



United Nations  
Industrial Development Organization

*Some like it cool*



UNIDO and  
the Montreal Protocol



## TEAM

Editorial team: Mounirah Bissiri, Andrés Celave-Fernandez, Luise Eisfeld, Maartje Geerlings, Fukuya Iino (project manager), Mirjana Ilijin, Matthias Koster, Alice Miller (editor), Ole Nielsen (project manager), Giorgia Pasqualetto, Yana Prosvirova, Katinka Vigh, Chelsea Wald, Jiani Wu.  
Graphic Designer: Adelaida Contreras.

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# UNIDO and the Montreal Protocol



## Director General of UNIDO

*UNIDO has a strong legacy as an implementing agency of the Montreal Protocol, and with the recent Kigali Amendment, we are ready for some new challenges.*

Since becoming the fourth implementing agency in 1992, UNIDO has completed around 1,400 projects in developing countries and economies in transition. Not only do we assist these countries to comply with their obligations under the Montreal Protocol, but we simultaneously support industry, thus promoting and accelerating Inclusive and Sustainable Industrial Development (ISID). We now implement around 35 per cent of the Montreal Protocol projects approved by the Multilateral Fund in terms of dollar value.

At UNIDO, our commitment to industry, innovation and infrastructure aligns with Sustainable Development Goal 9. But our work does not stop there, as this booklet shows. The work of the Montreal Protocol Division covers goals from Gender Equality to Responsible Consumption and Production to Climate Action.

The recent amendment to the Montreal Protocol shows that the treaty is more relevant than ever. For 29 years, the Protocol has not only reduced the release of ozone depleting substances and thus prevented damage to the ozone layer, but it has also mitigated climate change, because ozone depleting substances are strong greenhouse gases. The Kigali Amendment, which commits to phase down HFCs, only increases that commitment to combat global warming.

With the new amendment, the Division's work will go on, as well as begin to chart new territory. There is a lot to be done. UNIDO will continue to assist the Parties to the Montreal Protocol to not only promote Inclusive and Sustainable Industrial Development, but also to protect the ozone layer and increasingly to bring substantial, sustainable reductions in climate gas emissions.

A handwritten signature in blue ink, consisting of stylized Chinese characters.

Li Yong



## Executive Secretary Ozone Secretariat

United Nations Environment Programme (UNEP)

*At the Ozone Secretariat, we have watched UNIDO's progress as an implementing agency of the Montreal Protocol from the beginning. UNIDO has always been notable for its creative and innovative approaches to implementing the Protocol.*

UNIDO has continually sought new, elegant solutions to the challenge of phasing out ozone depleting substances. In developing countries, the phase out of methyl bromide – in which UNIDO assisted 70 per cent of projects worldwide – is a perfect example. Through a number of inventive, ozone friendly methods, UNIDO not only helped developing countries to phase out the ozone depleting chemical, but actually assisted individuals, companies, and industry to improve their products, food security and economic output along the way.

Today, UNIDO is leading in adapting the newest and most environmentally friendly technologies to developing countries. For example, PRAHA, a project which aims to find the best technical solutions for the challenge of air conditioning in countries with high ambient temperatures, not only showed promise in its initial findings, but triggered many additional international programmes to continue what has become a committed, ongoing process.

UNIDO's Montreal Protocol Division has a large number of technically oriented staff members, allowing the group to combine expertise, knowledge, teamwork and experience, all of which lead to the successful implementation of its services.

UNIDO is committed to developing new approaches to overcome emerging challenges while at the same time ensuring that its proposed alternatives are gentle on the climate. This has always been an important goal, and now, with the Kigali Amendment to phase down hydrofluorocarbons (HFCs) under the Montreal Protocol, this is more vital than ever. To date, UNIDO has provided innovative solutions, and I am sure it will continue to do so in the context of this new, exciting challenge, in assisting and offering choices to developing countries to transition away from high global warming HFCs.

A handwritten signature in blue ink, appearing to be 'Tina Birmpili'. The signature is stylized and fluid.

Tina Birmpili

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## Beginnings

In mythology, the goddess Nüwa smelted a stone of seven colors, and blocked a hole in the sky to repair the wall of heaven. Chinese artist Yuan Xikun saw Nüwa as a symbol for the present day challenges of ozone depletion and climate change. China has used the Goddess Nüwa for a communication campaign to reduce and phase out **hydrochlorofluorocarbons (HCFCs)**.



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“Perhaps the single most successful international agreement to date has been the Montreal Protocol.”

Former UN Secretary-General Kofi Annan

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Members of UNIDO's Department of Environment

**The Montreal Protocol is the most successful environmental agreement in history.**

**The international treaty was established in 1987 to prevent the use and production of chemicals that deplete the ozone layer.**

# A quiet triumph

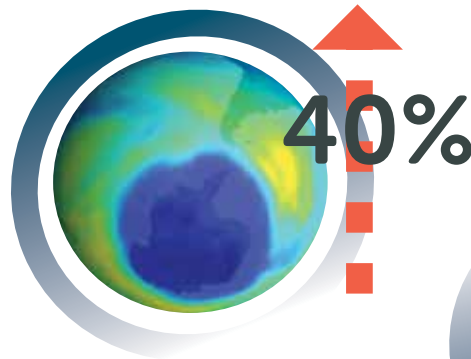


The ozone layer – a fragile shield made of a faintly blue, pungent kind of oxygen – protects the earth from harmful ultraviolet rays, which can cause skin cancer and cataracts, and damage agriculture and wildlife.

After scientists discovered ozone depletion in the 1970s, a hole in the ozone layer was detected above Antarctica in 1985. **The global community swung into action.** The Montreal Protocol on Substances that Deplete the Ozone Layer was established under the Vienna Convention, and came into force in 1989. Subsequently, **the treaty was ratified by every country in the world.** Under the Protocol, developed countries contribute to the Multilateral Fund, which assists developing countries to comply with their Montreal Protocol obligations.

The Montreal Protocol was the first environmental treaty to set **different targets for different members.** For instance, while developed countries were required to completely phase out ozone depleting chlorofluorocarbons (CFCs) by 1996, developing countries were given until 2010.

With the continued work of the Parties to the Montreal Protocol, the Ozone Secretariat, the Multilateral Fund, and the implementing agencies, the hole in the ozone layer is recovering, and is expected to disappear completely around the middle of the century. But while work to restore the ozone layer continues, **there is also a new challenge to face: global warming.**

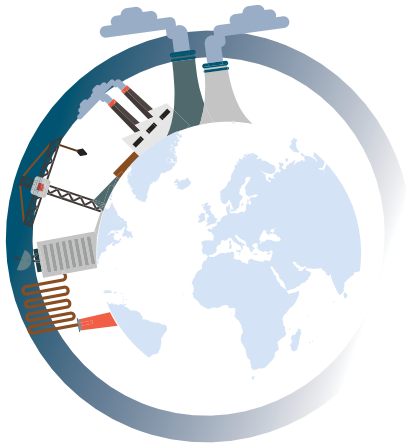


Levels of ozone depleting substances would be five times higher than today.

By 2013, the hole in the ozone layer above Antarctica would have grown by 40 per cent.

There would be a deep hole in the ozone layer above the Arctic, large enough to affect northern Europe.

# A world without the Montreal Protocol



millions  
more  
cases



Around the globe, ozone depleting substances would have thinned the ozone layer by around 15 per cent.

Higher UV radiation levels would have damaged terrestrial and aquatic ecosystems, biogeochemical cycles, materials, and air quality.

**There would be millions more cases of fatal skin cancer, and tens of millions of cases of non-fatal skin cancer and cataracts.**



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Since 1992, UNIDO has been an **implementing agency** of the Montreal Protocol's funding mechanism, the Multilateral Fund.

UNIDO's **Montreal Protocol Division** assists developing countries to phase out ozone depleting substances, and **phase in new ozone and climate friendly alternatives.**



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For UNIDO, **sustainable, clean technology is balanced with healthy industry.**

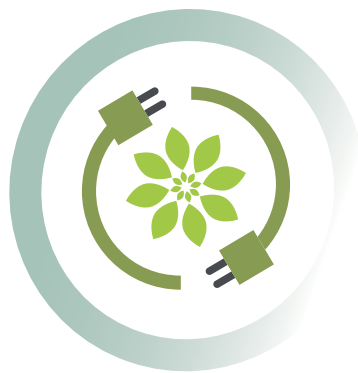
Target sectors include refrigeration, air conditioning, foam manufacturing, agro-industry, solvents and healthcare. UNIDO develops and implements **programmes that support industry players** not only to switch to environmentally friendly technologies, but also to **improve products, economic performance and employment opportunities.**



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**Around 1,400 Montreal Protocol projects** have been completed by UNIDO since 1992, with the financial assistance of the Multilateral Fund, the Global Environment Facility, and bilateral contributions from developed countries.

# UNIDO steps in



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UNIDO's actions fall under the concept of the **circular economy**. UNIDO assists in the conversion of manufacturing processes and products to **environmentally sustainable** alternatives. Technical training, equipment and safety practices help to **extend the life of the product**. UNIDO supports

government institutions to **monitor consumption** of ozone depleting substances, **strengthen** regulatory frameworks, and **educate** customs officers, policy makers and the general public. Finally, UNIDO is active in refrigerant management, where the emphasis is on **recovery, purification and re-use**.



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UNIDO has regularly been recognized as an especially effective implementing agency of the Montreal Protocol. Since 1992, UNIDO has helped phase out 71,000 tons of ozone depleting substances per year, which is **more than a third of the consumption of ozone depleting substances in the developing world**.

# The story so far...

**1966**

UNIDO is established to promote and accelerate the industrialization of developing countries.



1960

1970



**1974**

UNIDO and the newly founded United Nations Environment Programme (UNEP) create a joint environmental programme to safeguard the environment without compromising industrial development.

**1985**

The **Vienna Convention for the Protection of the Ozone Layer** is established, a framework to increase coordinated research on the ozone layer.

Scientists detect a **hole in the ozone layer** above Antarctica.



1980

**1987**

The **Montreal Protocol for the Protection of the Ozone Layer** is created under the Vienna Convention, and comes into force in 1989. Countries agree to phase out ozone depleting substances according to a schedule.



**1989**

The Parties to the Montreal Protocol agree on the total phase out of CFCs and halons.

**1991**

The **Multilateral Fund for the Implementation of the Montreal Protocol** is established. It is funded by developed countries to assist developing countries to meet their obligations under the Montreal Protocol.

UNEP, the UN Development Programme (UNDP) and the **World Bank** become implementing agencies of the Multilateral Fund.

1990

**1992**

UNIDO becomes an implementing agency of the Multilateral Fund.

The Copenhagen Amendment to the Montreal Protocol adds hydrochlorofluorocarbons (HCFCs), hydrobromofluorocarbons (HBFCs), and methyl bromide to the phase out schedules.



**1994**

Halon production ceases in accordance with the Montreal Protocol.



## 2006

UNIDO becomes an implementing agency of the **Global Environment Facility (GEF)**.



## 2007

On the 20th anniversary of the Montreal Protocol, the Parties agree on an accelerated timetable to phase out hydrochlorofluorocarbons (HCFCs). Developing countries commit to essentially phase out HCFCs by 2030.

## 2000

### 2008

The Parties to the Montreal Protocol agree to pilot projects for the possible destruction of banks of ozone depleting substances.



### 2009

UNIDO secures approval from the Executive Committee of the Multilateral Fund for the first ever **HCFC Phase Out Management Plan (HPMP)**, in the former Yugoslav Republic of Macedonia. UNIDO goes on to implement Phase Out Plans in 72 countries.

UNIDO adopts a new policy on **gender and women's empowerment**.



### 2010

Developing countries successfully phase out CFCs, halons and carbon tetrachloride (except for essential use exemptions).



## 2010

### 2013

UNIDO's Member States adopt a new Lima Declaration, which sets the foundation for a new vision of **Inclusive and Sustainable Industrial Development (ISID)**.



### 2015

UN Member States adopt the 2030 Agenda for Sustainable Development, including a set of **Sustainable Development Goals (SDGs)**.



Under the Paris Agreement, 195 countries commit to limiting global warming to well below 2°C.

Developing countries successfully phase out methyl chloroform, as well as the fumigant methyl bromide, used frequently in agro-industry (with selected defined exemptions).

### 2016

The last of the CFCs – in metered dose inhalers – are completely phased out in developing countries.



In Kigali, Rwanda, the Parties pass an amendment to phase down hydrofluorocarbons (HFCs). This extends the Montreal Protocol beyond the phase out of ozone depleting substances to industrial climate gases, leveraging the Protocol's established success in addressing the use of industrial gases.

UNIDO celebrates its **50th anniversary**.



**TOGETHER**  
for a sustainable future

### 2017

UNIDO celebrates 25 years of implementing the Montreal Protocol.

# Sustainable Development

UNIDO is committed to the Sustainable Development Goals.

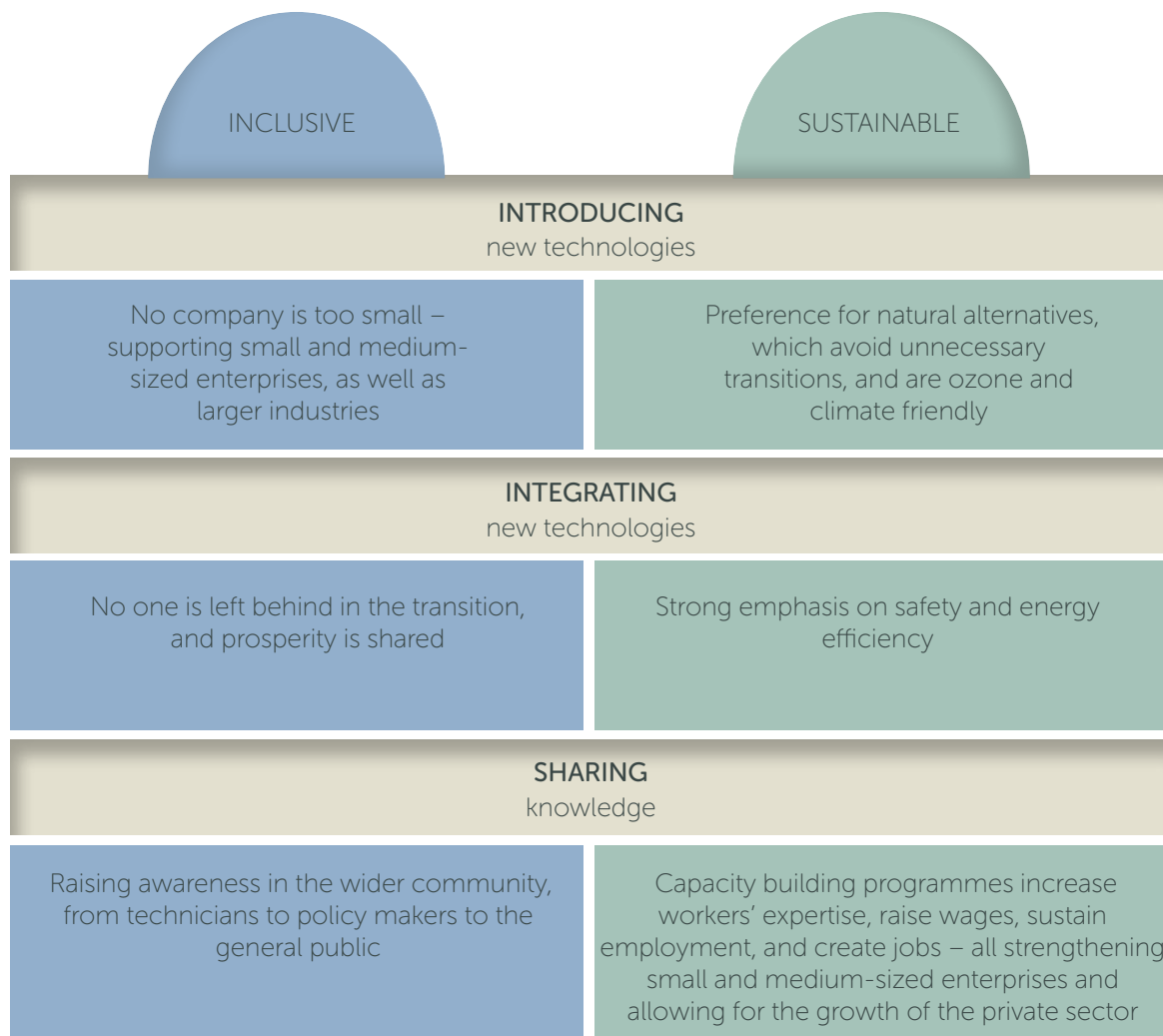


Each story in Chapter Two highlights a particular goal in relation to the Montreal Protocol Division's work.

# Our plan: Inclusive and Sustainable Industrial Development

The Montreal Protocol Division’s work benefits both industry and the environment.

**Industry and industrialization** are the key drivers of economic growth and development. The Montreal Protocol Division promotes **inclusive** and **sustainable industrial development** in the following ways:





# The big chill

## Fighting climate change under the Montreal Protocol

The Montreal Protocol is also a **significant force against climate change**. Many ozone depleting substances also contribute to global warming. By eliminating these substances, **UNIDO has already helped avoid the use and potential emission of 338 million tons of CO<sub>2</sub>-equivalent per year between 1990 and 2015.**

This is equivalent to:



The 2020 greenhouse gas emission reduction targets of Germany, France and the UK combined.



Spain's CO<sub>2</sub> emissions in 2012.



The CO<sub>2</sub> emissions of 99 coal-fired plants.



The CO<sub>2</sub> emissions of 71 million passenger vehicles driven for a year.

**The recent inclusion of the HFC amendment to the Montreal Protocol** shows that in the future, **the Protocol will be an even more powerful instrument against global warming**. It has been suggested that reducing HFCs under the Montreal Protocol **could avoid 0.5°C of global warming by the end of the century.**

See the **Future** section for more about what comes next for UNIDO.



# Changing to



# Today's World

Changing today's world







# Agro-industry

Around the world, the fumigant methyl bromide (MeBr) was commonly used in agriculture for storage and in the production of crops such as tomatoes, strawberries and tobacco seedlings. A colorless, nonflammable, highly toxic gas, methyl bromide protects against nematodes, weeds, fungi and insects.

When methyl bromide was listed under the Montreal Protocol as a harmful chemical that depletes the ozone, alternatives needed to be found. Assisting developing countries, UNIDO helped to provide effective, non-chemical technologies such as grafting plants, soil solarization, soilless cultivation, and bio-fumigation, as well as Integrated Pest Management programmes. As the main implementing agency for this sector, UNIDO was responsible for 70 per cent of the total phase out in developing countries.

UNIDO assisted 55 developing countries in 175 different projects to phase out methyl bromide, and succeeded in eliminating the use of more than 8,000 metric tons of the chemical worldwide, each year. With UNIDO's help, developing countries were not only able to shift to natural alternatives, but also to improve food security and product quality.

## Growing opportunities

**"I do want to study."**

Hundreds of women gained new skills and greater earning power while applying sustainable, eco-friendly techniques to phase out methyl bromide in **Mexico**.



UNIDO is committed to **gender equality and women's empowerment.**





Grafting – connecting the tissue of one plant to another – not only strengthens and protects plants, but it also serves as an alternative to methyl bromide, a toxic chemical which depletes the ozone layer. An effective pesticide, methyl bromide was used for decades for fumigation and storage in silos and mills. Between 1995 and 1998, Mexico was the largest user of methyl bromide in the developing world. When the chemical was phased out under the Montreal Protocol, sustainable alternatives had to be found.

Grafting is one of those alternatives. Promoted by UNIDO in cooperation with the Mexican government and local companies, grafting is now the major technology used in Mexico for the production of tomatoes, peppers, melons, and watermelons. A process which merges the root of one plant with the stem of another, grafting was found to be extraordinarily effective in preventing plant diseases that were transmitted from the soil. Grafted plants have increased vigor, higher tolerance for high and low temperatures as well as salinity, and also provide a very high yield. Grafting extends the farming season, and even improves the quality of the product.

Women are a crucial part of the grafting process. Of the several phases in the process, one is called the cut, where one plant's stem is connected to another plant's rootstock. This delicate procedure requires specially trained staff. In Mexico, most of those employed in this role are women, predominantly under the age of 30, with an average of two or three children.

Many of these women used to work as seasonal laborers or in company packing departments. Being a grafter is a specialized job requiring a greater skill level, for which the women receive more pay. This allows for economic stability,

more purchasing power, and better living standards for the women and their families. **Laura Isela**, a grafter in San Quintin, Baja California, said that as a result of grafting, **"little by little, I have improved different aspects of my life."** Women's contribution to the household economy is recognized; household tasks are shared more evenly between partners, and levels of domestic violence have decreased.

Being a grafter opens up more opportunities, allowing women to send their children to higher education, purchase a house, or even start their own business. **Maritza Meija**, a grafter in Guaymas, stated that her job had opened up opportunities for her and her family: **"I do want to study. This helps me. It helps me a lot to pay for high school or university. The same goes for my son."**

Gender equality is an important goal for UNIDO, and its gender mainstreaming strategy is sensitive to ways in which the needs and priorities of women and men can be different. **"Here they value me as a woman," Areli Rodríguez**, a grafter in Sonora, explained. **"They give priority to the fact that we are women."** Companies in Baja California, Baja California Sur, Sonora and Colima all use grafting techniques, and have trained more than 1,700 people, 700 of whom are women.

In 2014, Mexico eliminated methyl bromide altogether. From the phase out, 27 per cent (or 406 metric tons) of methyl bromide was replaced by grafting techniques. Following collaborations between companies, the Mexican government, international agencies and workers, grafting continues to protect the health of workers and consumers, improve the soil, and protect the ozone layer.

## Farmers' markets, global markets

**"Our exports are now safe."**

When **Morocco** was required to phase out methyl bromide, UNIDO assisted growers to switch to ozone friendly agricultural practices, ensuring sustainable food production and the continued success of global exports.



UNIDO promotes sustainable agriculture through the phasing out of methyl bromide, which ensures that crop production is **efficient, safe and gentle on the environment.**





Agro-industry is crucial for the Moroccan economy. Morocco produces fruit and vegetables not only for local markets, but also for export to Europe and the world. Half of Morocco's labor force is involved in agriculture. When the commonly used fumigant methyl bromide was phased out under the Montreal Protocol, this constituted a threat to industry.

In Morocco, methyl bromide was used to treat soil in the cultivation of tomato, strawberry, banana, melon and watermelon, green bean, cucurbit and cut flowers. With the assistance of UNIDO, various alternatives were found to eliminate the use of the toxic chemical.

For tomatoes, as well as cucurbits and a large proportion of melons and watermelons, the technique of grafting was used. This is a natural, environmentally friendly process that actually increases the strength of the plants. In the strawberry sector it was necessary to use a chemical called metam sodium. Another key alternative to methyl bromide was compost. Not only is composting an entirely natural process, it improves the health of soil and plants, leading to better productivity and food safety, and creating

more income for growers. **"The fact that we managed to swiftly find alternatives was very important for the farmers,"** said Mounir Miku, a tomato farmer in Agadir. **"Our exports are now safe."**

In a joint intervention between UNIDO, the Ministry of Agriculture, and private sector institutions such as APEFEL (Association of Fruit and Vegetable Growers and Exporters), a Center for Technology Transfer was set up in the city of Agadir to promote these new alternatives. The center provides training, technical research, and manuals and toolkits to assist growers with the new processes.

The swift shift to alternatives in Morocco enabled growers to continue to be competitive in national and international markets, while protecting the ozone layer. Today, Morocco's fruit and vegetable markets are extraordinarily successful, and the phasing out of methyl bromide in no way harmed that success. Overall, the project phased out 866 metric tons of methyl bromide, and natural processes such as grafting and compost even improved crop production.



# Refrigeration and air conditioning



Refrigerants are a large part of the overall consumption of ozone depleting substances in the world. They are used to cool our refrigerators, freezers, cold storage rooms, warehouses and air conditioners, as well as chillers, the large installations used to centrally cool buildings such as hospitals, hotels, or office buildings. Refrigeration is vital for food processing, storage, and security – all crucial parts of industrial development.

Much of the work of UNIDO's Montreal Protocol Division occurs in this sector. To date, there have been more than 450 projects in 61 countries.

After successfully phasing out most of the harmful CFCs in the 1990s, the focus shifted to phasing out damaging HCFCs. But when HCFCs were being phased out, they were often replaced with other chemicals – called HFCs – which do not deplete the ozone, but contribute to global warming. UNIDO, however, is committed to solutions that are not only ozone friendly but also gentle on the climate, and is actively promoting these alternatives. Wherever possible, UNIDO uses natural refrigerants – like hydrocarbons, CO<sub>2</sub>, and ammonia – which are both ozone and climate friendly.

New projects in the refrigeration sector include an exploration of air conditioning technologies for countries with high ambient temperatures, and a project to replace cold storage technology, with an eye on both ozone and climate. You can read about these projects in the **Future** section.

## Tide's rising

**"The waters right now are up to the boundary."**

In **St Vincent and the Grenadines**, the palpable threat of climate change helped to encourage an ambitious approach to phasing out ozone depleting substances.



UNIDO is committed to solutions that are not only **ozone friendly**, but also **friendly to the climate**.







In the island nation of St Vincent and the Grenadines, sea levels, floods, and hurricanes are on the rise. **“We often joke that God has to be Vincentian – since most hurricanes in our vicinity do not directly impact us,”** said Janeel Miller-Findlay, Director of Environmental Management. **“But climate change is a real threat here. In some areas, the waters right now are up to the boundary.”** The small Eastern Caribbean nation is extremely vulnerable to climate-related natural disasters, with around 33 per cent of GDP lost from severe weather events.

The Vincentian government needed to find an alternative to HCFCs, which were being phased out under the Montreal Protocol. HCFCs deplete the ozone layer, as well as being potent greenhouse gases. But while the easiest alternative, HFCs, do not damage the ozone layer, they still contribute to climate change. In the future, it would be necessary for a further phase out – to find an alternative for the HFCs. With the assistance of UNIDO as their technical implementing agency, the government decided to go straight from HCFCs to hydrocarbons, a natural alternative that is both ozone friendly and climate friendly.

Not only did the government decide to “leapfrog” – skip the transition to HFCs and switch straight to HCs – but they also decided to do it as fast as possible. They told the Executive Committee of the Multilateral Fund that they were prepared to go well beyond what was expected. For developing

countries, the phase out date for HCFCs is 2030.\* The Committee suggested that St Vincent and the Grenadines should phase down 35% of HCFCs by 2020. But the government proposed instead a 100% phase out by 2025.

**“They thought it was a bit ambitious,” Miller-Findlay said, “but I thought I knew my market well enough.” When the committee approved it, Miller-Findlay said, “I went home and we started on it right away.”**

The government partnered with UNIDO, as well as other government and private sector agencies to deliver training to familiarize technicians with the new refrigerants. UNIDO also provided equipment so that the National Ozone Unit could test all refrigerants that enter at the ports. Although not all local companies are endorsing HCs yet, three of the five major servicing companies have sent all of their technicians to training, and other technicians have also participated. Miller-Findlay says that while some parts of the process have been easier because St Vincent is so small, other parts have been more difficult, and the supply of refrigerant continues to be a challenge.

Although storms continue to visit St Vincent and the Grenadines, the government is acting to prevent climate change. In fact, St Vincent and the Grenadines are not only on track to meet their goal to phase out HCFCs completely by 2025. They are already two years ahead of schedule.

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\* Total phase out is actually in 2040, with a service tail of 2.5% per year allowed until 2040

## Propane persuasion

**“First we had to convince ourselves.”**

In **China**, it was a significant challenge to convince everyone that propane was a safe refrigerant, and to introduce it to the market.



UNIDO promotes **sustainable solutions for industry.**





At first glance, propane (R-290) appeared to be the ideal solution for the air conditioning sector in China. Under the Montreal Protocol, China had to phase out HCFCs by 2030. Propane is natural, ozone friendly, energy efficient, and has very low global warming potential.

However, there was a great deal of resistance to introducing the substance. One of the key obstacles was safety; propane is highly flammable.

But the refrigeration sector had already provided an example to follow. Since the 1990s, when the Chinese market had to phase out CFCs, the Chinese government with the help of UNIDO made the switch to isobutane (R-600a) and cyclopentane in the domestic refrigeration industry. Like propane, these alternatives are flammable, but they are also climate friendly, ozone friendly, and energy efficient. Since their introduction to the market, there has been a major increase in refrigerator manufacturing in China. There have been no known accidents. The conversion has saved around 16 billion kilowatt-hours of electric power, equivalent to the annual average energy consumption of more than 4 million people in China.

Despite this precedent, it was still difficult to make the shift to propane in the air conditioning sector. **“We had a very hard time at the beginning,”** said **Zhong Zhifeng**, the Deputy Director of the Foreign Economic Cooperation Office in the Ministry of Environmental Protection. **“To adopt a new technology, you need a huge amount of effort – money and time – so we faced a lot of challenges.”**

So, how did the Ministry overcome the safety concerns? At this question, **Zhifeng** smiled. **“First we had to convince ourselves,”** he said. The Ministry had to be absolutely certain that the new technology would not endanger human health. They engaged a third party institution,

specializing in risk assessment, and after a thorough examination, it was found that the risks were very low. In fact, the chance of something going wrong was lower than being hit by lightning.

In order to convince others, the Ministry encouraged the manufacturers to research propane themselves. Slowly, other companies began to accept that not only was propane sufficiently safe, but it was energy efficient.

A pilot programme at the Midea company was the first project in China under the Multilateral Fund, and involved close work between UNIDO and the Chinese government, technicians from enterprises, and the industrial associate, China Household Electrical Appliances Association (CHEAA). The project successfully promoted the use of propane as a suitable alternative to HCFCs.

Following the success of the demonstration project, the government, with UNIDO’s assistance, is now incentivizing enterprises to convert to propane in a manner which is market-orientated. Promising collaborations have resulted after seven years of hard work by FECO, CHEAA, and the industry. The first collaboration was Shenzhen University’s purchase and installation of 243 sets of propane air conditioners, and other collaborations have followed. In 2016, the largest air conditioner manufacturers began promoting propane conversions.

While **Zhifeng** acknowledged it will still take time, he believed that with joint effort and persistence, propane would be marketed and promoted successfully in the air conditioning sector. Generally, there is increasing commitment to green procurement for public institutions in China. While propane has been used successfully in smaller air conditioners, **Zhifeng** looks forward to transferring this experience to a larger scale. **“We still have some barriers,”** he said, **“but in the future we believe we will be successful.”**





# Foam

Polyurethane foams have many uses, from shoe soles and disposable cups, to insulation for fridges, freezers and buildings. Plastics such as polyurethane and polystyrene can have a “foamy” quality, which is provided by foam blowing agents.

At first, CFC-11 was widely used as a foam blowing agent. When CFCs were found to damage the ozone layer, they were initially replaced by HCFCs. In the foam sector, HCFC-141b was used as a foam blowing agent for polyurethane foam and extruded polystyrene foam, because it insulates and foams effectively. However, HCFC-141b is not only an ozone depleting substance but also a greenhouse gas, and it was also listed under the Montreal Protocol. The chemical is due to be phased out by 2030 in developing countries.\*

The foam sector is a major source of ozone depleting substances in developing countries. UNIDO has nearly 250 projects in the foam sector in more than 40 countries.

The main alternatives to HCFC-141b are hydrocarbons and water based technology, both of which are ozone friendly and gentle on the climate.

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\* Total phase out is in 2040, with a service tail of 2.5% per year allowed until 2040.

# The former Yugoslav Republic of Macedonia

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## Trailblazers

**"We were the first."**

With the first programme in the world to phase out HCFCs, **The former Yugoslav Republic of Macedonia** began the journey that many countries would follow.



UNIDO's programmes include **educational components for technicians, customs officers, policy makers, and the general public** to work towards ozone and climate friendly solutions.





The former Yugoslav Republic of Macedonia was the first developing country in the world to implement a programme to phase out HCFCs under the Multilateral Fund. The programme was approved by the Executive Committee of the Multilateral Fund in April 2010, and the guidelines for developing countries were released a year later. Macedonia's experience served as a model not only for the donor but for other countries around the world. To date, UNIDO has implemented HCFC phase out programmes in 72 countries.

In Macedonia, the national phase out strategy was designed by the Ministry of Environment and Physical Planning with UNIDO's technical assistance and the financial support of the Multilateral Fund. The main objectives were to minimize the use of ozone depleting substances until they were eliminated, to strengthen the regulation of these substances, and ensure emissions reduction by recovery, purification, and reuse of refrigerants.

The foam industry in Macedonia was a key target for phasing out ozone depleting substances. The conversion programme required an alternative to the current chemical, HCFC-141b. **"With UNIDO's help, Macedonia decided to go beyond the Montreal Protocol,"** said **Emilija Kjupeva-Nedelkova**, Manager of the Ozone Unit

in Macedonia. **"We were aiming not only for the phase out of ozone depleting substances,"** she said, **"but also aiming to avoid using a blowing agent which has global warming potential."**

The chosen solution is water-based and ozone friendly, with low climate impact. Although HFCs were frequently used in the foam sector – and before October 2016 there were no restrictions for their usage – UNIDO and the Macedonian government decided to leapfrog to a natural alternative.

Of the four foam manufacturers in Macedonia, two companies have already converted to the new technology, and the other two are currently in the process of conversion, with UNIDO project support. **"We have excellent communication with stakeholders, service technicians and with inspectors,"** Kjupeva-Nedelkova said. She said she was pleased to report that the companies using the new technology are now far more competitive on the national market.

Part of UNIDO's long term strategy includes an education component. This means educating not only technicians and customs officers about how to manage new technologies, but also working with policy makers and the wider public to raise awareness of ozone and climate friendly alternatives.







# Healthcare, solvents, destruction

UNIDO has also been involved in several other sectors, which we will touch on in this section.

In the healthcare sector, the phase out of CFC metered dose inhalers (MDIs) has seen the last of the CFCs phased out, while protecting the environment and human health. UNIDO assisted four developing countries to phase out MDIs.

Solvents, often used in cleaning, are another area where creative alternatives needed to be found; the selected alternatives include water, alcohols, esters, ketones, and hydrocarbons. More than 100 projects were implemented in the solvent sector with UNIDO's assistance, in 30 different countries.

Finally, the issue of the destruction of ozone depleting chemicals – or ODS “banks” – is not an explicit part of the Montreal Protocol, but helps with the goals of the Protocol. New pilot projects are beginning to tackle this challenge.

## Breathe easy

**“The new product has been very well received.”**

In the Islamic Republic of Iran, the phase out of MDIs marked a final goodbye to the last of the CFCs.



UNIDO protects **human health**, and not only in specific instances like for users of MDIs. All of UNIDO’s Montreal Protocol projects protect human health, because protecting the ozone layer prevents cases of skin cancer and cataracts.





When CFCs were phased out worldwide in 2010, there were a few temporary urgent use exemptions, where an acceptable solution had not yet been found. One of those exceptions was metered dose inhalers (MDIs), commonly used to treat asthma and other respiratory problems. This year, with the complete phase out of CFC MDIs, CFCs will be completely phased out worldwide – including all previous exemptions.

The first priority in the case of MDIs was human health. MDIs are used throughout the world. It is estimated that there are over 300 million people with asthma worldwide, and 65 million people suffering from moderate to severe chronic obstructive pulmonary disease (COPD), both of which require such inhalers. According to the World Health Organization, 80% of asthma deaths and 90% of COPD deaths occur in low and lower-middle income countries. Asthma is also on the rise throughout the world. It was essential to find a replacement that would work just as well, if not better than the CFC inhalers.

In Iran, the challenge of the replacement technology was tackled by a local company, Sina

Darou Laboratories, in cooperation with UNIDO and the Iranian government. The Iranian market size for MDI inhalers was 4.5 million annually, and 90 to 95 per cent of this was locally produced by Sina Darou Laboratories. UNIDO, the government and Sina Darou Laboratories found ways in which to create a product that was ozone friendly, and provided the same, reliable service to patients. Suppliers for machinery and technology were identified; relevant machinery was installed and tested; and operators for the machinery were trained. The transition took 36 months to finalize.

**“The whole process went very smoothly,”** said **Dr. Mazhari**, executive deputy of Sina Darou Laboratories Company. **“The new product has been very well received by physicians and patients so far.”**

In 2011, the Islamic Republic of Iran became the first country in the Asia-Pacific region to phase out CFC-based metered dose inhalers. Sina Darou Laboratories were able to close their manufacturing plant for CFC-based inhalers in 2010. The company continues to manufacture ozone friendly inhalers today.

## A watery end

**“For the next generation.”**  
The phase out of solvents in **Indonesia** led to the use of pure water, and huge benefits for local companies.



UNIDO is committed to **sustainable solutions** that **benefit cities and communities**, as in the phase out of Volatile Organic Compounds (VOCs).





Solvents are liquids or gases which can dissolve, suspend, or extract other substances. They are often used in cleaning, particularly degreasing metal parts and circuit boards or heavy machinery, dry cleaning, and paint or coating removal, but also in household and industrial products. We use solvents around the house in adhesives, nail polish remover, personal care products, and inks. But selected solvents – TCA or methyl chloroform; CTC; and CFC-113 – are damaging to the ozone layer, and several solvents are also powerful Volatile Organic Compounds (VOC), creating health problems in the wider environment in which they are used.

UNIDO began assisting to phase out solvents under the Montreal Protocol in 1993. In Indonesia, ozone depleting solvents were used in several areas, such as injection molding, which includes the manufacturing of polyurethane shoe soles; small electrical motors such as washing machines or vacuum cleaners; and industrial cleaning in the energy sector and railways. Because the substance and solvent have to match, finding a replacement can be difficult.

For many industrial cleaning processes, it was discovered that rather than using ozone depleting chemicals, it was possible to use high pressure water cleaning. Pure water, when distributed at a very high pressure, can perform this industrial cleaning effectively. No heating or detergent is necessary.

Water based technologies were not possible in all cases. In the case of injection molding and small electrical motors, these were cleaned in a

process similar to the earlier process, but with the replacement of perchloroethylene, a chlorinated hydrocarbon. The companies benefitted from the latest model of an application machine, which was not only considerably more efficient than earlier models. It also used vapor cleaning for small molds, small metals, and shoe soles, within a closed unit where all the chemicals are reused, and not released into the environment.

The companies benefitted in many ways from the switch to these environmentally friendly, emission free technologies. One of the companies, PT **Solindah Kita**, stated that UNIDO had allowed them **“to sustain this programme for the next generation, and to support the government in green industry and sustainable industrial development.”** The new technologies were far more efficient than the older ones, so the companies saved on energy costs. They also saved on operational costs, as the new machines were automatic. The fact that these companies now comply with the Montreal Protocol and use environmentally friendly technologies also allowed them to enter global markets. The total phase out of solvents in Indonesia was achieved in 2008.

There are ongoing human health benefits from UNIDO’s intervention, and not just from lessening the deleterious impact on ozone and climate. Research has shown that VOCs have adverse health effects in the short and long term. Cleaner processes – including the elegant solution of pure water, along with technology which allows for the re-use of chemicals – protect the health of workers and the wider population.

# Destruction creates

**“The equipment that we gave them  
is a kind of treasure.”**

In **Mexico**, the challenge to dispose of dangerous chemicals led to opportunities for individuals and industry.



UNIDO's interventions not only benefit the environment, but also emphasize **decent work** and **economic growth**.





In the past, Mexico was one of the principal emitters of ozone depleting substances (ODS) in the developing world. Large amounts of ozone depleting substances can still be found in existing equipment, stockpiles, products and waste streams, which together are known as ODS banks. Unless they are collected and destroyed, these banks will leak into the atmosphere, with serious repercussions for both the ozone layer and the climate. Although destroying ozone depleting substances is not necessary to comply with the Montreal Protocol, the disposal helps with the Protocol's goals. In 2008, the Parties to the Montreal Protocol agreed to analyze and fund pilot projects to destroy ODS banks.

With UNIDO's assistance, a pilot project was set up in Mexico. At first, it was unclear how to go about the process, according to **Agustin Sanchez**, the National Coordinator of Mexico's Ozone Protection Unit. There were so many questions: what was the best way to manage, transport, and destroy these dangerous chemicals? What were the risks, and how could they be avoided?

Training was necessary so that the gases could be collected, classified, managed, and destroyed. For the destruction component, skilled technicians were required. The destruction training program was aimed towards those who were already working as technicians. Many of the technicians

had received no formal training for many years, and some had never trained, but had learned on the job. With the training program, **Sanchez** observed, technicians gained a different status. **"For many of them, the equipment that we gave them is a kind of treasure ... They know how to use it, and they're using it... and they are bringing to the recovering and recycling centre these gases, and they've improved their job, they improve their status, they are able to earn more money."**

All trained technicians are registered with an ID number. Today, large companies – such as supermarket chains and refrigeration companies – ask for a technician's ID number when they are recruiting. According to **Sanchez**, the companies far prefer to contract technicians with these ID numbers, and this means that technicians are motivated to receive this training. **"In the past,"** Sanchez said, **"these technicians had bad practices, they didn't have any training. Now they've gone to the training center and got this registration in the system, and they got a better job. It's something we're proud of."**

Of course, these technicians are not only improving their own livelihoods. They are improving the lives of everyone, by preventing further damage to the ozone layer and helping to combat global warming.



# Changing tomorrow's world





# tomorrow's world

Changing tomorrow's world

净重: 25 kg

毛重: 28 kg

批号:

生产日期: 200 年 月 日

# Cool it, folks

**“We are looking for something more sustainable.”**

The question of air conditioning in high ambient countries is the start of a promising process between the countries of **West Asia**, industry, and UNIDO.



UNIDO is committed to new **innovations** in industry.





In countries with high ambient temperatures, air conditioning is not a luxury: it is a necessity. Around 15 per cent of the global market for air conditioning is shared between Gulf countries. These countries also present a special challenge for phasing out ozone depleting substances, because the main alternatives to HCFCs are potent greenhouse gases. The challenge is to find alternatives that are gentle on the climate. In cooperation with UNEP and the countries of West Asia, UNIDO has started the journey to try and find a sustainable solution.

In high ambient temperatures, air conditioners do not last or perform as well as they do in cooler countries. This is because of the additional stress on the equipment to bridge the gap between cool indoor and high outdoor air temperatures. Leakage and energy efficiency are both significant problems. While leakage can be considerably reduced with increased awareness and training, efficiency remains a challenge.

In 2013, the PRAHA project (Promoting Low-GWP Refrigerants for Air Conditioning Sectors in High Ambient Temperature Countries) was approved by the Executive Committee of the Multilateral Fund, with UNIDO and UNEP as the implementing agencies. The project intended to investigate alternative refrigerants which are gentle on the climate. It was implemented in consultation with Bahrain, Kuwait, Qatar, Oman, Saudi Arabia, the UAE, and Iraq, and testing of prototypes was held in the United States.

The project also had a technical assistant component, with a total of five international conferences in Dubai, and study tours in China

and Japan so that participants could gain familiarity with alternative technologies. Study tours were hosted in China by the Chinese Household Electrical Appliances Association (CHEAA) and China's Ministry of Environment and in Japan by the Japan Refrigeration and Air Conditioning Industry Association (JRAIA) and the Japanese government. This gave manufacturers from beneficiary countries the opportunity to see how different alternatives – such as the climate friendly R-290 – were used successfully in air conditioning manufacturing plants and compressor manufacturers. This not only presented market opportunities for the participants, but also aided South-South co-operation.

The first PRAHA project established a better understanding of the problems faced in high ambient temperatures. By testing various alternatives, it became clear that a full product redesign would be necessary, and the appropriate components needed to be developed and made commercially available. Patents and intellectual property rights remain a subject for discussion.

PRAHA has become a committed, ongoing process. PRAHA I triggered a number of new international studies, as well as a second step, PRAHA II. The beneficiary countries, together with UNIDO and UNEP, are continuing to work towards finding the most environmentally friendly way forward. **"We are looking for something more sustainable, together with UNIDO and UNEP and the countries,"** said Hassan Mubarak, the National Ozone Officer for Bahrain. **"PRAHA is not a project anymore, but a process."**

### Big fish, big pond

**“Power saving is substantial.”**

A pilot project in **Viet Nam** is the first of its kind to explicitly benefit the ozone layer and prevent climate change.



UNIDO ensures **sustainable consumption and production** in projects that are designed to last.





In Viet Nam, a cooperation between UNIDO and the Global Environment Facility (GEF) allows business owners to convert their cold storage facilities to new, environmentally friendly technology. While the Montreal Protocol refers specifically to the phase out of ozone depleting substances, there are other areas – such as the destruction of ozone depleting substances, or combatting climate change – that also help the Protocol’s goals.

In this case, the particular goal was mitigating climate change. UNIDO underwent intensive study to work out where the GEF’s resources might be most effectively deployed. After analyzing different sectors – foam, refrigeration, air conditioning, and beyond – it was deduced that it would be best to work on existing installations. This meant working with end users, rather than manufacturers or the servicing industry, to convert existing facilities. The target was cold storage, part of the cold chain for perishable products, and crucial for food processing and fisheries.

A pilot project was developed in cooperation with end users in Viet Nam. With GEF support, UNIDO assisted four end users to convert their cold storage rooms to new technology, using natural refrigerants that are both ozone and climate friendly. Not only does this reduce the

use of harmful chemicals – which deplete the ozone and contribute to climate change – but it is also an opportunity to save a great deal of energy. **“Energy efficiency is high, power saving is substantial,”** stated the GEF Focal Point, **Do Nam Thang**. In fact, the selected companies now save 20 to 40 per cent on their energy costs.

UNIDO is committed to long term solutions. The technicians must be trained, the components and refrigerants made available, and the regulatory framework adjusted if necessary. Because the Vietnamese government had limited experience of using hydrocarbons in refrigeration, UNIDO assisted the government to develop a regulatory framework.

After the success of this pilot project, UNIDO is working to spread the word in Viet Nam among as many end users as possible, and trying to locate funding sources for further conversions. While the new equipment was imported for the project, UNIDO is also putting technology manufacturers in dialogue with end users, in order to facilitate a future agreement between clients and providers.

While this particular project is currently implemented in Viet Nam, it has been designed to be easily adapted to other countries. It is an intervention with the potential to bring significant benefits to both the ozone layer and the climate.

## Condition's critical

In **Tunisia**, the introduction of transcritical CO<sub>2</sub> (R-744) in supermarkets sets an example to help mitigate climate change worldwide.



UNIDO designs demonstration projects to introduce **cutting-edge technologies** which phase out greenhouse gases and **mitigate climate change**





In a new pilot project, UNIDO is working with a supermarket chain in Tunisia to introduce transcritical CO<sub>2</sub> (R-744) systems for cooling and freezing food products.

A hundred years ago, CO<sub>2</sub> was used in refrigeration, reaching peak use in the 1920s. After that point it was replaced with new chemicals – called CFCs – which were more efficient and could operate at lower pressures. When it was discovered that CFCs were harmful to the ozone layer, they were often replaced with HCFCs or HFCs, the first of which also deplete the ozone, and both of which are powerful greenhouse gases.

Because CFCs, HCFCs, and HFCs are now all listed under the Montreal Protocol, a new alternative had to be found, and one solution was to return to using CO<sub>2</sub>. In the last fifteen years, industry has developed technology to allow CO<sub>2</sub> to fulfill today's refrigeration needs in selected areas, such as supermarket refrigeration and vending machines. While CO<sub>2</sub> has been used in refrigeration in developed countries for some time, this pilot project is one of the first instances that it will be used in a developing country with a high ambient temperature.

High ambient temperatures present a challenge, because CO<sub>2</sub> is generally less energy efficient in such conditions. However, in the last five years, industry has developed state of the art technology

that allows for transcritical CO<sub>2</sub> systems which are efficient even in high ambient temperatures. Tunisia will serve as an example to showcase this new technology.

Unlike the majority of Montreal Protocol projects, which work with manufacturers, this project sees UNIDO working with end users in the retail sector. Supermarkets in developing countries usually use several hundred kilograms of HCFC-22, which has high rates of leakage, and is currently being phased out under the Montreal Protocol. The transition to a CO<sub>2</sub> system is considerably more expensive than the typical alternative, HFC-404A. However, the comparative impact on the climate is dramatic. While the global warming potential of HFC-404A is nearly 4,000, the global warming potential of CO<sub>2</sub> is only 1.

In addition to Tunisia, UNIDO is implementing similar projects in Argentina and Jordan. These countries were chosen for several reasons, including the countries' readiness to implement the project, as well as the potential for replicating the project worldwide. If these projects prove successful, they will lead to similar projects in Latin America, the Middle East, and North Africa to enable widespread use of transcritical CO<sub>2</sub> in the retail sector. This will mean a significant reduction in the use of damaging chemicals, energy savings for end users, and a serious contribution to tackling climate change.



Executive Session of the Climate and Clean Air Coalition's High Level Assembly, Vienna, Austria, 21 July, 2016



# The future of the Montreal Protocol

We are small. If we can do it, other countries can do it too. Some of the other countries are producing countries, and they can start producing the ozone-friendly, climate-friendly alternatives as well. I don't think it's an issue. It's setting an example.

Janeel Miller-Findlay, St Vincent and the Grenadines, Vienna, July 2016

We have phased out all those substances, and very soon we are going to phase out the HCFCs, but we are not going home. We are going to stay here, because we have to deal with the HCFCs.

Agustin Sanchez, Mexico, Vienna, July 2016





The 28th Meeting of the Parties (MOP 28) to the Montreal Protocol on Substances that Deplete the Ozone Layer  
Kigali, Rwanda, 10-14 October, 2016

# Phase down, switch up, chill out

The Kigali Amendment

**October**  
**2016**

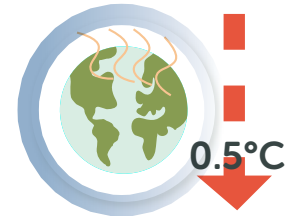
In Kigali, Rwanda in October 2016, the 197 Parties of the Montreal Protocol agreed to **an amendment to phase down HFCs**. This shows not only trust in the legacy of the Montreal Protocol, but a crucial gesture towards the future, where protecting the ozone will be united with fighting climate change.



HFCs are used in air conditioning, refrigeration, foams, and aerosols, often as a replacement for ozone depleting substances. While they do not deplete the ozone, they do contribute to global warming.



While developed countries will begin to phase down HFCs by 2019, developing countries will freeze their consumption levels in 2024 or, in some cases, 2028. Before the middle of the century, all countries will consume no more than 15-20 per cent of their baseline consumption. UNIDO will play a key role in helping to achieve this goal.



It is estimated that **these measures could prevent up to 0.5 degrees Celsius of global warming by the end of the century.**

It was clear from the Meeting of the Parties in Kigali that energy efficiency will be an important issue for the future. In developing countries, cooling needs are soaring, due to rising population, rapid economic growth, urbanization and climate change. The market for residential air conditioning is booming; in India, air conditioner sales increase by more than 10 per cent each year. Global air conditioning stocks are expected to grow by 700 million units by 2030, and growing demand for refrigeration and air conditioning units worldwide could potentially increase electricity usage by four fifths between 2010 and 2100.

For nearly three decades, UNIDO has been working towards greater energy efficiency not only in numerous projects and approaches related to industrial energy efficiency, but also, specifically relating to the Montreal Protocol, in its work with refrigeration and air conditioning, as well as insulation foams. In the PRAHA project, UNIDO tackles energy consumption through an innovative approach to sustainable air conditioning for high ambient countries. Dramatic energy savings are also a result of UNIDO's cold chain project in Viet Nam, and a target of the conversion to new transcritical CO<sub>2</sub> systems in Tunisia.

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"This is about much more than the ozone layer and HFCs. It is a clear statement by all world leaders that the green transformation started in Paris is irreversible and unstoppable. It shows the best investments are those in clean, efficient technologies."

UN Environment Chief Erik Solheim, October 15, 2016

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"We are moving toward a more sustainable world - and our pace is quickening... Our children, our grandchildren, and every one of us will be better off for what the Parties to the Montreal Protocol achieved today."

John Kerry, US Secretary of State, October 15, 2016

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# Bold, cold future

UNIDO moves forward

Technologies are continually changing, and new challenges always wait around the corner. But UNIDO remains committed to implementing truly innovative approaches in developing countries and economies in transition. With decades of experience undertaking conversions, training technicians, and awareness raising, UNIDO is perfectly positioned to assist developing countries and economies in transition to save energy, accelerate industrial development and tackle climate change.

UNIDO's processes are rooted in its client countries. As an organization based on industrial development, UNIDO is well placed to deal with industrial gases like HFCs. UNIDO is also capable of expanding its scope, as in more tailored risk assessment, such as in China's conversion to R-290, as well as in PRAHA II.

The recent amendment to the Montreal Protocol shows that the world is moving to systematically tackle climate change. Future challenges include not just the phase down of HFCs, but also how to simultaneously achieve energy efficiency gains, and balance these crucial environmental measures with truly sustainable industrial development. With a vast range of experience, UNIDO is perfectly placed to meet these challenges.





## Some like it cool

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### Check out our UNIDO Montreal Protocol videos:

UNIDO phases out CFCs in asthma inhalers in **Mexico**  
UNIDO and the **Montreal Protocol**

Helping farmers, protecting the ozone layer in **Chile**

In **Mexico**, empowering females agribusiness workers

UNIDO and the Montreal Protocol in **Morocco** – Arabic

UNIDO's Montreal Protocol Project in the **Philippines**

2013 Ozone Day celebration in **Morocco** – French

Montreal Protocol and ODS Destruction Project in **Mexico**

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Vienna International Centre · P.O. Box 300 · 1400 Vienna · Austria  
Tel.: (+43-1) 26026-0 · E-mail: [info@unido.org](mailto:info@unido.org)  
[www.unido.org](http://www.unido.org)