In one example, UNIDO helped a confectioner to use safe and sweetwater to make marmalade for chocolate fillings.



In **Serbia**, the National Cleaner Production Centre (NCPC) is a particularly strong player in implementing sustainable chemical solutions, including new business models such as Chemical Leasing.





Industries in the Southern Mediterranean region face high energy costs, scarcity of water and increasing pressure for environmental certifications from international markets. In 2009, UNIDO launched the MED TEST initiative to help industrial enterprises meet these challenges through the transfer of cleaner technology. Pictured here is the leather industry in **Tunisia**, where previously discarded animal products are turned into resources for manufacturing soap and other products.

Unfortunately, many countries lack expertise in **resource efficiency strategies**. To

remedy that, since the mid-1990s UNIDO and the United Nations Environment Programme (UNEP) have been working together to support the development of national service providers. Today, these

have grown into a global network, called **RECPnet**, with over 70 members specialized in providing RECP services to industry in developing and transition economies.



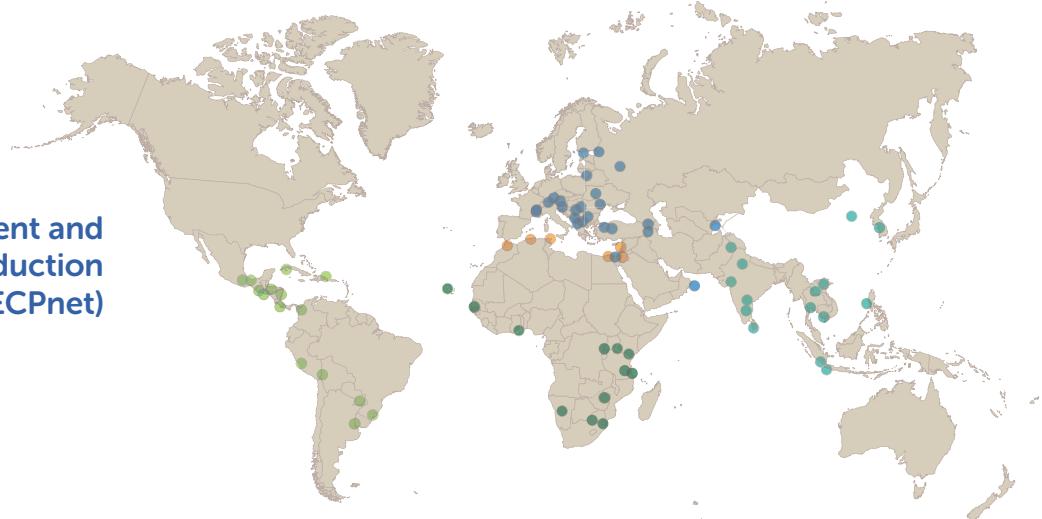
Since 1994, UNIDO and UNEP have been working together to build local capacity in Resource Efficient and Cleaner Production (RECP) methodologies in developing countries. Around the world, national centres provide awareness-raising workshops, training programmes, in-house assessments, technical assistance and policy advice. In **Kenya**, RECP interventions have included the replacement of diesel-fueled trucks with a ropeway system to transport tea-leaves.



MED TEST II, a component of the UNIDO-led SwitchMed programme, facilitates the shift towards sustainable consumption and production in the Southern Mediterranean region. To date, UNIDO has trained nearly 160 professionals from Tunisia, Morocco, Lebanon, Jordan, Palestine, Israel, Egypt and Algeria to offer resource-efficient and environmentally friendly production solutions to companies by applying the Transfer of Environmentally Sound Technology (TEST) approach. In **Israel**, connecting energy efficiency, material efficiency and pollution reduction means companies are finding new ways to save raw materials and reduce waste.



Resource Efficient and Cleaner Production (RECPnet)



Our resource efficiency efforts span whole regions, such as the European Union's Eastern Neighborhood and the South Mediterranean region, both areas that might face particular challenges in adapting to the European Union's rapidly developing circular economy policies. Helpfully, our colleagues in UNIDO's Department of Trade, Investment and Innovation also assist companies to provide quality products, including those that conform to international environmental standards, so they can enter and maintain their presence in global value chains.

In other cases, UNIDO is [extending resource efficiency](#) beyond the borders of one company to groups of industries; a prime example of such approaches is the establishment of **eco-industrial parks**. Here, companies wanting to go beyond compliance in their environmental performance find the means to do so, not only by sharing environmental services and receiving targeted RECP advice, but also by taking advantage of each other's byproducts, such as heat, water and recycled materials. Eco-industrial parks could make important contributions in the move towards the circular economy, both in industrialized and developing countries.



In **Viet Nam**, UNIDO supported an eco-industrial park model, which meant companies cooperated to reduce waste and increase resource efficiency. Other ongoing UNIDO projects—in China, Colombia, Ethiopia, India, Indonesia, Morocco, Peru, Senegal and South Africa—all show the great potential of the eco-industrial park model. In an industrial zone in China, a UNIDO-supported programme helped generate synergies yielding over \$10 million in savings and an over \$16 million revenue increase, as well as 167,000 tons of reduced carbon dioxide and 1.4 million tons of reduced landfill.

Circular economy practices also result in significant [energy savings](#) through the reuse of secondary materials. One ton of recycled aluminum cans can save up to 9 million tons of carbon dioxide-equivalent (CO₂e). A ton of recycled mixed paper can save 3.5 million tons of CO₂e, and the same amount can be saved by recycling one ton of carpet.

Our colleagues in UNIDO's Department of Agri-Business Development are working to increase the proportion of produce consumed to what is actually being harvested; currently, the share stands at only 50 per cent. Interventions include optimizing of storage and cold chain, but also waste reduction through improving technology, optimizing processes and making use of by-products.



LONG-LASTING

Keeping you round

We are also committed to improving products to make them safer and extend their lifespan.

By eliminating ozone depleting substances, UNIDO has already helped avoid the use and potential emission of **338 million tons of CO₂-equivalent per year** between 1990 and 2015, equivalent to a year's emissions from 99 coal-fired plants.

We aim not only to eliminate toxic substances from products as early as during their design phase; if we find them contaminated, we also treat them postproduction, at the same time extending their lifespans and enabling easier recycling and reuse. One set of examples for designing products to contain less harmful substances before these products are even manufactured is the projects under the Montreal Protocol. There, production of refrigerators or insulation foams—often on a large scale—is converted to new technologies, so the products no longer contain ozone-depleting substances. Leaking of such substances into the environment can thus be avoided, and the products are also much easier to dispose of.



Most industrialized countries have banned hydrochlorofluorocarbons (HCFCs), which are potent greenhouse gases that can deplete the ozone layer. Developing countries are now working to phase them out, too. In **Pakistan**, UNIDO took the lead on assisting industry

with the phase-out in order to reduce the demand for HCFCs, ensuring better products, greater longevity and easier disposal. Overall, UNIDO has implemented plans to phase out HCFCs in 72 countries.

An example of **improvement during the use of a product** is when our projects help countries to remove toxic substances from electrical transformers and put the transformers back into use. Other projects promote **recovery and reuse** of refrigerants to avoid their deliberate venting to the atmosphere.



The former Yugoslav Republic of Macedonia faced significant hurdles when it came to managing polychlorinated biphenyls (PCBs). But with the help of a multi-pronged project with UNIDO, the country is now well on its way to eliminating the threat of these harmful pollutants, and new services include identifying contaminated transformers, treating them, and returning them to the production process.



St Vincent and the Grenadines is one of 72 countries UNIDO is assisting to phase out ozone depleting substances. All of these projects include training technicians to ensure that products are correctly serviced. Training technicians helps to extend the lifespan of products.



Gulf countries share around 15 per cent of the global market for air conditioning. In high ambient temperatures, air conditioners do not last or perform as well as they do in cooler countries. In order to achieve a better product, UNIDO and UNEP initiated a process to redesign prototypes, in order to find sustainable, efficient ways to cool down.

In China, we are just beginning with a project that will redesign products to make them easier to reuse, remanufacture and recycle; a concept called "**cradle-to-cradle**". We are cooperating with industries that are looking into the requirements and process of remanufacture, disassembly and recycling, to prolong the useful life of the product.

We also **increase a product's lifespan by designing it for longer life, as well as making sure that quality technicians are available to repair it**. That's why we encourage companies to take the opportunity to improve their products' overall quality at the same time that they convert their production lines away from ozone-depleting substances.

We've also set up regional training centres and facilitated large-scale technician and student trainings in the refrigeration and air-conditioning sector. This ensures that the appliances will work as well as they should for as long as they can, while creating new jobs in the circular economy.

CONTINUOUS

What goes around comes around



Products contain **valuable resources**, which usually go unused once the product reaches the end of its life.

This is particularly true for electrical and electronic products, which are rich in copper and many other scarce metals, as well as materials that can also pose environmental and health risks, including plastic components. According to a study conducted by the United Nations University, more than 40 million tons of e-waste was generated globally in 2014, and very little of that is collected in an environmentally sound manner, or treated. New industries that provide e-waste services will protect the environment from contaminants such as mercury and cadmium, recover raw materials, provide affordable refurbished products and create new green jobs. We are supporting electrical and electronic waste recycling industries in developing countries such as Cambodia, Ethiopia, Uganda and the United Republic of Tanzania, and are working to extend our projects throughout the Economic Community of West African States (ECOWAS) and the Southern African Development Community (SADC), as well as regionally in 13 countries in Latin America.



In **Ethiopia**, UNIDO and other international organizations worked with the government to design an e-waste strategy. The new strategy promotes the sound management of e-waste, secure handling of non-recyclable materials, and the highest possible recovery rate

for valuable materials. In addition, Ethiopia will host regional workshops and capacity building activities for countries in Eastern Africa, serving as a model for the region.

Similarly, we have projects that create solid-waste management industries in places where none existed, such as Labé, Guinea. These industries bring health to the whole community, as well as jobs—in this case, largely to youth and women. In order to create more value from the waste they collect, the workers compost organic waste and sell plastic waste to recyclers.



In [Guinea](#), UNIDO trained more than 4,000 young people and women in solid waste management, including waste collection and sorting, sanitation and the integrated management of public spaces. The project offers a

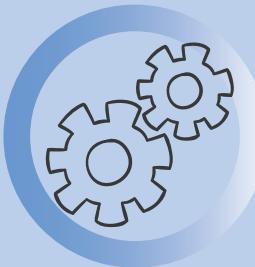
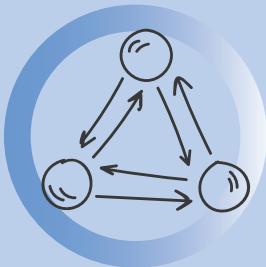
hopeful model for addressing West Africa's most pressing environmental, economic and social problems.

This also relates to our cradle-to-cradle project, which aims to change product design for longer life and better recycling, use more biodegradable plastics, and design good products without using what might later become hazardous substances. These changes in the product design will help to reduce risks that any remaining waste poses to the environment.



INCLUSIVE, EFFICIENT, LONG-LASTING, CONTINUOUS

Come full circle: Forging ahead



Our vision for a truly sustainable industry is drawn from the possibilities we see

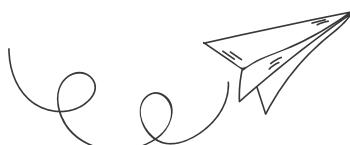
all around us in our daily work. The **building blocks of a circular economy already exist**, and UNIDO has been putting them in place in industries all around the world for the last 50 years.

The case for industry to buy into the circular economy is remarkably compelling. A circular economy reduces resource dependency and resource use, including energy thereby reining in production costs, narrowing market exposure and limiting costs stemming from resource extraction and generation. It additionally leads to the introduction of economically viable methods of reducing pollution, and separating harmful from reusable waste material.

Beyond individual enterprises, these benefits further extend to **entire industrial sectors**, or even **national economies**. The circular economy encourages inter-company exchanges and synergy-building, leading to better economic, social and environmental performance. This in turn helps raise the overall performance of national economies and opens up new markets and jobs.

On an international level, the circular economy facilitates the exchange of goods across borders by introducing standards to secondary raw materials that were previously considered waste. Improved product characteristics such as extended lifetime, recyclability and serviceability further help ensure that products can be used and sold on the global market. By helping overcome international trade barriers in this way, the circular economy offers new possibilities by which countries can prosper.

Countries today stand at a turning point. On the one hand, the pursuit of unsustainable, linear patterns of consumption and production threatens the well-being of future generations, while on the other hand, a restorative approach to increased prosperity is opening itself up to the world. **Together with our global partners, and in service to our Member States, UNIDO will continue to advance economic competitiveness, create shared prosperity and safeguard the environment in the world's developing and transition countries.**





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