UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

SUSTAINABLE DEVELOPMENT GOALS


# MONTREAL PROTOCOL AND BEYOND

## 17 STORIES ALONG THE JOURNEY FROM OZONE PROTECTION TO SUSTAINABLE DEVELOPMENT

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# FOREWORD
# BY STEPHAN SICARS

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The 2030 Agenda for Sustainable Development and the 17 Sustainable Development Goals (SDGs) embody the global commitment to build a more sustainable future for all. These universally agreed objectives address the most urgent environmental, social and economic challenges of our time. The SDGs are ambitious – including the eradication of extreme poverty and world hunger – but also measureable and actionable, with specific targets to be achieved by 2030. The Goals are broad, but also interconnected, recognising how achievements in one sphere can bring about progress in another. Achieving food security and improving healthcare both contribute to the eradication of poverty; climate action helps protect ecosystems and human health; and fostering peace and inclusive societies translates into progress towards a more sustainable global economy. With just under 10 years left to meet these ambitious targets, world leaders have called for a "Decade of Action" to deliver the Goals.

The United Nations Industrial Development Organization (UNIDO) sees industry as a vehicle to accelerate sustainable development and achieve the SDGs. An inspiring example of this is the role industry has played in achieving the ever more ambitious targets of the **Montreal Protocol**.

This is where our journey begins: with the Montreal Protocol and the global commitment to protect the Earth's ozone layer. It all started in the 1970s, when scientists discovered that the ozone layer was under threat from a group of chemicals known as **ODS**. ODS had become key components in major manufacturing sectors and global trade goods, including refrigerators, air conditioners, foam and aerosol sprays, fire extinguishers and pesticides. Recognising the vital role of these sectors and their reliance on ODS, the international community understood that it would take decisive and global action to phase out these substances. From this determination the Montreal Protocol, regulating the production and consumption of ODS, emerged as the first treaty in the history of the United Nations to be signed by all 193 Member States*.

In 1992, UNIDO joined the frontline, as an implementing agency of the **MLF**. Since then, the Montreal Protocol has transformed industries around the globe, eliminating particularly harmful chemicals, and from early on, accelerating progress in many other fields. This includes - of course - industrial development, but also technology transfer, vocational training, food preservation, transport safety, institutional capacity development, various aspects of trade issues, transparency, south-south co-operation and others. The impact of the Montreal Protocol on so many aspects beyond ozone protection has made it particularly relevant for the 2030 Agenda for Sustainable Development and its 17 SDGs, which, since 2015, have inspired and driven decision-makers worldwide to take transformative action, individually and collectively, for people, planet and prosperity.

A great example of this is the adoption of the Kigali Amendment in 2016 to phase-down **HFCs**, which have a minimal effect on ozone depletion, but major global warming impacts. Recognising the contribution of HFCs to climate change, the Parties to the Montreal Protocol adopted the Kigali Amendment, thereby expanding the scope of the treaty towards more ambitious climate action.

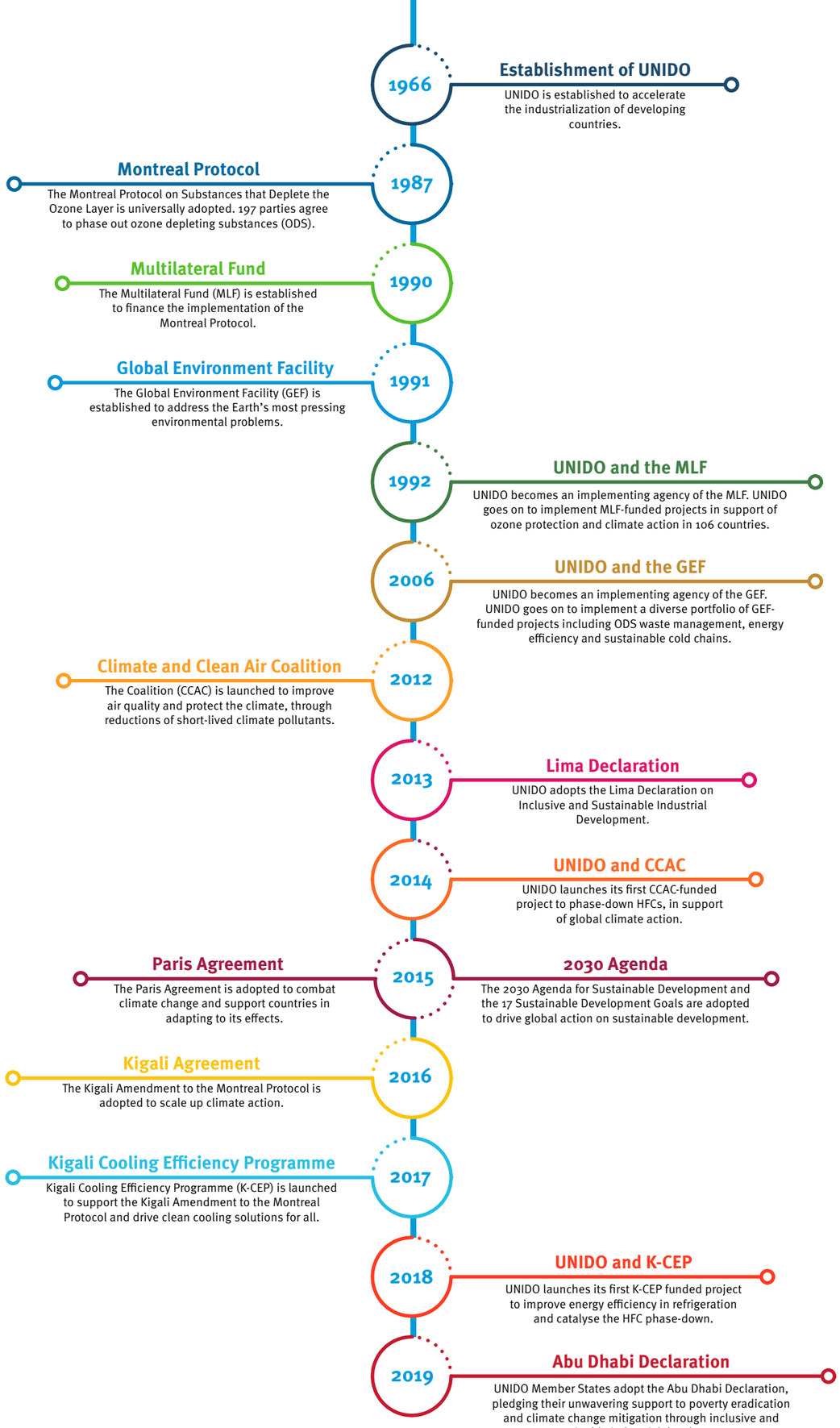
As the Montreal Protocol has become more ambitious, so has the work of UNIDO, guided by the 2030 Agenda and our mandate of inclusive and sustainable industrial development. This calls for industry to contribute to sustainable development in all its dimensions: social, economic and environmental. UNIDO has helped industries transform their linear production models of "take, make, dispose" to the circular economy approach of "reduce, reuse, redesign, remanufacture, recycle, and recover". Together, we have also taken on ambitious socio-economic goals, from gender equality to youth empowerment, promoting a role for everyone, irrespective of age, gender, race or disability.

UNIDO works with governments to develop and enforce the policies and regulations needed to address these environmental and social challenges. Working hand-in-hand with industries, UNIDO is also well positioned to help companies put these policies into action. With the Decade of Action on the SDGs gaining momentum, it is time to look back and see how far we have come. On our journey, we have seen a transformational shift in the industrial sector and inspiring examples of industry's contribution to the SDGs.

This publication is a collection of stories that celebrate the changing face of industry, reflecting on how the efforts supported by UNIDO to improve the environmental performance of the productive sector, have brought about sustainable solutions to other global challenges. This work is broad in nature, engulfing a multitude of stakeholders, from governments and industries to employees and consumers. It is innovative in pioneering new technologies and approaches, to find the best-suited alternatives for companies, sectors and countries. Most importantly, this work goes beyond the phase-out and replacement of chemicals. As shown in this publication, these efforts can have a wider impact on our societies and a ripple effect on sustainable development.

The success of each project – and every story featured in this publication – is a result of the extraordinary dedication and coordinated action of many stakeholders. This exemplifies how our efforts, when well coordinated and decisively implemented by governments, industry, entrepreneurs and the general public, can bring us all closer to a world in which economic development, environmental sustainability and social inclusion are all valued and, ultimately, achieved.


* The Montreal Protocol has been ratified by all United Nations members, as well as Niue, the Cook Islands, the Holy See and the European Union.




# INTRODUCTION

The 2030 Agenda for Sustainable Development and the 17 **SDGs** carved out a definitive role for industry in Goal 9: "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation". This recognises some of the major contributions of industry to modern society, but also invites us to consider industry's wider role in driving sustainable development. If we apply each SDG as an individual filter, we can look at industrialization from 17 different lenses and appreciate the ever more ambitious role of industry on the global agenda.

UNIDO's Montreal Protocol Division was born out of a global call for action to address the threat of **ODS** emissions from industrial activities, to people and the planet. This commitment, embodied in the **Vienna Convention** and the **Montreal Protocol**, has transformed key manufacturing sectors, from refrigeration and air-conditioning to agro-industry and healthcare.

Since 1993, UNIDO has worked hand-in-hand with industries and institutions to phase out 65,186 **ODP**-tonnes, substituting each ton of ODS with a less harmful substance or a new process. While institutions have played a major role in developing and enforcing the necessary policy framework, the industries we work with have taken on the challenge of redesigning their products and manufacturing processes, so that they are compatible with non-ODS alternatives.

In this time, the work of our Montreal Protocol Division has become more ambitious, engaging a broad coalition of institutions, associations and development partners, in support of wider sustainable development goals. Our growing portfolio of cold chain projects, in cooperation with the **GEF**, recognise the vital role of cooling for food processing, storage, and food security – major stepping stones on the path to 'Zero Hunger'. New initiatives to find energy-efficient alternatives to ODS and high **GWP** refrigerants, in cooperation with the **CCAC** and the **K-CEP**, build on global efforts to promote energy efficiency, so as to limit greenhouse gas emissions and meet the targets of the Paris Agreement on climate change. The core of our work, funded by the **MLF**, has also evolved, from ozone protection to climate action. By this means, we continue to mitigate the environmental impacts of industry, to protect the terrestrial and marine ecosystems that are critical for human development.

This publication celebrates the changing role of industry in response to global calls for action and the bold and transformative measures we have seen in each of the countries we work in, condensed into one story for each SDG. The stories are based on real-world experiences: the challenges that needed to be overcome, the advances that were made and the drivers behind each project. As such, they are only a snapshot of what we do - within a larger and growing portfolio of UNIDO projects - and who we work with.

Only a handful of our valued partners - industries, associations, governments and donors - feature in these stories. However, we see this publication as an homage to every individual we have worked with, and will continue to work with, to drive inclusive and sustainable industrial development. We are certain there will be many more stories to tell.

# NO POVERTY

End poverty in all its forms everywhere.

Poverty presents itself in many forms. With the Earth's temperature rising across the globe, cooling is emerging as a basic need to protect low-income households from extreme heat. Cooling is also a big concern for emerging economies, as heat-related illnesses impact labour productivity and well-being.

With rapidly expanding markets and middle-class growth in Asia, the pressure is on to find sustainable cooling solutions. The region is home to five of the world's most populated countries facing climate hazards and cooling-related risks: Bangladesh, China, India, Indonesia and Pakistan.[1] Due to a multitude of socio-economic factors, including population density, poverty levels and dependence on agriculture, these countries are some of the most vulnerable to the direct and indirect impacts of climate change.

In Pakistan, the air-conditioning market is growing steadily, alongside public and private investments in infrastructure.

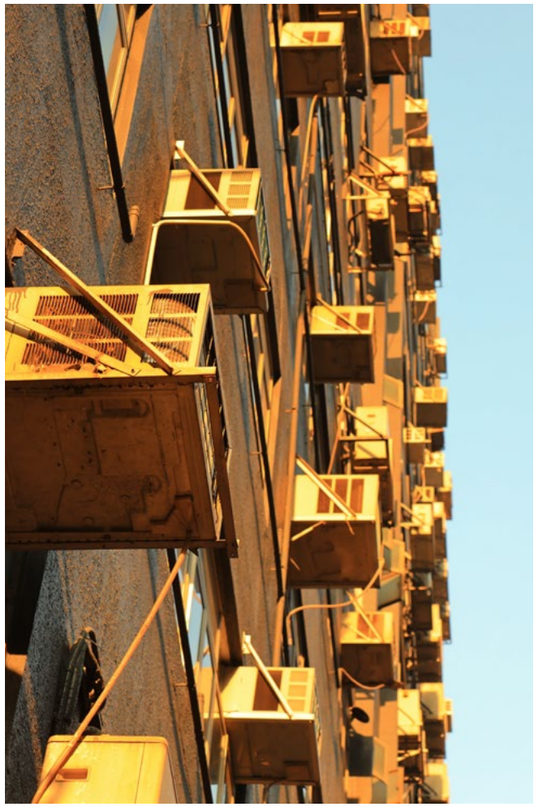
**Now the challenge is to find clean and efficient cooling solutions, so that we can protect the most vulnerable, without causing serious environmental impacts or accelerating climate change.**

To meet this challenge, the Government of Pakistan, UNIDO and **UNEP** are working directly with local air-conditioning manufacturers, to change the future of cooling in Pakistan.

**View SDG 1 Targets**

The most common refrigerant used in air-conditioning equipment in Pakistan is HCFC-22 (or R-22). HCFC-22 is an **ODS**, with a high **GWP**. This means that air-conditioning systems that rely on HCFC-22 play a part in damaging the Earth's ozone layer and contributing to climate change.

There are many promising alternatives to HCFC-22 on the market, but manufacturers cannot simply replace one refrigerant with another. They generally need to redesign their appliances, purchase additional equipment and adopt new maintenance practices. Under the **HPMP** for Pakistan, UNIDO is helping local manufacturers find suitable alternatives and put them into practice.



**Dawlance, a Pakistani enterprise that produces 119,000 air-conditioning units per year, opted to switch from HCFC-22 to climate-friendly R-290 – better known as propane.**

UNIDO is helping Dawlance redesign their models, mount a new refrigerant charging board and install additional safety equipment, including gas detection and ventilation systems and new leak detectors. UNIDO is delivering training on servicing practices and safety inspection, taking into account propane's flammability.

Training is an important component of the HPMP for Pakistan, and follows a 'train-the-trainer' model, so that qualified experts can go on to train other technicians in the servicing sector. This not only contributes to skills development and job creation, but is also an important step to phase-out HCFC-22. The servicing sector in Pakistan is mostly made up of small workshops employing one or two technicians and is characterized by seasonal workers. During the high-season for servicing (in the summertime), the small workshops consume around 20 kg of HCFC-22 per month, and larger workshops, with more than two technicians, consume around 40 to 50 kg of HCFC-22.

***Service technicians play an important role in keeping cooling systems in the country running, particularly smaller units in low-income households. The train-the-trainer programme is giving them the skills to improve their services, but also their employment prospects.***

***By the same token, industry leaders like Dawlance are increasing their competitiveness by adopting sustainable business models. The key players in Pakistan's HPMP are not only protecting vulnerable members of society from heat exposure, but also driving economic growth and job creation. By this means, they are helping pave a path out of poverty.***

These activities are being carried out in the framework of the **HPMP** for Pakistan, funded by the **MLF**.

HPMPs are sector-wide programmes designed to help countries reduce their use of HCFCs, which destroy the earth's ozone layer and contribute to greenhouse gas emissions. Each HPMP is unique and funding received from the MLF allows UNIDO to implement a wide range of activities in support of ozone protection and climate action. In 2020, the MLF approved 18.3 million USD of funding for UNIDO projects around the world.

# ZERO HUNGER

End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

Zero hunger. To grasp the enormity of this goal, we have to look at the entire food supply chain and understand the journey from farm to fork. This journey along the cold chain – an uninterrupted series of temperature-controlled environments to transport, stock and distribute food - begins with cold storage. Annual food loss worldwide, due to inadequate cold storage and poor cold chain management, amounts to 475 million tonnes of food. This could feed up to 950 million people a year.[2] This much is certain: without effective and reliable cold storage, we cannot achieve zero hunger.

Cold storage units regulate temperature and humidity, to ensure the quality and safety of our food. Maintaining a consistently low temperature is particularly important for deterring the growth of bacteria and preventing food-borne illnesses, which affect 600 million people a year worldwide.[3]

**View SDG 2 Targets**

In Viet Nam, cold storage is a critical component for the rapidly growing aquaculture sector. Approximately 3.4 million people (or 4% of the population) derive their income directly from aquaculture and capture fisheries.[4] An even greater percentage of the population is involved in processing, trading of fishery products and related activities. If their products do not make it to market, they suffer economic losses.

From a socio-economic perspective, cold storage is vital for reducing food loss, increasing food security and protecting the livelihoods of producers. From an environmental perspective, cold storage poses some challenges, as cold chain logistics account for 11% of the world's electricity consumption [5] and rely on refrigerants, many of which have a high **ODP** or a high **GWP**. In this sense, the challenge is two-fold: how can we establish sustainable, climate-friendly cold storage to help us deliver safe and nutritious food across the globe.

**Kigali Amendment - Industry advocates for green solutions**

In Viet Nam, there are around 400 cold storage facilities used in the fisheries sector, all dependant on HCFC-22, a potent greenhouse gas. Most facilities have an average of 10 refrigeration machines running on HCFC-22, amounting to approximately 4,000 cold storage units for this sector alone. The majority of cold storage equipment is manufactured domestically, using second-hand compressors and unit coolers. With this outdated equipment, many storage facilities suffer from inefficient energy use and significant refrigerant leaks, of up to 20 – 25% of the total refrigerant charge contained in the units. This not only poses a concern for food safety, but also for the environment, when considering the greenhouse gas emissions from refrigerant leakage.

Recognizing the growing importance of this sector and the alarming levels of greenhouse gas emissions produced by the existing cold storage facilities, the Government of Viet Nam partnered with UNIDO, to change the landscape. The ultimate aim of this project: to transition to hydrocarbon-based refrigerants, with zero ODP and a low GWP. First, UNIDO and the Government of Viet Nam set out to develop the 'enabling environment' for the adoption of hydrocarbon refrigerants. That is to say: the policy, legal, and regulatory measures to control the use of HCFCs and promote the use of climate-friendly refrigerants. Then, it was time to engage the private sector, with pilot projects in 4 regions of the country: Ho Chi Minh city, Hanoi city, Vinh city and Quang Ninh province. UNIDO delivered a total of 25 hydrocarbon-based refrigeration units to cold storage facilities, to demonstrate the feasibility and benefits of the new technology.

UNIDO also delivered training on good servicing and maintenance practices, to reduce refrigerant leakages and increase energy efficiency, as well as dedicated training on the safe handling of hydrocarbon-based refrigerants.

***These advances are helping Viet Nam transition away from HCFCs, thereby minimizing negative environmental impacts, whilst ensuring that the food industry operates efficiently, with minimal food loss. This brings us one step closer to achieving zero hunger.***

These activities were carried out in the framework of the "Improving Energy Efficiency and Reducing ODS Emissions in the Cold Storage Sector" project, funded by the **GEF**.

The GEF is a trust fund designed to address global environmental challenges. In 2020, the GEF approved 44.9 million USD of funding for UNIDO projects around the world.

**Video** **Kigali Amendment - Industry advocates for green solutions**

**Article** **R290 units in Vietnam's cold stores delivering 20-25% efficiency gains**

# GOOD HEALTH & WELL-BEING

Ensure healthy lives and promote well-being for all at all ages.

Modern healthcare is a complex and extensive industry. It encompasses health care professionals, hospitals and health facilities, pharmaceuticals, diagnostic laboratories, and medical equipment and services. Manufacturing industries may not be at the face of healthcare campaigns, but without dedicated companies producing medical equipment and devices, we could not deliver essential health care services across the globe.

Medical devices must comply with the most severe regulatory standards and quality requirements. One of the highest priorities in the healthcare industry is the prevention of pathogens (a bacterium, virus, or other microorganism that can cause disease). This is a complex challenge given the nature of medical devices, which are made up of a series of moving parts with ridges and crevices in which bacteria and viruses can hide. The industry therefore relies on powerful solvents, many of which have a high **ODP** or high **GWP**, for cleaning equipment at every stage of the production process.

In Tunisia, the medical devices manufacturing sector is growing rapidly to meet global demand.

**In 2019, Tunisia exported optical, technical and medical apparatus worth €634 million.[6]**

In parallel, the country is becoming an ever more popular destination for health and wellness tourism, driving the demand for medical devices within Tunisia.

Now, Tunisia is working with UNIDO to introduce climate-friendly solvents and clean technologies in medical device manufacturing processes, to phase out greenhouse gases and help mitigate the impact of climate change on human health.

**View SDG 3 Targets**



SO.F.A.P Medical is a Tunisian pharmaceutical company specialized in the manufacturing of medical devices, including syringes, needles, infusion and transfusion sets. SO.F.A.P was heavily reliant on ozone-depleting HCFC-141b for the manufacture of syringes, both as a solvent and a thinning agent for silicone oil. Syringes are coated with a layer of silicone oil, to reduce friction when the needle pierces a patient's skin - anyone who has ever had a vaccine, should be grateful for this technology. When applying the silicone, the tool used to coat the needle is also coated in oil and needs to be cleaned carefully and regularly, calling for a high demand and frequent use of HCFC-141b.

Facing the challenge of altering two key components of their production process, SO.F.A.P partnered with UNIDO and the National Agency for Environment in Tunisia (ANPE) to find a cost-effective and sustainable alternative to HCFC-141b. Following numerous product trials, laboratory testing and performance evaluations, UNIDO and SO.F.A.P successfully identified an alternative solvent, with no ODP. They were then faced with another problem: the new solvent technology was 20 times more expensive than HCFC-141b.

The solution for this was simple and elegant. Recognizing the high consumption of HCFC-141b for the silicone oil application, UNIDO, ANPE, SO.F.A.P and a group of private sector technology providers, designed an automatic silicon spray machine, to circumvent the use of HCFC-141b altogether.

**UNIDO supported SO.F.A.P with the redesign of the production line, training and equipment installation, which resulted in an 80% reduction in the amount of solvent required.**

Following the completion of this project in 2019, SO.F.A.P launched a range of green products for the domestic and European market.

***This partnership demonstrates the wide expanse of possibilities for delivering climate-friendly, energy-efficient and affordable solutions for the healthcare industry.***

These activities were carried out in the framework of the **HPMP** for Tunisia, funded by the **MLF**.

# QUALITY EDUCATION

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Education is the key to unlocking the potential of each individual in our global community. Skilled employees raise the productivity of labour forces and make investment in industry more attractive. This contributes to sustained employment, higher wages and decent jobs. In the **RAC** sector, skills and expertise are also a matter of safety. Technicians need to understand what materials they are working with and master tools, technologies and techniques to keep themselves, other people, and the planet safe.

To successfully phase-out **ODS** and **F-gases** from major manufacturing sectors, both end-users and technicians need to understand what alternatives are available, and which ones are best-suited. There are many sustainable alternatives, but each one comes with its own performance, compatibility and safety considerations. Technicians working in the RAC sector need both theoretical and practical knowledge, so that they can work with fluorinated and non-fluorinated gases and incorporate safe handling practices into their daily routine.

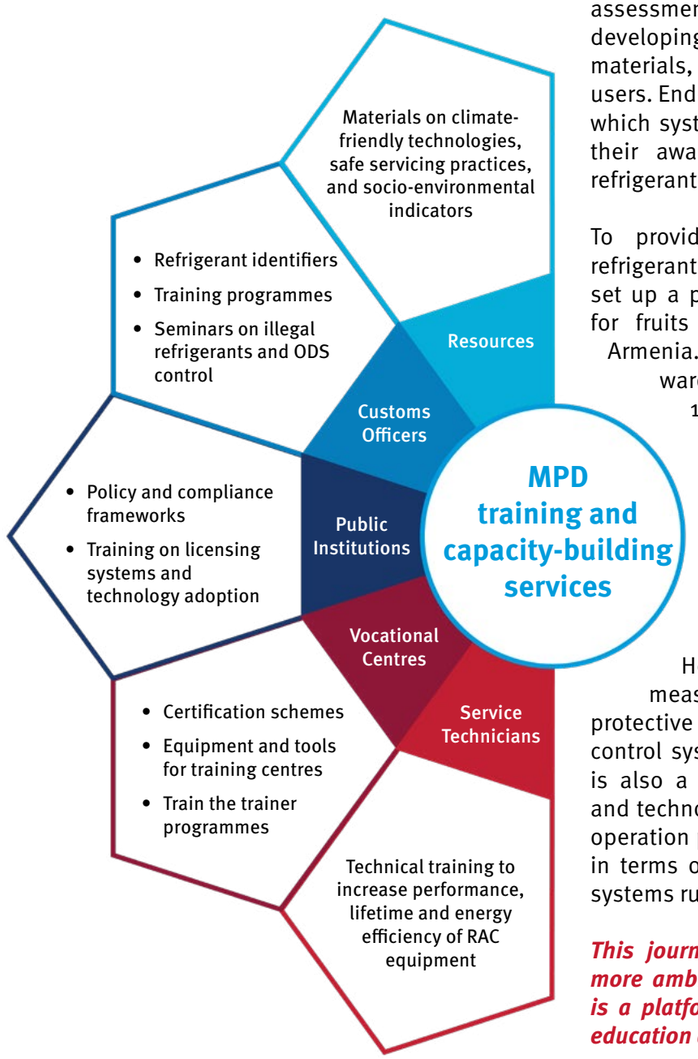
In Armenia, the Government is working to make training and certification for RAC sector technicians mandatory. The idea is for all technicians to receive a minimum standard of training, in line with international standards on the safe handling of ODS, F-gases and natural refrigerants. But policy is only one piece of the puzzle. The Government realises that to reach all technicians at the national level, they need to work with industry associations, institutes of higher learning and vocational centres. With support from UNIDO and the Russian Federation, the Government successfully launched a centre of excellence for the training and certification of technicians – not just for Armenia, but also for neighbouring countries in the Eastern Europe and Central Asia region.

> **“The HVACR training centre is very well equipped with several RAC didactical units (including AC split, unit with F-gases, equipment with $CO_2$ and with hydrocarbons). The technological relevance of the equipment is high.”**
>
> **Centro Studi Galileo**

**View SDG 4 Targets**

**Promoting life-long learning in the refrigeration & air-conditioning sector, Armenia**

The “Regional Centre for Continuing Education and Certification for **HVACR** Industry Professionals” in Armenia was born of an ambitious vocational centre and 5 specialised RAC technicians. Together with the Government of Armenia and UNIDO, these partners set out on a journey to scale-up technical training in the RAC sector and put natural refrigerants on the map.




The first step was to equip the Centre. UNIDO provided simulation equipment, tools and supplies for hands-on training on sustainable alternatives to F-gases, energy efficiency and good refrigeration practices. UNIDO then enrolled the 5 technicians in an intensive ‘train-the-trainer’ programme, where they learned how to develop their own teaching curriculum and set up practical and theoretical assessments for certification. The Centre then began developing training manuals and communication materials, directed both at technicians and end-users. End-users are ultimately the ones who decide which system to install, so it is critical to increase their awareness and understanding of natural refrigerants.

To provide a real-world example of natural refrigerants in industry, UNIDO and the Government set up a pilot project at a distribution warehouse for fruits and berries in the Kotayk Province, Armenia. UNIDO worked hand-in-hand with the warehouse to convert their very harmful CFC-12 refrigeration system to one run on R290 (propane). Propane’s advantage is its ultra-low **GWP** and zero **ODP**. On the other hand, propane is flammable, so strict safety measures have to be put in place.

The Centre now organises site visits to the warehouse for trainee technicians. Here, they can see how the safety measures – including an explosion-proof protective casing and a R290 sensor linked ot the control system – work in practice. The warehouse is also a good demonstration site for end-users and technology providers. They can see the system operation parameters in real time, and the benefits in terms of resource use and energy efficiency of systems run on natural refrigerants.

***This journey shows us that in the face of ever more ambitious climate targets, the RAC industry is a platform for innovation, continuing technical education and lifelong learning opportunities.***

These activities were carried out in the framework of the “Development of international regional centre of excellence for training and certification and demonstration of low-global warming potential alternative refrigerants for the Europe and Central Asia region” project, funded by the **MLF** and the Russian Federation.

**Article** Training and continuing education for HVAC technicians

**Video** Inauguration of the Regional Centre for HVACR Industry Professionals (Russian)