



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

CIRCULAR ECONOMY and the Montreal Protocol Division

Department of
Environment





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About this publication

The aim of this publication is to introduce the work of UNIDO's Montreal Protocol Division (MPD) and its support for the circular economy. It illustrates how the Division integrates circular economy practices into its services, which include the conversion of production facilities, product design, capacity building, new business models and policy advice. It presents selected MPD case studies that highlight a key aspect of the circular economy, one which epitomizes its very essence – the value of products, materials and components is retained by slowing their flows and enabling their reuse. This is exemplified in three interlinked areas of MPD's work – increasing the recovery, recycling and regeneration of refrigerants, materials and components; designing out harmful substances through

greening product design; and increasing the lifetime of refrigeration and air conditioning appliances. It highlights how, in all aspects of MPD's work, effort is made to ensure that product lifetime is extended, resources are optimized, waste is minimized and value is retained.

This publication is part of a series by UNIDO showcasing ways in which to facilitate the uptake of circular economy practices, as well as views on how to simultaneously improve environmental sustainability and advance economic development in developing and middle income countries.





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1 | Retaining Value in Sustainable Industry

UNIDO's mandate is to promote and accelerate Inclusive and Sustainable Industrial Development (ISID) (SDG 9) in developing countries and economies in transition by contributing to poverty reduction, economic growth, and sustainable development.

UNIDO is fully committed to contributing to the achievement of the Sustainable Development Goals (SDGs), including responsible consumption and production (SDG 12) and climate action (SDG 13), while delivering on its mandate to support Member States in achieving ISID.

The building blocks of a circular economy have existed for decades now and already underpin many of our technical assistance projects, policy advice and innovation initiatives. Circular economy practices, therefore, fully complement UNIDO's mandate and we are dedicated to supporting Member States in introducing such practices into their economies and industrial value chains to help improve resource productivity and minimize waste.

Today's manufacturing takes materials from the materials supply chain and turns them into products. Within current consumption patterns, these products usually have only one lifetime, after which they are discarded. This "take-make-use-discard" model – also known as the linear economy – is enormously inefficient. It not only depletes the planet's limited resources and creates a multitude of waste, pollution and health issues, it also makes a substantial contribution to greenhouse gas (GHG) emissions.

An economy achieving full circularity is an ideal. It enables stakeholders to aim high when setting their vision, priorities and strategies for inculcating circular practices within their industries and societies for a better future.

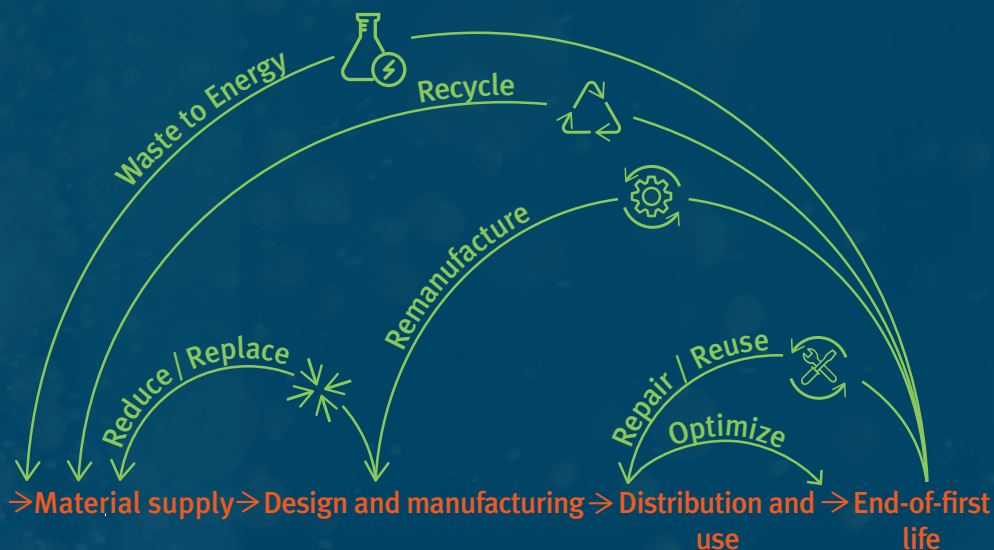
Through circular practices and business models – reduce, replace, regenerate biomass, repair, refurbish, re-manufacture, reuse and recycle, product-as-service, and waste-to-energy – everything gets additional lifetimes, is reused as an input material, part or component, or energy source, or as a last resort, disposed of.

The retained value in products and resources continue to create new business opportunities, income and jobs many times, and not only once as in a linear industrial system, where products usually end up in landfills at the end of their first life with negative impacts on health and the environment.



UNIDO defines circular economy as an industrial economy that routes materials, parts and products back into use several times and creates more value and less waste. It is an alternative in which value is maintained for as long as possible, products are designed to last, and the generation of waste is minimized.

- Linear supply chain
- Circular economy practices



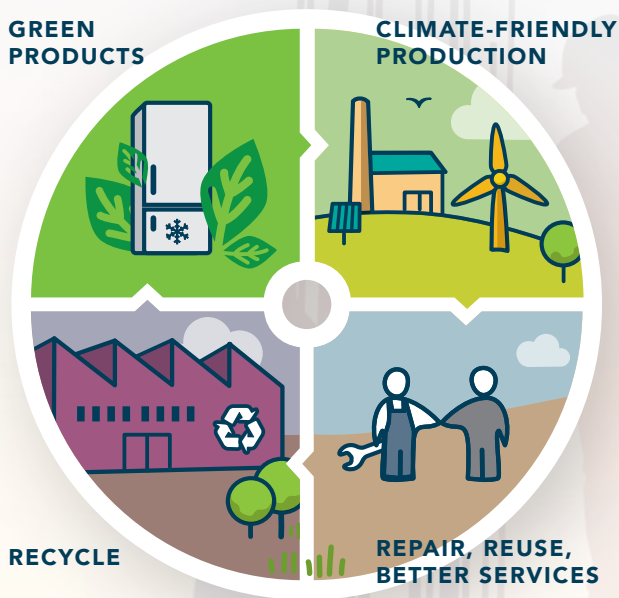
ECONOMIC OUTCOME: increased resource productivity	ENVIRONMENTAL OUTCOME: reduced environmental impact	SOCIAL OUTCOME: improved well-being
Reduced production costs and improved competitiveness	Reduced emissions of greenhouse gases	New jobs and incomes
New business activities and models	Reduced emissions of pollutants and end-of-life waste	Improved health and working conditions
New markets and investment opportunities	Quality of ecosystem services ensured	New partnerships and collaborations
Enhanced consumer loyalty	Natural resources (water, land and materials) preserved	Innovations and technologies that make life easier
Increased long-term availability of supply	Biodiversity safeguarded	

2 | Cooling the World, Closing the Loop

The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty that aims to protect the ozone layer by phasing out the production, consumption and emissions of ozone-depleting substances (ODS). It also aims to prevent climate change by reducing the consumption, production and emissions of substances with high global warming potential (or high GWP), commonly referred to as greenhouse gases (GHGs). Chemicals on the list of controlled substances under the Protocol through its Kigali Amendment include, inter alia: halons, methyl bromide, carbon tetrachloride, methyl chloroform, chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and hydrofluorocarbons (HFCs). These substances are mainly used in refrigerators, air conditioning units, foams, solvents, aerosols, fire extinguishers and related products. When released into the atmosphere, these chemicals damage the stratospheric ozone layer, which protects humans and the environment from harmful levels of ultraviolet radiation from the sun. The health and environmental impacts of high level UV radiation include increased skin cancer and eye cataracts; reduced growth and yields of crops; threats to productivity and biodiversity of natural ecosystems; damage to productivity of fisheries; and degradation of materials for clothing and construction. Adopted on 15 September 1987, the Protocol is to date the only United Nations treaty ever that has been ratified by every country on Earth – all 197 UN Member States.

UNIDO's Montreal Protocol Division (MPD) within the Department of Environment assists developing countries and economies in transition in phasing out ODS, phasing down GHGs, and phasing in non-ozone-depleting substances. Together with our bilateral-stakeholder partners, MPD's technical services focus on introducing innovative technologies, strengthening systems and building human capacities to achieve inclusive and sustainable industrial development. The work of the Division covers goals from gender equality to responsible consumption and production to climate action. The Division is creating a significant climate impact by supporting small and medium-sized enterprises as well as large enterprises in adopting alternatives that have a low or zero GWP. It is also creating significant economic impacts through supporting these enterprises in improving products, economic performance and employment opportunities. Working predominantly with the foam sector, the refrigeration and air conditioning (RAC) manufacturing sector and the RAC servicing sector, it has already implemented more than 1000 projects





in 105 countries. The Division's services, which are fully aligned with action that transitions towards a circular economy, include the following:

- Converting and upgrading production facilities to cost-effective cleaner technologies so that production stays clean and materials remain in use for longer;
- Phasing out controlled substances from products as early as the design phase and supporting industry in finding ways to redesign products to contain fewer harmful substances before these products are even manufactured;
- Building capacities in technology, industrial safety and good service practice by promoting qualified service and repair to reduce refrigerant leakages and extend lifespans;
- Promoting service-oriented business models, such as refrigerant management programmes, in which value is retained, products and resources are reused and supplies are circular;
- Supporting governments in monitoring ODS and GHG consumption, strengthening regulatory frameworks, and providing policy advice on standardization, labeling and certification schemes.

3 | MPD in Action!



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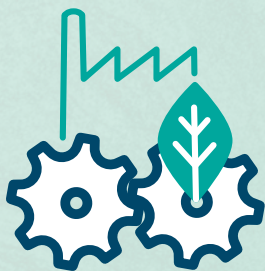
**countries working with
Montreal Protocol Division
and are in compliance with
Montreal Protocol**

Afghanistan, Albania, Algeria, Argentina, Armenia, The Bahamas, Bahrain, Benin, Plurinational State of Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Burkina Faso, Burundi, Cameroon, Chad, Chile, China, The Congo, Cote d'Ivoire, The Democratic People's Republic of Korea, Ecuador, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, The Gambia, Grenada, Guatemala, Guinea-Bissau, Honduras, Islamic Republic of Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Macedonia, Madagascar, Malawi, Mexico, Montenegro, Morocco, Mozambique, Myanmar, Nicaragua, The Niger, Nigeria, Oman, Pakistan, The Philippines, Qatar, Rwanda, Saint Lucia, Saudi Arabia, Senegal, Serbia, Sierra Leone, Somalia, South Africa, The Sudan, Suriname, Syrian Arab Republic, Togo, Tunisia, Turkey, Turkmenistan, Uganda, The United Republic of Tanzania, Uruguay, Bolivarian Republic of Venezuela, Viet Nam, Zambia



42.3 million

**tonnes of
CO₂-eq emission
reductions achieved
in 2019 alone**



140

**enterprises being
converted since
1 January 2015**

(1 company/week)

4 | From Action to Impact



319

projects approved,
implemented or under
implementation since
1 January 2015

(with a total US\$ 377,491,736)

The services of the UNIDO Montreal Protocol Division (MPD) work to encourage the adoption of sustainable industrial solutions for pollution reduction and circular economy by designing and implementing a wide range of projects tailored to developing countries and economies in transition. The following case studies provide a snapshot of some of the Division's projects, which form part of a much larger and growing portfolio of circular economy projects, as just one element of UNIDO's broader work on circular economy.



45%

of developing countries
where UNIDO is
implementing Enabling
Activities have ratified
the Kigali Amendment

To read more on
all our projects in
partner countries,
PLEASE VISIT:



bit.ly/openUNIDO



The Middle East's First Climate-friendly Supermarket

According to the Food and Agriculture Organization of the United Nations, 90 per cent of food wastage in developing countries occurs in the supply chain.

Reliable refrigeration systems can dramatically reduce food losses by keeping products cold along the supply chain, thus establishing a 'cold chain'. Cold chains are important links in moving closer to a circular economy. As well as reducing food loss, they can also help farmers to manage demand throughout the year, allowing them to command higher prices for their crops and consequently building increased prosperity in rural areas. However, the cold chain itself needs to be as green as possible. There is a need for new energy-efficient refrigeration technologies that eliminate the use of greenhouse gases and reduce the need for maintenance and repair, particularly in countries with high ambient temperatures, such as Jordan.

Main Approach

In collaboration with the Ministry of Environment of Jordan, and with funding from the Climate and Clean Air Coalition (CCAC), UNIDO has piloted innovative, climate-friendly refrigeration at the Al Salam supermarket in the capital of Amman. From design through to installation, the technology transfer encompassed the full-scale replacement of the supermarket's existing system, with climate impact considered at every stage of the process in the provision of the new, green equipment. Essential safety and maintenance training for local technicians and engineers was also provided and re-enforced through awareness-raising activities.

UNIDO implements a large number of projects and programs for, mainly, the conversion of manufacturing industries in the refrigeration sector, but also for on-location assembly of refrigeration systems. 2019, UNIDO implemented 20 such programs and projects in 18 countries, with a total budget of US \$124 million. UNIDO's work on such projects in that year alone will lead to 25.3 million tonnes of CO₂ equiv. emission reductions.

FACTS & FIGURES

- 5 trainers/facilitators trained
- 30 technicians trained
- 30+ green jobs secured/created
- \$500,000 worth of equipment/technology transferred
- 20–30% energy savings
- 10 regional and international workshops and conferences carried out
- 10,000 people reached regionally and internationally through events and publications
- Zero in-store food waste and zero maintenance costs for the first year of operation



The supermarket owner in Amman has reported that the system is delivering on energy savings, zero food loss and no maintenance costs in the first year of operation. The Jordanian manufacturer involved in greening the design of the system increased energy efficiency by ensuring that waste heat from the system is recovered to supply sanitary hot water.

Results and Impact

This is the Middle East's very first transcritical CO₂ refrigeration system in a supermarket. In involving local manufacturers, technicians and supermarkets, the project has helped to promote innovation within the national industry, paving the way for follow up projects in the region.

Furthermore, the local engineers and technicians trained as part of the project will not only support better servicing and maintenance, but also ensure that resource efficiency gains continue to be generated in the future. This project demonstrates that, within the cold chain, emissions of environmentally harmful gases can be reduced significantly with buy-in from local industry and the support of state-of-the-art technology.



SCAN HERE for a video on the project



Capacity Building Spells the End of CFCs in Ecuador

In the circular economy, when a product reaches the end of its useful life and it is beyond repair, remanufacturing or repurposing options should automatically be considered.

In cases where repair, remanufacturing or repurposing is not viable, components and materials should be recovered and reused in a way that maintains their value as far as possible. For some everyday appliances, such as refrigerators, there are environmental implications that need to be taken into account when dealing with these components. In Ecuador, as in many developing countries, old refrigerators were previously disposed of as one piece, resulting in the release of environmentally harmful refrigerants into the atmosphere. The refrigerants used in these appliances, such as chlorofluorocarbons (CFCs) and hydrofluorocarbons (HFCs), need to be recovered using special procedures. Whether for the purpose of destruction, as

with the ozone-depleting, already obsolete CFCs, or for the purpose of reuse, as with the transitional HFCs, special equipment and training is needed. Once the refrigerants are recovered, the refrigerator can be broken up for spare parts or materials.

Main Approach

UNIDO supported technicians to process refrigerators adopting best available technologies and best environmental practices at dedicated centres of excellence across the country. Under the project, these centres provided training, equipment and tools to enable technicians to recover refrigerants for either reuse or destruction.

UNIDO implements a large number of projects and programs for, mainly, capacity building, but also for policy support in servicing, good practices and end of life cycle. 2019, UNIDO implemented 110 such programs and projects in 68 countries, with a total budget of US \$35.2 million. UNIDO's work on such projects in that year alone will lead to 4.4 million tonnes of CO₂ equiv. emission reductions.

FACTS & FIGURES

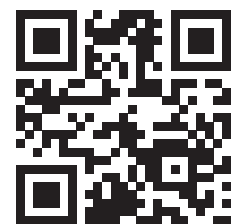
- 2.8 metric tons of CFCs destroyed
- Release of 30,000 tonnes of CO₂ equivalent avoided
- Minimizing impact at end-of-first-life
- Reusing HFCs
- Recycling components and materials
- Technicians trained (directly/indirectly through train-the-trainers)
- Equipment delivered for technicians/centres of excellence

Trials were also developed for the potential destruction of unwanted CFCs in cement kilns, as well as for the reclamation – that is, a process akin to remanufacturing – of HFC refrigerants.

Results and Impact

As a result of the project, Ecuador is the first South American country to successfully destroy CFCs, thus reducing emissions of synthetic greenhouse gases. Thanks to the training and equipment provided at the centres, technicians now feel more confident and able to dismantle and dispose of end-of-life refrigerators, to separate and properly reuse or refurbish certain components, as well as either reclaim refrigerants or make them available for proper destruction.

Owners now have access to repair or disposal advice, thus reducing both e-waste and the release of harmful gases into the atmosphere. By successfully testing the reclamation of HFCs, the project has demonstrated the potential for their reuse, allowing a reduction in resource use by looping the refrigerant through additional life cycles. Awareness-raising and capacity building in the practice of HFC conservation also led to a change in use patterns, establishing these gases as assets rather than waste.



SCAN HERE for more info on the project





Driving Sustainability in Insulation Foam

Globally, the fastest growing sector in terms of resource use is the construction sector, offering an array of opportunities to promote the circular economy.

Using environmentally benign materials, minimizing overall material use, and maximizing the energy efficiency of buildings are all circular economy practices that can be adopted in the construction sector. The manufacture of insulation foam, used in refrigerators and insulation panels, is just one example of how an industrial process can be adapted to achieve all of these benefits. Manufacturers now design out certain ozone depleting greenhouse gases called hydrochlorofluorocarbons (HCFCs), and replace them with alternatives. This can lead to foams insulating better, enhanced resource efficiency, and/or increased energy efficiency.

Main Approach

UNIDO has helped to convert foam production lines at 11 enterprises in Iran through the development of individual investment projects. From the redesign of foam production equipment through to the establishment of a supply chain, the manufacturing facilities now use pentane as a climate-friendly alternative. Technicians were also trained in the servicing of the foam production equipment, as well as in the safe use of the flammable alternative.

UNIDO implements a large number of projects and programs for, mainly, the conversion of manufacturing industries in the foam sector, but also for individual foam production lines. 2019, UNIDO implemented 26 such programs and projects in 23 countries, with a total budget of US \$55.8 million. UNIDO's work on such projects in that year alone will lead to 19.8 million tonnes of CO₂ equiv. emission reductions.

FACTS & FIGURES

- 4 enterprises in the sandwich panel manufacturing sector converted to new technologies
- 7 enterprises in the domestic refrigerator manufacturing sector converted to new technologies
- 1613 metric tons of ODS phased out in Iran's foam sector

Results and Impact

From helping to reduce food losses, to increasing the energy efficiency of a key building material, the project increased Iran's ability to use high-quality insulation foams for buildings and refrigerators with environmentally sustainable, locally available technologies, while reducing climate impact at the same time. The successful conversion of the enterprises and the enhanced capacity of technicians servicing foam production equipment will also help to improve effectiveness and efficiency, saving additional resources in the foam production process.





Photo: Daria Shevtsova / Pexels

Creating Value through Waste Management

Armenia, Belarus, Kazakhstan and Ukraine are proud producers of fresh fruits and vegetables, and leaders in the production of industrial machinery, trade and manufacturing.

Countries such as Armenia, Belarus, Kazakhstan and Ukraine rely heavily on refrigeration and air conditioning (RAC) equipment for economic growth. However, there is no proper end-of-life treatment of RAC equipment in the region and it is routinely sent to landfill where it creates problems for the environment. When these appliances are not disposed of correctly, they can emit gases that deplete the ozone layer and contribute to climate change. Additionally, all of the valuable materials in refrigerators and air-conditioning units like aluminium, copper, plastic and glass, which can be used as resources for production processes, are lost. Addressing this problem therefore has two key benefits: it reduces the environmental

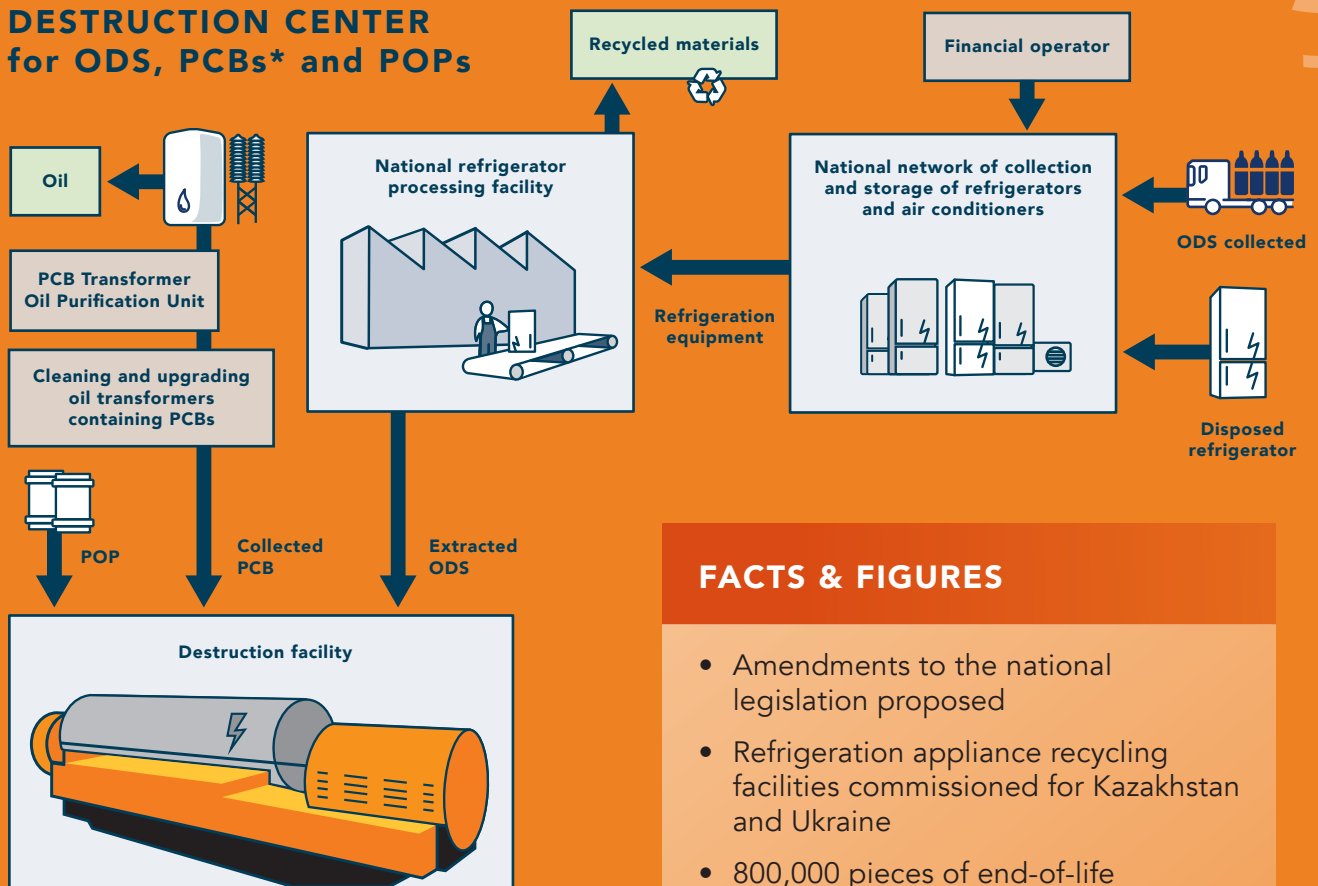
impact of landfilling and generates economic opportunities by transforming waste into raw materials.

Main Approach

UNIDO's regional project supports the development of a comprehensive waste management system for RAC appliances – from the moment they reach their end-of-life, until the greenhouse gases (GHGs) they contain are safely disposed of. UNIDO is also supporting the region in adapting legislation to minimize the environmental impact of waste disposal. Recycling centres, where ozone depleting substances (ODS) can safely be extracted

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DESTRUCTION CENTER for ODS, PCBs* and POPs



* Polychlorinated biphenyls (PCBs)

FACTS & FIGURES

- Amendments to the national legislation proposed
- Refrigeration appliance recycling facilities commissioned for Kazakhstan and Ukraine
- 800,000 pieces of end-of-life refrigeration equipment expected to be recycled
- 248 metric tonnes of ODS estimated to be extracted and disposed of
- 2 additional recycling facilities due to be established

and valuable raw materials can be recycled from end-of-life refrigerators, freezers and air conditioning units, will also be established and training will be provided at all stages of the waste management system.

Expected Results and Impacts

With the recycling technology installed under the regional project, it is expected that it will be possible to recover approximately 95 per cent of the insulating foam contained in refrigerators and freezers. It is estimated that this will reduce typical refrigerator landfill waste by 85 per cent (by weight). ODS will be recovered and destroyed, preventing their release into

the atmosphere and mitigating environmental impact. This will save landfill space and reduce resource consumption. Valuable refrigerator materials, such as metal, copper, aluminium and plastic will also be recovered and resold commercially on the recycling markets. By ensuring a high recovery rate for refrigerants, the new waste management systems will not only reduce emissions of ODS and greenhouse gases, but also help to establish new economic opportunities.





Preparing a Move to Greener Services

Making high-value consumer goods last longer and work harder is a crucial element of the circular economy. Extending product lifetimes and increasing functionality enhances resource efficiency and reduces the environmental impact of emissions at the same time.

The cold chain remains an important area for circular economy efforts. Refrigeration and air conditioning (RAC) systems must be properly serviced in order to ensure that the potential environmental benefits are optimized and greenhouse gas leakages are safeguarded against.

In Turkey, as in many other developing and middle income countries, a legislative and regulatory framework is needed in order to strengthen the RAC service sector. With this in mind, a UNIDO project aimed to help prepare the country for the ratification and early implementation of the Kigali Amendment to the Montreal Protocol. Introduced in October 2016, the Amendment aims for the phase-down of environmentally harmful hydrofluorocarbons (HFCs) by cutting production and consumption.

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FACTS & FIGURES

- Support for the institutional arrangements achieved
- National strategies discussed
- Legislative workshop carried out
- 150 participants attended technical sectoral workshops on HFCs alternatives
- Capacity building for legislators and awareness raising initiatives planned

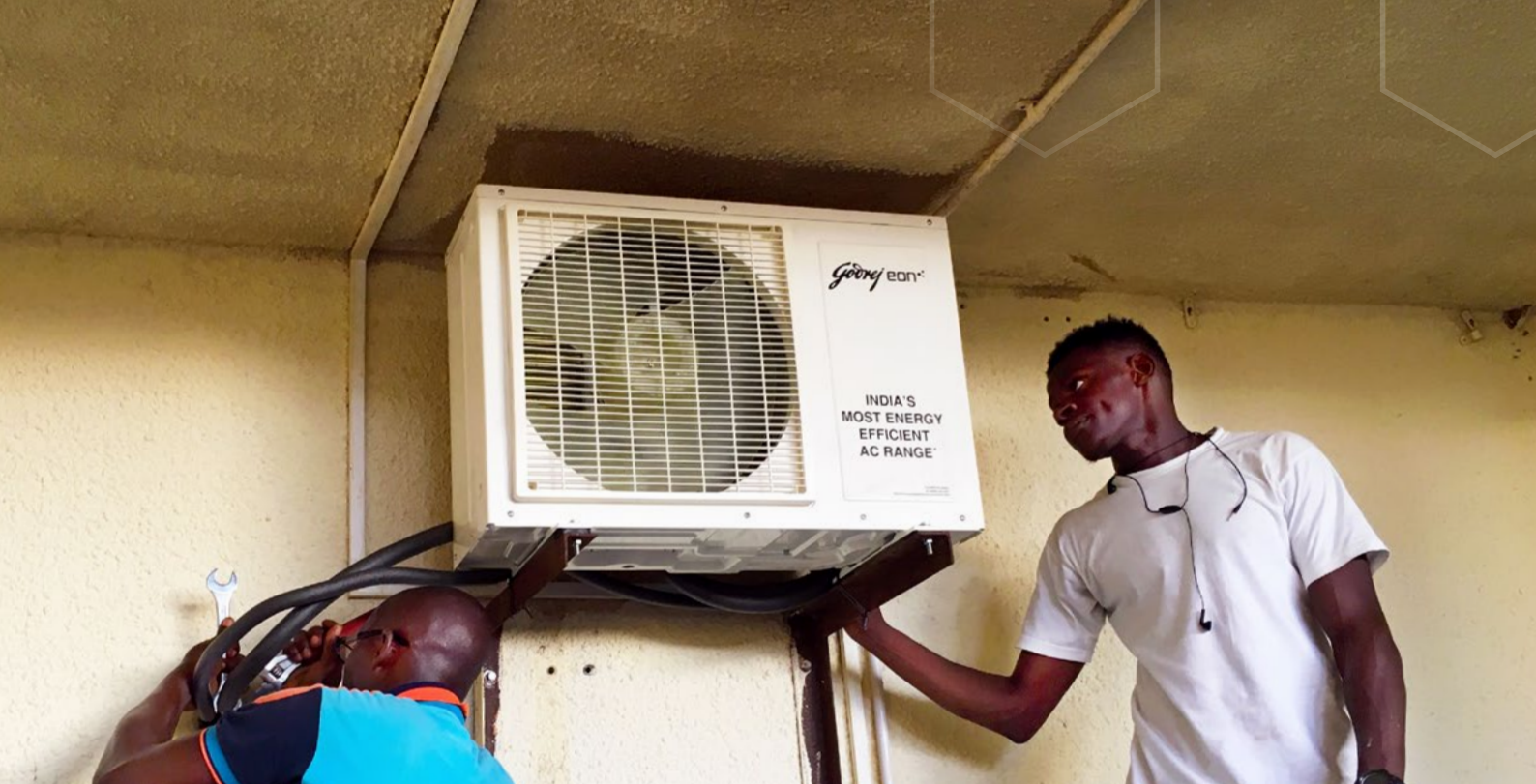
Main Approach

Through the project, UNIDO brought together policymakers and national and international experts to come up with technical solutions and a legislative framework that will help to create an environment conducive to HFC reduction. The focus is on reducing the overall usage of HFC refrigerants and promoting the most sustainable models of RAC equipment. This form of policy support provides the basis for the adoption of climate-friendly alternatives and cost-effective solutions that successfully reduce HFC use and also meet consumer demand.

Expected Results and Impact

Facilitating a reduction in HFC refrigerant use in the service sector will foster best practices and circular economy practices, which, at the same time, address the demand for improved air conditioning maintenance and servicing. In this way, the policy and regulatory support provided will help to boost the RAC servicing sector in Turkey and position the country well for further future development and application of low climate-impact technologies.





Foundations for the Use of Green Alternatives

If air conditioning systems are poorly maintained, whether due to a lack of skills or of basic tools, this can lead to the leakage of environmentally harmful hydrochlorofluorocarbons (HCFCs), which shorten a system's lifespan and increase energy costs.

Traditionally seen as a low-cost option, HCFCs are becoming less available and more expensive. Meanwhile, the high investment costs associated with installing new climate-friendly equipment, combined with high electricity costs, serve as a deterrent for end-users in The Gambia who already have to deal with tight market prices for their products. These issues can be addressed by providing incentives, as well as safety and maintenance training for the use of climate-friendly technologies and alternative refrigerants.

Main Approach

With funding from the Global Environment Facility (GEF), UNIDO provided support to companies in the RAC servicing sector including technical assistance on policymaking and technology transfer. This included support in developing regulatory frameworks which enable the conversion of industrial RAC facilities from the use of ozone-depleting substances (ODS) and greenhouse gases (GHGs) to the use of alternative refrigerants. Together with the Gambia Technical Training Institute (GTTI), capacity building initiatives were aimed at service technicians, while awareness-raising on the energy saving and environmental benefits of better maintenance and servicing was aimed at owners and managers of industrial RAC facilities.

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FACTS & FIGURES

- 20 trainers/facilitators trained and certified
- 150 technicians trained in the installation and maintenance of air conditioning units
- At least 150 green jobs secured/created
- 200 new, energy-efficient and climate-friendly air conditioning units delivered
- 22 companies received newly installed units and technical support
- 22 companies adopted best technologies/new technologies

Results and Impacts

As part of an end-user incentive mechanism, new energy-efficient air conditioning units were procured and installed in local organizations and public buildings. This incentive has made such investments more attractive, while also attracting local consumers' attention and demonstrating the government's commitment to improving energy efficiency and moving towards alternative refrigerants. In this way, the use of subsidies has led to the establishment of markets for greener, more sustainable, and more circular products.

The entrepreneurs and technicians working in the servicing sector are now trained in the installation and maintenance of the new units, as well as in the essential safety procedures for the use of the flammable hydrocarbons. The training of trainers is enabling "super technicians" to pass on their knowledge by replicating the training in their communities, further building capacities and securing jobs.



8 DECENT WORK AND ECONOMIC GROWTH



13 CLIMATE ACTION





Brazil's First Climate-friendly Beer Cooler

Focusing on the design of products is essential to achieve a substantial move towards a circular economy.

At the design phase, hazardous substances can be avoided, resource use can be minimized, resource efficiency in the production process can be improved, serviceability can be enhanced, product lifetime can be extended, and recyclability can be optimized from the very outset.

Given the harmful effects that refrigerants can have on their surroundings and the environment, UNIDO undertakes a large number of projects where refrigeration equipment is redesigned using low-impact, alternative refrigerants. In addition, the amount of refrigerant for each unit can be drastically reduced, and related resources can be saved.

As most beer coolers use ozone-depleting, high-impact climate gases like hydrochlorofluorocarbons (HCFCs) as refrigerants, part of the challenge is to adopt affordable green technology while making economic and environmental gains. At the same time, the most climate friendly alternative technology, propane, is flammable so it makes sense to reduce the amount of refrigerant within the closed system.

Small and medium-sized enterprises (SMEs) are constantly looking for ways to be more energy efficient, reduce environmental impact and improve customer experience. Chopeiras CITTI, a small, locally-owned manufacturer of

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FACTS & FIGURES

- 10% energy efficiency improvement
- Reduction in production and labour costs
- Reducing resource consumption through energy efficiency
- Replacing ozone-depleting substances (ODS) with climate-friendly alternatives

beer coolers based in Ribeirão Preto, Brazil, is one such enterprise. A new design introduced under a UNIDO project reduced the amount of refrigerant needed by a factor of 11, from 1.2 kg to 0.09 kg for each unit; the climate impact of the refrigerant per unit was reduced by a factor of 1500.

Main Approach

UNIDO partnered with Chopeiras CITTI in a project aimed at developing a beer cooler capable of cooling at least 20 litres of beer per hour. Together with local consultants and mechanical engineers, a complete product redesign resulted in a far more energy efficient

product. The provision of new equipment, safety training, and changes to existing manufacturing equipment and facilities all enabled the company to safely use alternative, flammable refrigerants in a fully-tested, climate-friendly solution.

Results and Impacts

The project demonstrates that SMEs can integrate circular economy practices that have both a positive environmental and economic impact. The beer cooler's improved, green design increased energy efficiency, decreased refrigerant leakage rates and reduced overall resource use (in this case refrigerant, electricity and raw materials). At the same time, the new design extended the lifetime of the product. By replacing HCFCs with a propane alternative, an environmentally harmful component was designed out, which not only resulted in greenhouse gas emissions reduction, but also substantially reduces the challenges involved with the recovery, storage and destruction of refrigerant once the beer cooler reaches the end of its useful life.

In terms of economic impacts, the company experienced savings in labour costs due to the reduced assembly time, and savings in production costs due to the use of fewer raw materials. As a result of these improvements, the company requested UNIDO to continue the support, by implementing a full conversion of their manufacturing facilities with the aim of extending the same alternative technology to larger capacity beer coolers. At the same time, the benefits, in particular the cost reductions in manufacturing, and the decision by the manufacturer to convert their complete product line, encourage other SMEs in the sector to switch to more climate-friendly, economically profitable designs.





Providing Access to Green Alternatives in Chad

Refrigeration and air conditioning (RAC) products provide essential services to industry and society across the world, including in Chad, where a UNIDO project focused on enhancing the RAC servicing sector.

Refrigerants require careful handling, the absence of which can lead to leakages and lasting damage to refrigeration systems and to the environment. Many refrigerants are also greenhouse gases. Moreover, for countries like Chad, they need to be imported. Certain refrigerants that are governed by international treaties, such as the Montreal Protocol, are increasingly difficult and expensive to obtain, shortening the lifetime of refrigeration equipment due to limited servicing options.

The conservation of refrigerants can reduce Chad's reliance on such imports, and extend the lifetime of refrigeration equipment, while reducing the related greenhouse gas emissions. This eliminates the need for often limited investment to replace a refrigeration system essential to an industry's operation. Adequate training is therefore needed for technicians in the adoption of circular economy practices that contribute to leakage prevention and recovery, extending the lives of systems and mitigating such risks.

UNIDO implements a large number of projects and programs for, mainly, capacity building, but also for policy support in servicing, good practices and end of life cycle. 2019, UNIDO implemented 110 such programs and projects in 68 countries, with a total budget of US \$35.2 million. UNIDO's work on such projects in that year alone will lead to 4.4 million tonnes of CO₂ equiv. emission reductions.

FACTS & FIGURES

- 6 Centres of Excellence strengthened
- 44 metric tons of ODS phased out
- 50 technicians trained (so far – status November 2019)
- 10 technician's trainers trained

Main Approach

UNIDO provided equipment, tools and training to centres of excellence across the country to promote good practices in the RAC servicing sector. Improved analysis of refrigeration systems, enhanced leakage detection, better repair quality, and ability to recover, test and reuse refrigerants, combined with access to alternative technologies with low climate impact all formed part of the project approach.

Results and Impact

Centres of excellence in N'Djamena, Doba, Abeché, Moundou, Sarth and Mongo were strengthened through the provision of equipment and tools. By reducing the strain on refrigeration systems, proper service training extends the life of appliances. The training provided adds to the servicing sector value chain, with formal training of this kind securing jobs and increasing incomes in the sector.

Awareness of the availability of alternative refrigerants will encourage their market penetration in the country and contribute to sustained reduction in the use of ozone depleting substances (ODS), further reducing the environmental impact of such gases.

8 DECENT WORK AND ECONOMIC GROWTH



13 CLIMATE ACTION





Leading the Way in Resource Recovery

Refrigerants are the invisible agents that power our refrigeration and air conditioning (RAC) systems in industries such as the pharmaceutical, automotive and food processing sectors.

Although refrigerants are valuable products, those containing chlorine or fluorine (HCFCs, HFCs) pose significant threats to the environment, and are therefore controlled under the Montreal Protocol. In South Africa, where all of these refrigerants are imported, service technicians and installers face dwindling stocks, while conversion of existing RAC systems to other technologies is not a viable option. Both technicians and installers are faced with the need to implement circular economy practices in order to be able to continue satisfying service requirements and make a living.

The recovery, reclamation and reuse of refrigerants offers an effective and safe way of

retaining their value as well as their utility; in particular since the current prevalent practice is to vent these gases into the air in case of a service. In RAC systems, refrigerants can be emitted into the atmosphere if the system is not adequately sealed, by accident, during maintenance or when systems are dismantled or disposed of. Refrigerant conservation is the most direct way to reduce emissions, while ensuring a supply of refrigerants which will become increasingly scarce and more valuable in the future. This translates to substantial economic opportunities through the establishment of recovery, recycling and reclamation facilities for the environmentally sound management of refrigerants.

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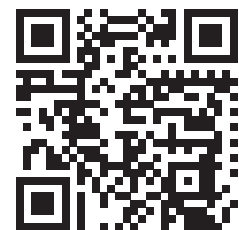
FACTS & FIGURES

- 4 national recovery, recycling and reclamation facilities established
- Necessary reclamation facility equipment provided and delivered
- Environmentally sound training for operators conducted
- Training workshops in “good refrigeration management practices” carried out

Results and Impact

The project has established national recovery, recycling and reclamation facilities in Johannesburg, Durban, Cape Town and Port Elizabeth, equipped with tools for the safe extraction and cleaning of refrigerants for the purposes of reuse. As a result of extensive training, operators are implementing environmentally sound practices and adopting recovery plans that allow refrigerants to be reclaimed and reused. Awareness and training on good refrigeration practice has educated operators on the consequences of leaks and enabled them to prevent leakages, while providing the knowledge to improve materials management. Stakeholders in the RAC sector have gained an insight into refrigerant reclamation for the future, establishing refrigerants as a resource rather than a waste and strengthening refrigerant conservation efforts in South Africa.

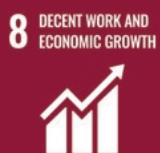
The establishment of these facilities assists South Africa’s RAC sector in integrating circular economy practices. Refrigerants live for hundreds of years; by substantially extending the fraction of their life cycle when they are having a utility, i.e. before they are emitted, the sector is optimizing the utilization of resources, thereby minimizing waste, reducing the need for new substances and increase climate impact. In providing training, capacities have been built so that refrigerants can be reclaimed and reused, thereby extending the life of the product, preventing unnecessary replacement of refrigeration systems ahead of time and again contributing to a circular economy. The project has also offered new approaches to resource use for small and medium-sized enterprises by enabling access to a new service model for refrigerants that did not previously exist.



SCAN HERE for a video on the project

Main Approach

In cooperation with the Department of Environment, Forestry and Fisheries (DEFF) and the Association of South African Refrigeration & Air Conditioning Contractors (SARACCA), UNIDO developed a strategy for the introduction of sustainable approaches in the RAC sector. Equipment is being provided to established facilities, as well as capacity building in the form of training on the safe recovery and management of refrigerants, the servicing of equipment, and the maintenance of tools.









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