

Stay Cool and Go Green:

Making Cold Chain More Efficient and Sustainable



Cold chain is an essential part of our daily life. It has revolutionized the trade of perishable goods by making it possible to transport fresh produce across long distance, significantly enhanced food safety and enabled the preservation of temperature-sensitive pharmaceutical products. During COVID pandemic, the cold chain has played a critical role in supporting healthcare initiatives, particularly in vaccine distribution and immunization programs.

Yet, establishing and operating cold chains consume significant amount of energy, and may involve using refrigerants that are highly potent climate pollutants (read [here](#)). Although low-carbon and efficient cold chain technologies are available, their market penetration in developing countries is still low. Assistance is needed to support these countries in closing the technology and financing gap.

UNDP has been working closely with governments and businesses on advancing sustainability of cold chain through technical assistance, knowledge sharing and capacity development. With the financial support from the Multilateral Fund for the Implementation of the Montreal Protocol (MLF) and other donors, UNDP helps countries to develop cold chains using more efficient technologies and alternative refrigerants that have much less climate impact.

These experience, together with other breakthrough technologies and practices from governmental and industrial partners, were shared by UNDP's side event during the forty-fifth meeting of the Open-ended Working Group of the Parties to the Montreal Protocol ([OEWG 45](#)).

Greening the Supermarkets in Colombia

With the support from UNDP, Colombia developed a *National Green Strategy for Supermarket* that will guide the greening of cold chains and refrigeration systems of supermarkets in the country. According to

Mr. Edwin M. Dickson from the National Ozone Unit of Colombia, this national strategy made projections on how refrigeration equipment in supermarkets will consume energy from 2020-2030 and identified measures and alternative refrigerants to improve energy efficiency and reduce environmental impact. With these measures and alternative technologies fully adopted, Colombia can achieve as much as 50% of greenhouse gases emission reduction in all its supermarkets in 2030 compared with 2019 level.

Using CO₂ as a refrigerant in Supermarket in Chile

Although CO₂ is commonly known as a greenhouse gas, it is actually one of the safest and most environmentally friendly options for refrigeration. Other widely used refrigerants (fluorinated gases to be specific) are often thousands to tens of thousands of times more potent than CO₂ at trapping heat in the atmosphere. Recent breakthroughs have reduced the cost of CO₂ refrigeration technology and its adoption in automobile air conditioning, heat pumps, and commercial refrigeration systems are gaining momentum.

Mr. Pier Zecchetto, technical expert from Chile introduced how CO₂ technology was successfully adopted in his country over the past decade. Funded by Climate & Clean Air Coalition (CCAC) and the Multilateral Fund, the Ozone Unit of Chile's Ministry of Environment partnered UNDP on a project that introduced transcritical CO₂ refrigeration systems in major supermarkets in Chile. "When the project first started in 2014, there were only 3,000 stores using CO₂ technology worldwide and Chile had no experience at all." Pier said. Through technology innovation, pilot demonstration, knowledge sharing and capacity building, the project has helped to reduce the costs of both the CO₂ refrigerants and its systems installation in Chile. The capacity on CO₂ systems maintenance were also enhanced. The number of CO₂ systems increased from 0 to 30 from 2016 to 2023 and major supermarket chains now considers CO₂ as their primary choice for refrigeration in the future.

Ms. Claudia Paratori Cortés, National Ozone Officer of Chile presented the national policies on enhancing energy efficiency and climate change mitigation in the heating and cooling sector. Efficient heating and cooling are fully integrated in Chile's national climate and energy policies, including the *Framework Law on Climate Change* and the *Law on Energy Efficiency*. These two legislations have set ambitious targets to achieve Minimum Energy Performance Standards (MEPS) for all commercial, residential, and public refrigeration and air conditioning equipment and 65% GHGs emission reduction in heat and cooling sector by 2050.

Greening Cold Chain Infrastructure using NH₃/CO₂ Cascade Refrigeration Systems

A cascade refrigeration system is a system that use one refrigerant as cooling media to condense the other refrigerant. In a NH₃/CO₂ cascade refrigeration system, CO₂ is specifically used for the low-temperature stage together with ammonia which is used for the high-temperature stage. Compared with the traditional two-stage system using only NH₃, a NH₃/CO₂ cascade system has lower operating and capital costs and needs much less NH₃, which is flammable and toxic and requires strict safety measures to be put in place.

Mr. Shimei Hao, General Manager of Moon Tech (Thailand) shared cases that use NH₃/CO₂ cascade refrigeration systems in China and Thailand. The project in Haidu Seafood company in Shandong Province, for example, installed 12 sets of cascade systems that provide a cold storage capacity of 104,000 tons. The technology saves up to 90% of NH₃ compared with the traditional system using only NH₃ and avoided the use of HCFC-22 (a potent greenhouse gas and a controlled substance of the Montreal Protocol) by 114 tons each year.

Best Practices for End-of-Life Refrigerant Management

As refrigeration becomes more affordable and accessible throughout the world, having a sustainable and circular approach for end-of-life refrigerant management is also becoming more important. **Ms. Louise McCaan**, Global Commercial Director and **Ms. Elvira Nigido**, Group Sustainability Compliance Manager from A-Gas, introduced how resource conservation and carbon offset can be achieved through adopting Lifecycle Refrigerant Management (LRM) solutions. By recovering/reclaiming refrigerants from existing systems, destructing “end of life” gases (where no re-use is possible) and supplying the reclaimed refrigerants to reduce the need for virgin products, LRM can greatly reduce emissions from the refrigeration and air-conditioning sector (global emission from the ODS & HFC banks¹ are estimated to equate to 1.5 GT CO₂ equivalent per annum). LRM is also a key enabler of the circular economy and limit the amounts of virgin refrigerants required and reduce premature destruction for products still in-demand.

Enhancing Energy Efficiency while Phasing Down HFCs

The adoption of the Kigali Amendment to the Montreal Protocol provides a unique opportunity to protect the climate by phasing down refrigerants (HFCs or hydrofluorocarbons) with high global warming potentials, while enhancing the energy performance of air-conditioning and refrigeration systems.

Mr. Anderson Alves, Regional Coordinator for Asia and the Pacific of the Montreal Protocol Unit, Chemicals and Waste Hub of UNDP, presented UNDP supported projects in Bangladesh, China and Dominican Republic, which showcased how HFCs are replaced while higher energy efficiency is achieved at the same time. The new technologies may seem to be more costly in the beginning, but as manufacturers, installers and users become more familiar with these technologies and upgrade/improvement continues, they will be more widely accepted and their costs will be reduced too.

¹ Total amount of ozone depleting substances (ODS) and HFCs contained in existing equipment, chemical stockpiles, foams and other products not yet released to the atmosphere.