**Complete HCFC Phase-Out in Ukraine through Promotion of zero ODS,**

**low GWP, Energy Efficient Technologies**

**Problem to be addressed**

Hydrochlorofluorocarbons (HCFCs) are gases used worldwide in a variety of applications including refrigeration, air conditioning, foam blowing, solvents, aerosols, and fire suppression. HCFCs represent the largest remaining use of ozone-depleting substances (ODS) having ozone depletion potentials (ODPs) ranging from 0.005 to 0.12 and are being used as transitional substitutes for globally phased-out chlorofluorocarbons (CFCs) with higher ODPs roughly equal to 1. As HCFCs contribute both to ozone depletion and global warming, the use of HCFCs is being phased out under the Montreal Protocol on Substances that Deplete the Ozone Layer.

In September 2007, the 20th anniversary of the Montreal Protocol, the Parties accelerated the phase-out schedule of HCFCs and at the same time encouraged countries to promote the selection of alternatives to HCFCs that minimize environmental impacts, in particular impacts on climate. Ukraine is a non-Article 5 Party to the Montreal protocol and therefore had to accelerate HCFC phase out reaching 75% reduction from its baseline level of 164.20 ODP tonnes[[1]](#footnote-1) by 2010, 90% reduction by 2015, 99.5% reduction in 2020 and finally achieve a completed HCFC phase-out in 2030.

Although there are currently 34 HCFCs that are subject to the phase-out, only a few are commonly used. The most widely used in Ukraine as well as worldwide include HCFC-22 (usually as a refrigerant and/or a component in refrigerant blends R-402A, R-406A, R-408A and some others), HCFC-141b (as a solvent and foam-blowing agent), and HCFC-142b (as a foam-blowing agent and component in refrigerant blends).

Ukraine does not produce HCFCs but still actively imports them to be used in polyurethane production industry and in refrigeration and air-conditioning (RAC) equipment servicing sector, e.g. as refrigerants used for cooling and air conditioning, solvents and coolants used in the manufacture of building materials, defence industry, aviation, medical and railway facilities, automotive industry, etc.

Based on the reported HCFC consumption in 2015-2017Ukraine is currently nominally in compliance with its obligations under the Montreal Protocol. However, field surveys identified that demand for HCFCs in the RAC servicing sector is about 19,7 ODP tons/year it is expected to remain unchanged for at least next 3-5 years due to availability of out-dated refrigeration and air-conditioning equipment that requires service. This is above 2019 consumption target of *<16.42* ODP tons/year and vastly greater than 2020 target of *<0.82* ODP tons/year.

Moreover, low efficiency refrigeration and air conditioning equipment and high leakage rates of refrigerant gases with high global warming potential (GWP) are responsible for a significant share of GHG emissions in the country. While emissions in the RAC sector originate from the use of high GWP refrigerants and energy consumption of RAC systems, the goal is also to accelerate the transfer of environmentally friendly technologies in the refrigeration and air conditioning sectors contributing to environmental sustainability and promoting a green economy.

Besides, due to inadequate/limited legislative framework related to ODSs and F-gases, obtaining information on the use of ODSs in general and HCFCs in particular is a tough task as the statistics covers export-import operations only. Moreover, customs data cannot provide an accurate picture of the imports and exports of HCFCs as these data are based on customs codes that are not specific enough and do not allow differentiation between the imported or exported quantities of individual HCFCs or blends containing HCFCs, both of which are needed to calculate the annual consumption HCFCs for the data to the Ozone Secretariat and verify the compliance with HCFC phase-out schedule. The above considerably complicates any HCFC related information gathering and the study of HCFC consumption in Ukraine for the development of HCFC phase-out strategy grounded on a climate-friendly transition.

Another issue is significant under-representation of women in the RAC sector. The Women in HVACR American industrial group reported that women made up only 1.4% of the heating, ventilation, air conditioning, and refrigeration industry in 2017. There is a lack of statistics on women working in this field in Ukraine, but their representation is clearly insufficient. To address the global HVACR market’s growth, the labour shortage and to promote gender equality, it is important empowering women to pursue a career in this field. Moreover, studies have consistently demonstrated that more diverse companies outperform less diverse companies.

The proposed project is therefore to address: (i) regulatory, data and capacity gaps to the final phase-out of HCFCs through support to the inforcement of ODP related legislation, improved information management, capacities and raised awareness; (ii) facilitate complete HCFC phase-out in Ukraine along with avoidance of HFC adoption through strenthening regulatory context for alternative refrigerants and demonstration of low GWP technologies in RAC servicing sector.

The project builds on the UNDP-GEF regional HCFC project which assisted four (4) Non-article 5 CEITs in the CIS (Belarus, Tajikistan, Ukraine and Tajikistan) in meeting their accelerated Montreal Protocol HCFC phase-out requirements for 2015 reduction milestones and by preparing the countries to look into strategies to ensure 2020 milestone complaince is practically implementable.

With help of the new proposed GEF/UNDP project, Ukraine will be able to (1) comply with its Montreal Protocol’s commitment to of achieving 99.5% phase out by January 1, 2020 and phase out the HCFC service tail of 0.5% by 2030 or earlier; (2) to help introduce replacements for HCFCs having less impact or no impact on climate in RAC sector thereby achieving climate co-benefits.

**Root causes and situation analysis**

HCFCs are consumed in following end-use categories in Ukraine:

* Foam XPS manufacturing (HCFC-22 and as a mixture with HCFC-142);
* PU foam application (system and blending houses with small-to-medium downstream users dependent on HCFC-141b) and refrigeration manufacturing (HCFC-141b based polyols);
* Solvents (HCFC-141b); and
* RAC equipment servicing sector (HCFC-22) for comfort, commercial and industrial cooling, refrigeration.

The following HCFCs and HCFC blends are imported to Ukraine for the following purposes:

**HCFC-22** is used as a refrigerant in unitary air conditioners, cold storages, retail food refrigeration equipment, chillers, and industrial process refrigeration. Also historically used (in smaller quantities) as a blowing agent for certain foam applications and as a propellant in aerosols;

**HCFC-141b** is used as a blowing agent in rigid polyurethane foams and integral skim foams and in aerosol solvent cleaning applications;

**HCFC-142b** is used as a blowing agent in extruded polystyrene boardstock, and (in small quantities) in refrigerant blends and as a retrofit refrigerant, such as in motor vehicle air conditioners that previously used chlorofluorocarbon.

HCFC blend **R-406А** (a three-component mixture based on R22 / R600a / R142b in the 55:4:41 ratio) is used for transport refrigerating systems, commercial refrigeration equipment.

HCFC blend **C10M1-A** (a three-component blend based on R22 / R21 / R142b in the 65:5:30 ration) is used for modernization of refrigeration systems operating on R-12, mainly on rail transport.

The pattern of HCFC consumption in Ukraine in 2010-2017 as reported to the Ozone Secretariat (table 1 here below), shows that due to its wide applicability HCFC-22 is the predominant refrigerant contributing to almost 90% of HCFC consumption in the country. The use of HCFC-142b has substantially dropped due to support from earlier TA projects. The reported consumption of HCFC-141b is to practically discontinue in the sector of polyurethane and mixed systems production by 2020 as a result of the on-going investment demonstration projects under the UNDP-GEF Regional HCFC project. The remaining HCFC-141b consumption of approximately 15-19 tons/year (1.65 - 2.09 ODP tons/year) in the solvents sector for RAC equipment servicing will likely to continue in the coming years.

**Table 1: Ukraine, Reported HCFC consumption in 2010-2017 (ODS Data reporting Forms for Ozone Secretariat**) in metric tons

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **HCFC/year** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** |
| HCFC-21 | 0 | 0 | 0 | 0.04 | 0 | 0 | 0 | 0 |
| HCFC-22 | 951 | 997.45 | 1500 | 585.06 | 557.73 | 82.52 | 274.50 | 200.00 |
| HCFC-124 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HCFC-141b | 229 | 207.78 | 300 | 202.5 | 68.50 | 4.60 | 9.20 | 19.24 |
| HCFC-142b | 145 | 12.60 | 200 | 76 | 62.06 | 0.84 | 0 | 2.83 |
| HCFC-406A | 0 | 0 | 0 | 0 | 119.78 | 0 | 0 | 0 |
| HCFC-С10M1-A (Blend of R22/R21/R142b) | 0 | 0 | 0 | 0 | 31.28 | 0 | 0 | 0 |
| Total net consumption of ODSs, tons | 1325 | 1217.83 | 2000 | 863.60 | 840.33 | 87.95 | 283.7 | 222.08 |
| **Total net ODP, tons** | **86.9** | **80.4** | **97.3** | **53.39** | **49.06** | **5.1** | **16.11** | **13.30** |
| *Consumption target* | *<41.05* | *<41.05* | *<41.05* | *<41.05* | *<41.05* | *<16.42* | *<16.42* | *<16.42* |

According to the HCFC consumption data submitted to the Ozone Secretariat, Ukraine is in line with the HCFC consumption targets. However, recent field surveys show the higher use of HCFCs as reported by companies compared to the consumption data based on imports. This discrepancy can be explained by the existing stocks of unused HCFCs currently being used by the companies. Another reason could be availability of HCFCs through unauthorized imports.

**Table 2:** **Ukraine, field survey data on HCFC use in 2014-2018 by HCFC type** in metric tons

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **HCFC / Year** | **2014** | **2015** | **2016** | **2017** | **2018** |
| HCFC-22 | 631.42 | 318.65 | 241.2 | 232.5 | 291.8 |
| HCFC-141b | 148 | 136.7 | 64.64 | 52.15 | 53.4 |
| HCFC-142b | 4 | 2 | 2 | 2,83 | 1 |
| HCFC -406A | 104.1 | 60 | 50 | 40 | 30 |
| HCFC-С10M1-A | 32.28 | 0 | 0 | 0 | 0 |
| Total, metric tons | 919.8 | 517.35 | 357.84 | 327.48 | 376.2 |
| **Total ODP tons** | **59.027** | **36.107** | **23.34** | **20.984** | **23.695** |

**Table 3: Ukraine, field survey data on HCFC use in 2014-2018 in key sectors** in metric tons/ODP tons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **2014** | | | **2015** | | | **2016** | | | **2017** | | | **2018** | | |
| **Sector** | HCFC consumption  (tons) | **HCFC consumption (ODP-tons)** | Percentage share | HCFC consumption (tons) | **HCFC consumption (ODP-tons)** | Percentage share | HCFC consumption (tons) | **HCFC consumption (ODP-tons)** | Percentage share | HCFC consumption (tons) | **HCFC consumption (ODP-tons)** | Percentage share | HCFC consumption (tons) | **HCFC consumption (ODP-tons)** | Percentage share |
| XPS | 249.8 | **13.73** | *23.27* | 121.8 | **6.699** | *18.55* | 93.2 | **5.126** | 21.97 | 72.5 | **3.988** | *19.00* | 22.8 | **1.254** | *5.29* |
| Manufacturers of polyurethane systems/ mixing enterprises | 138 | **15.18** | *25.72* | 136,7 | **15.037** | *41.65* | 64.64 | **7.11** | 30.47 | 52.15 | **5.737** | *27.34* | 35.4 | **3.894** | *16.44* |
| Servicing of refrigeration equipment | 532 | **30,108** | *51.01* | 258.85 | **14.371** | *39.80* | 200 | **11,10** | 47.56 | 202.83 | **11.26** | *53.66* | 318 | **18.547** | *78.27* |
| **Total** | 919.8 | **59.027** | *100* | 517.35 | **36.107** | *100* | 357.84 | **23.34** | **100** | 327.48 | **20.98** | *100* | 376.2 | **23.695** | *100* |

As of 2018 RAC equipment servicing sector in Ukraine accounts for approximately 80% of the HCFC consumption in Ukraine, including up to 74% of all HCFCs are used for servicing of industrial refrigeration equipment. Severe decline in RAC equipment sales in during 2014-2016 caused significant changes in the market. Companies with foreign investments either left the market (e.g. “Island” (Russia), “Baltic Master” (Lithuania), "Emerson, Jonson Controls") or significantly reduced the number of their employees (e.g. “Gea Grasso”, “Danfoss”, “Alfa Laval”). The RAC servicing sector is now highly dispersed, dominated by relatively small local players. 200 to 300 relatively small local companies currently operating on the market have also tangibly reduced the number of employees to 5-20 persons per company on average. There are about 3000 certified technicians in the country with the majority in large industrial regions, including the city of Kyiv (approx. 450 technicians), Dnipropetrovsk oblast (390 technicians), Kharkiv oblast (300 technicians), Odesa oblast (210 technicians), Zaporizhia oblast (220 technicians), Lviv oblast (190 technicians), Mykolaiv oblast (300 technicians) as provided in the Table 4 below.

One of the biggest challenges in the RAC industry is exceptionally low representation of women and insufficiency of women role models or support networks. The underlying causes of this are gender stereotypes and bias, gender segregation of education majors and professions, and gender discrimination.

**Table 4. Profile of Ukrainian RAC sector by number of companies and technicians by region**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **#** | **Oblast** | **Number of companies** | **Number of technical staff** | **Companies with 5 and more technicians** |  |
| 1 | Kyiv (capital city) | 150 | 450 | 40 |  |
| 2 | Kharkiv | 90 | 300 | 25 |  |
| 3 | Odesa | 66 | 210 | 20 |  |
| 4 | Lviv | 64 | 190 | 19 |  |
| 5 | Mykolaiv | 60 | 190 | 18 |  |
| 6 | Zaporizhia | 56 | 220 | 18 |  |
| 7 | Dnipropetrovsk | 90 | 390 | 30 |  |
| 8 | Kyiv | 32 | 150 | 10 |  |
| 9 | Zhytomyr | 30 | 82 | 6 |  |
| 10 | Kherson | 30 | 50 | 6 |  |
| 12 | Cherkasy | 25 | 65 | 5 |  |
| 13 | Poltava | 26 | 68 | 5 |  |
| 14 | Sumy | 20 | 30 | 5 |  |
| 15 | Zakarpattia | 21 | 60 | 4 |  |
| 16 | Kirovohrad | 23 | 59 | 4 |  |
| 17 | Rivne | 20 | 50 | 3 |  |
| 18 | Ternopil | 15 | 50 | 3 |  |
| 19 | Donetsk | 18 | 40 | 3 |  |
| 20 | Сhernovtsi | 15 | 35 | 3 |  |
| 21 | Volyn | 15 | 35 | 3 |  |
| 22 | Luhansk | 10 | 28 | 2 |  |
| 23 | Ivano-Frankivsk | 18 | 65 | 5 |  |
| 24 | Chernihiv | 20 | 43 | 4 |  |
| 25 | Vinnytsia | 20 | 52 | 30 |  |
| **Total** | | **934** | **2912** | **244** |  |

The main source of income for these companies is the sale of spare parts and repair/maintenance of refrigeration equipment. A company engaged in servicing of refrigeration equipment consumes approximately 1,000 kg of HCFCs (mainly HCFC-22) per year. The main consumers of HCFCs in Ukraine in the sector of installation and servicing of refrigeration equipment are: “Inga” LLC, “Linda” LLC, “MontazhHladoServis” LLC, “Infrost” LLC, “Industriia Klimatu” LLC, “МAS SYSTEM” LLC, “Entel ServiceA” LLC, “AO “Promkholod” PE, “Ralko Technik” LLC, Zhmutskyi О.B. PE, “HydroHouse” LLC, “Split Service” LLC, “Industriia Klimatu” LLC, “ES-Engineering” LLC, “FRIGO Ukraine” LLC, “HUURRE Ukraine” LLC, “APEX” LLC.

Though sales of refrigeration and comfort cooling equipment decreased by 60-80% in 2016 compared to 2013, the use of HCFC-22 has not substantially dropped over 2014-2017 with a slight up-trend seen instead. Field survey data suggest that HCFC-22 demand in the RAC equipment servicing will likely remain at approximately 19-20 ODP tons/year which will/may jeopardize Ukraine’s obligations fulfilment of Montreal Protocol.

HCFC consumption pattern observed in the RAC sector in 2014 -2016 suggests the minimum demand for HCFC-22 at 211 metric tons or 11.65 ODP tons as shown below (Table 5). The maximum estimated demand is 3 times higher.

**Table 5: Pattern of HCFC consumption in the sector of RAC equipment servicing in 2014-2016 (lower limit)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sphere of equipment application** | **Number of enterprises, units** | **Amount of HCFC-22 available in equipment, tons** | **Annual demand for HCFC-22 for maintenance of equipment, tons** |
| RAC equipment of fruit storages and fruit houses | 300 | 60 | 12 |
| RAC equipment of trade facilities (retail food store chain) | 22,256 | 106.8 | 13.4 |
| RAC equipment of trade facilities (chain stores) | 2,850 | 68.4 | 8.6 |
| RAC equipment of public catering establishments | 56,000 | 224 | 28 |
| RAC equipment in dairy processing enterprises | 266 | 89.6 | 18 |
| RAC equipment in food industry | 8,614 | 430.7 | 71.8 |
| RAC equipment of Ukrainian Railways monopoly “Ukrzaliznytsia” PJSC | 1 | 310 | 60 |
| **Total** | 65,181 | 1,289.5 | 211.8 |

Starting from 2020 the allowed HCFC service tail will be *<0.82* ODP tons/year, while thousands RAC installations will need to be serviced regularly. For companies that are reliant on refrigeration, non-availability of HCFCs on market (along with the absence of HCFC banks, reclaimed refrigerants and affordable alternative technologies) can pose a serious threat to business and potentially jeopardize the national economy or even threaten to impair the national security of Ukraine in context of Montreal Protocol obligations fulfilment.

**Barriers**

Because most HCFC consumption in Ukraine is now in the RAC sector, the fleet of HCFC-dependent equipment will continue to be dependent on HCFCs for servicing, despite the control measures under the Montreal Protocol limit HCFC supply. Other challenges to transforming HCFC consuming sector(s) are:

*Regulatory barrier:*

* Absence of a specialized law regulating relations in the sphere of ozone layer protection along with related secondary legislation and standards.

*Environmental barriers:*

* There is no effective ODS management (and destruction) system in place. Private businesses servicing large ODS consumers are not sustainable.
* Central ODS waste storage site (bulk waste) is not available.

*Economic barriers:*

* Relatively low price of HCFCs as compared to alternatives.
* HCFC smuggling to Ukraine.
* Shortage of skilled technical personnel (at enterprises) capable of replacing HCFCs with alternatives.
* Shortage of reserve refrigeration capacities to ensure delay-free operation during HCFC replacement and therefore high risk of shutdown and related losses.

*Social barrier:*

* Under-representation of women in the RAC sector; prevalence of gender stereotypes and bias, gender segregation of education majors and professions, and gender discrimination.

*Financial barriers:*

* Difficulties in attracting financial support for HCFC phase-out projects due to high interest rates (20% and above) for loans in UAH.
* Low availability of affordable alternative technologies.

*Technological barriers:*

* Suitable technical solutions should be tailored to specific national circumstances, involving a wide consultative process with national stakeholders and industry representatives to ensure a proper design, address training needs and meet safety codes/standards requirements etc.
* Ukraine does not have national or subnational facilities for disposal / destruction of waste HCFC.

*Informational barrier:*

* Limited knowledge on rapid HCFC replacement among business owners and managers.

Moreover, to support climate benefits, HCFCs should be replaced via avoiding high-GWP HFCs while achieving high energy efficiency and by using safe and environmentally acceptable technologies.

The project is therefore to assist the Government of Ukraine to fulfil the country’s commitments on HCFC phase-out by addressing regulatory barriers, data and capacity gaps along with demonstrating achievable climate benefits in the HCFC phase-out as it relates to the RAC sector.

**Regulatory framework analysis**

The Ministry of Ecology and Natural Resources of Ukraine is the central executive body responsible for fulfilling the obligations arising from membership of Ukraine in the Vienna Convention and the Montreal Protocol. The function of the National Ozone Unit is assigned to the Division of Environmental Monitoring, Protection of the Ozone Layer and Technical Regulation of the Department of Climate Change and Protection of the Ozone Layer of the Ministry of Ecology and Natural Resources of Ukraine.

The Ministry of Ecology and Natural Resources of Ukraine issue permits for obtaining licenses for the import and export of ozone-depleting substances and goods containing them that are sent to the Ministry of Economic Development and Trade of Ukraine. Then the Ministry of Economic Development and Trade of Ukraine issues licenses for the import and export of ODS and goods containing them and monthly informs the Ministry of Ecology and Natural Resources about the licenses issued to the subjects of foreign economic activity.

Ukraine's commitments under the EU-Ukraine Association Agreement included implementation of the Regulation (EC) 2037/2000 on ozone depleting substances, which controls the production, importation, exportation, placing on the market, use, recovery, recycling, reclamation and destruction of all ODS, within 2 years of the entry into force of the Agreement and included:

−adoption of national legislation and designation of competent authority/ies;

−establishment of bans for controlled substances including ending the use of virgin HCFCs by 2010 and of all HCFCs by 2020;

−phasing out of the placing on the market of virgin HCFCs by 2015;

−establishment of obligations to recover, recycle, reclaim and destruct used controlled substances;

−establishment of procedures for monitoring and inspecting leakages of controlled substances.

Accordingly, Clause #261 of the Action Plan for the Implementation of the Association Agreement for 2014-2017, approved by Resolution of the CMU dated September 17, 2014 No. 847, envisaged implementation of the Regulation (EC) 2037/2000 on Substances that Deplete the Ozone Layer by August 2016. However, the Regulation (EC) 2037/2000 and commitments thereunder were not implemented.

There is still no national ozone-related law in effect. Draft Law "On Ozone Depleting Substances and Fluorinated Greenhouse Gases" <http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=64596> has received first-reading approval in the Parliament on 28.02.2019, but is pending full approval.

The draft law determines the powers of the central executive authorities in regulating the circulation of ozone-depleting substances and fluorinated greenhouse gases. It establishes the following duties of business entities:

* acquiring the status of operators of controlled substances,
* to conduct the leakage checks by the trained personnel;
* to recover, recycle, reclaim and destruct controlled substances;
* to report annually on the activities with controlled substances to the Ministry of Ecology and Natural Resources;
* to label the goods and equipment containing controlled greenhouse gases;
* provides for a ban on the production of controlled substances, the import of goods and equipment containing ozone-depleting substances, the use of virgin ozone-depleting substances (starting from 2021).

The draft law provides for the establishment of the electronic registry of the operators of controlled substances (business enterprises carrying out the import, export, placing on the market, storage, use or handling of controlled substances and/or goods and equipment containing them). Under the provisions of the draft law, the electronic registry will contain:

* business enterprises corporate information;
* information on the planned activities with controlled substances;
* information about the personnel which were issued the qualification certificate;
* Information on the controlled substances the operator possesses.

**STRATEGY**

The project will consist of three components: **Component 1** will address legislative and data gaps and facilitate implementation of national legislation; **Component 2** will support targeted phase-out investment and implementation of demonstration projects on HCFC replacement with zero-ODS/low-GWP alternatives in RAC servicing sector; **Component 3** will deal with public awareness and capacity building of key stakeholders, including strengthening capacity of Customs on control of HCFC/ODS alternative import/export and training of technical stuff. Component 4 is related to project management, monitoring and evaluation. Gender equality and women’s empowerment concerns will be mainstreamed across relevant components to engage women in the RAC sector.

The following describes activities envisioned under each component of the project, with expected outcomes and outputs to be achieved by each component:

**Component 1: Addressing legislative and data gaps and facilitating implementation of ozone-related legislation**

Proper legislative framework is essential on the path to meeting the phase-out schedule and remaining in compliance with the Montreal Protocol. The policy and legislation have also a great deal to do with shaping shift to modern technology course taken by the country through supporting new ozone- and climate-friendly technologies thereby contributing to development of the Green Economy. The project is therefore to help the government in development of the sub-laws to ensure the Law "“On regulation of economic activity with

ozone-depleting substances and fluorinated greenhouse gases” " implementation

Under this component the project will:

* Facilitate implementation of national legislation (the Law on Ozone Depleting Substances and F-Gases) through supporting the development of secondary legislation and the national electronic registry for operators of controlled substances;
* Carry out analytical and field research to determine HCFC consumption in the country and suitable ozone- and climate-friendly alternatives to HCFCs in different sectors of the economy;
* Provide expert support for the development of standards that establish technical requirements, quality control methods and procedures for the use of natural refrigerants.

**Outcome 1.1. National legislation on HCFC and HFC phase out and import/export control enforced, through adopting secondary legislation and deployment of mandatory electronic registry for operators of controlled substances**

**Output 1.1.1. Expert support provided to the development of secondary legislation regulating the practical implementation of the Law on Ozone Depleting Substances and F-Gases**

Development of secondary legislation to the Law on Ozone Depleting Substances and F-Gases adopted in first reading, including regulations (i) prohibiliting to release any ODS into the atmosphere, (ii) banning the import of HCFC-containing RAC equipment, (iii) prohibiting disposal of RAC equipment without recovery of refrigerant; (iv) setting refrigerant evacuation requirements, to maximize recovery of ODS during the maintenance and/or disposal of RAC equipment, (v) setting procedural requirements for sending refrigerant to a destruction or reclamation; (vi) setting requirements for packaging, labeling, size of containers containing HCFCs.

**Output 1.1.2. Mandatory electronic registry for operators of controlled substances developed and deployed**

Proper information management that includes data collection and reporting requirements is a key support tool for strengthening law enforcement with respect to monitoring the availability and usage of control substances and enhancing awareness. A mandatory electronic registry for operators of controlled substances can significantly facilitate the monitoring of how the provisions of the HCFC legislation are being followed by the relevant entities and (if supplemented with reporting requirements) allow for effective monitoring of HCFC flow to/from the country and possibly inside the country, as well as making best estimates of quantities of HCFCs used in particular sectors, and also of HCFC quantities being recovered, recycled and reclaimed. No other measure can be so effective for ensuring appropriate HCFC management, which is required to achieve a successful phase-out. Other important benefits are that the electronic registry will help to standardize data input, increase the awareness of the relevant entities of the need for eliminating HCFCs in the nearest future, and improve the traceability of changes of the status of operators. However, the registry will become a powerful tool only if proper requirements to the minimum data are set, current reporting practices (including reporting formats, traceability, and scope of reporting) are reviewed, all relevant entities and types of activities covered, etc. The project will support the Government in the development of requirements and specifications for a unified mandatory electronic register for operators of controlled substances and the development of a registry web interface and database based on an original software designed specifically for this purpose.

**Output 1.1.3. Development or adaptation of technical guidelines for ODS management**

## In Ukraine, there are no clear rules for handling ODSs and equipment containing ODS, that in practice enables leakage of refrigerant into the environment during transportation and storage. Development of technical guidelines for ODS management will allow setting standards for collection, storage, transport and disposal of ODSs, as well as qualification requirements for personnel engaged in ODS handling. The project will refer to the best European and Regional practices including the EU Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE); Technical Standard EVS-EN 50625-2-3:2017 Collection, logistics & treatment requirements for WEEE - Part 2-3: Treatment requirements for temperature exchange equipment and other WEEE containing volatile fluorocarbons or volatile hydrocarbons; Instruction on ODS management approved by the decree of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus of December 19, 2008. №122.

**Outcome 1.2. HCFCs and HCFC alternatives survey(s) completed to determine national consumption, use and applicability**

The survey(s) will determine the consumption and use of HCFCs in various sectors along with current alternatives to HCFCs including natural refrigerant solutions. This data (will help understand applicability of HCFC alternatives, including natural refrigerants such as carbon dioxide, ammonia, hydrocarbons, and synthetic gases of HFC and HFO groups, other technologies such as water absorbent, natural cooling, and heat pumps. This information will provide crucial data for managing HCFC phase-out process with respect to substitute technologies coming to replace HCFCs, including not-in-kind approaches. It will also enable the government to understand what the implications of the Kigali Amendment to the Montreal Protocol on phasing down HFCs will be for Ukrainian economy.

**Output 1.2.1. HCFCs and HCFC alternatives survey(s) completed for the following sectors**:

- chain stores (hypermarkets, supermarkets, retail stores in residential and public buildings, at gas stations, etc.);

- refrigeration systems of trade networks and food storage warehouses;

- agriculture (mobile and stationary milk coolers, storage facilities for fruits and vegetables, fast-freezers for fruits, berries and mushrooms);

- winemaking, brewing and production of soft drinks and juices (coolers for technological processes);

- medicine (storage of vaccines, blood products, mortuary refrigerators and laboratory equipment);

- cooking and catering kitchens, including at educational facilities (food storage rooms and refrigerators);

- confectioneries, candy factories and ice cream and dairy factories (food raw materials and finished products cooling equipment);

- transport (refrigerated wagons, containers and public transport air conditioning at railway and metro);

meat and fish processing (technological processing rooms, cooling, freezing and storage chambers);

- chemicals production (refrigerators and coolers used during the manufacture of drugs, plastics, polymers, insulating materials, acids and fertilizers);

- air conditioning systems and heat pumps used in industry, commercial and residential sectors.

These data will reveal trends in the application of both natural refrigerants with zero ODP and low global warming potential (GWP), such as carbon dioxide (CO2, GWP = 1), ammonia (NH3, GWP = 0), petroleum-derived hydrocarbons – propane (C3H8, GWP = 3), isobutane (C4H12, GWP = 3), pentane (C5H12, GWP = 5), propylene (C3H6, GWP = 2); and synthetic refrigerants (hydrofluorinated olefins), such as HFO-1234yf (GWP = 4), HFO-1234ze (GWP = 7), HFO- 1233zd (GWP = 4), HFO-1336mzz (GWP = 9).

**Outcome 1.3. Strengthening regulatory context for the use of natural refrigerants**.

HCFC phase-out has to be accompanied by the introduction of modern standards for safe handling, storage and use of low-GWP natural refrigerants that can replace HCFCs in the RAC equipment sector. Notwithstanding the strong advantages of natural refrigerants – they have zero ODP, a negligible GWP, are part of the natural biogeochemical cycles, do not form persistent substances in the atmosphere, water or biosphere and have been used as refrigerants for over 150 years, – they require additional safety measures as hydrocarbons (HCs) are flammable, carbon dioxide typically operates at a higher pressure than other refrigerants and ammonia is slightly flammable, corrosive and highly toxic. These refrigerants are very effective, but their use in Ukraine is hampered by various factors, including high perceived risk associated with their use. Although widely used in refrigeration and cooling systems and appliances worldwide, national standards restrict the safe use of natural refrigerants and therefore need to be updated to take account of technological progress.

**Output 1.3.1:** **Support for the development of standards that establish technical requirements, quality control methods and procedures for the use of natural refrigerants**

Current standards in use include outdated SNiP 2.11.02-87 “Refrigerators (1987) and Occupational safety norms 2-2.00-1.10-88 "Rules for the design and safe operation of freon refrigeration units" (1988). Modern standards are therefore crucial for transforming the RAC sector and building capacities of technicians to handle innovations in skilful and safe manner. The project is to cooperate with the Ministry of Ecology and Natural Resources of Ukraine and Ukrainian Research and Training Center of Standardization, Certification and Quality to support knowledge transfer and building initial national capacity on natural refrigerant safety standards, engaging women and men from diverse groups.

**Component 2: Targeted Phase-Out Investment and Demonstration Projects on HCFC replacement with zero-ODS/low-GWP alternatives in RAC servicing sector**

Demonstration projects are expected to serve as proof of the feasibility of HCFC alternative technology solutions under local conditions, in order to promote similar undertakings with reduced uncertainty and risk.

**Outcome 2.1: Strengthening the national system of HCFC reclamation**

Availability of refrigerant recycling and reclamation facilities in the country is the backbone of complete HCFCs phase-out (through reducing dependance on HCFC import) and smooth transition to HCFC-free technologies/servicing practices. Until 31 December 2029, reclaimed HCFCs may be placed on the market and used for the maintenance or servicing of existing equipment (provided that the container is labeled with an indication that the substance has been reclaimed and with information on the batch number and name and address of the reclamation facility).

**Output 2.1.1. Minimum 4 national Reclamation Centers upgraded to ensure supply of recovered and reclaimed HCFC-22 to the local servicing market**

Since recovery, recycling and reclaim of refrigerants will be made mandatory by law starting from 2021, it is proposed to upgrade 2-5 large national HCFC Reclamation Centers and 2 small technical maintenance centers, engaging at least one women-led centre, as the success in operating of these centers can lead to smoothening of the phase-out of HCFC-22 through reducing demand for virgin HCFC-22.

**Practical result:** Reclaim centres strengthened with sophisticated refrigerant identifiers to support HCFC reclaim system.

**Practical result:** Tools, portable recovery machines and other equipment are supplied to service companies and field technicians to complete support of HCFCs release prevention.

**Outcome 2.2: Exploiting the potential for natural refrigerants to replace HCFCs across applications and regions**

There is a variety of HCFC alternatives that can be used in retrofitting of old equipment and in new equipment in refrigeration and air conditioning. Technologies using carbon dioxide and hydrocarbons have been commercially available for many years and most recently alternative involving methyl formate and HFOs have been introduced in many countries.

The slow expansion of green cooling technologies with zero ODP and low GWP in Ukraine prompts the relevant international experience transfer / technology demonstration is needed to accelerate the use of climate-friendly alternative refrigirants in the country, additionally contributing to a more efficient use of energy and increasing awareness of available green technologies among the private and public sectors.

The project intends to demonstrate installation, commissioning and maintenance of equipment based on natural refrigerants both at a number of public (social) sector facilities (orphanages, boarding schools, nursing homes and other specialized institutions), and private (small and medium) enterprises, collecting and analysing data (disaggregated by sex, age, and other social identifiers) on potential beneficiaries of such equipment. Demonstration projects will be selected taking into account the following factors and priorities: a) equipment size (cooling capacity); b) to what extent technology can be the solution to climate change; c) financial sustainability and co-financing; d) high replicability and e) high energy efficiency.

**Output 2.2.1. Demonstration of CO2 based cooling systems**

CO2 is a non-flammable, non-toxic and environmentally benign natural refrigerant. СО2 (R744) as cooling agent can be an excellent choice when it comes to industrial refrigeration. Owing to the high working pressure, CO2 has a high volumetric refrigeration capacity (of approximately 5 times more than R22) and increased efficiency due to increased pressure drop in expansion valves. The higher pressure also means that CO2 systems and piping are more compact versus traditional systems (e.g. compressor size is approximately 1/5 of a R-404A based system), leading to lower material costs. The price of CO2 based refrigeration equipment can be up to 70-100% higher than R-22 based one, while energy consumption is usually 10 -50% less (with 20% energy savings on average). For example, the price of traditional equipment for fluorization tunnel (for freezing berries) is 200,000 EUR compared to R-744 based equipment ranging from 350,000 to 400,000 EUR, while electricity consumption is expected to decrease from 250 kW per hour to 180 ... 200 kW.

Although CO2 cooling technology has made significant gains globally in recent years, the following barriers and issues hamper its wide application in Ukraine:

- CO2 is a higher pressure refrigerant and a CO2 system pressure at an ambient temperature of + 30°C is 60 bar meaning more rigorous safety requirements;

- There are virtually no examples of R-744 based refrigeration systems in Ukraine meaning lack of practical knowledge related to their design, installation and commissioning.

- Lack of skilled technical personnel capable of servicing R-744 based equipment.

- The price of equipment containing R-744 as refrigerant is almost 2 times higher compared to conventional refrigerants.

- Special tools have to be purchased (vacuum pumps, gauge manifolds).

- Inspections of various control authorities could be stepped up due to specific safety requirements for refrigeration systems with R-744.

**Practical result:** The project includes the following potential demonstration activities to be implemented in the food realm:

7 low-temperature based refrigeration units and 26 medium-temperature refrigeration units (HCFC-22 based) for storing food at pre-school and school catering/dining facilities will be switched to CO2 (R -744) refrigeration technology, collecting and analysing data (disaggregated by sex, age, and other social identifiers) on potential beneficiaries of such equipment.

**Output 2.2.2. Demonstration of hydrocarbon-based refrigeration and air-conditioning**

Hydrocarbons are non-toxic refrigerants that have no ozone-depleting potential and a minimal impact on global warming. Thanks to their excellent thermodynamic properties, hydrocarbons are as good as or even better than HCFC refrigerants in most applications. The flammable chemical properties of hydrocarbons are well understood and managed in a wide range of different applications. For example, propane (R290) has been used worldwide for many years in commercial refrigeration systems, especially in light applications, and has the best prospects to be introduced in agricultural sector and at retail facilities in small cities, towns and rural areas in Ukraine. The normal charge of R290 is usually 40% lower than that of other refrigerant fluids. Thus, in a light commercial refrigeration system, the load is up to 150 grams of R290 (this is the maximum limit according to the current international IEC standard so far, but a revised standard expected in 2019 is to increase the charge limit for propane in commercial refrigeration to 500g). However, because it is flammable, it still arouses some fear in Ukrainian professionals who are not accustomed to dealing with it, and therefore R-290 based refrigeration technologies are recommended for demonstration activities under this project.

Refrigeration units using HCFC-22 are most common in the agricultural sector in Ukraine. They include equipment for cooling milk on dairy farms, and other refrigeration equipment designed for cooling, processing cold storage of agricultural products - milk and meat, fruits and vegetables. The main issues in this sector relate to obsolete equipment and technologies. The use of natural refrigerant R-290 (propane) to replace HCFC-22-based milk cooling equipment at 2-4 agricultural enterprises as well as at selected industrial enterprises in different regions of the country will be demonstrated within the framework of this project to showcase its high replicability and efficiency.

**Practical result**: In public (social) sector 17 medium-temperature refrigeration cabinets (running on HCFC-22) for storing food in schools and kindergartens will be replaced with zero ORP / low GWP refrigeration technology based on propane (R-290) or isobutane (R-600a), collecting and analysing data (disaggregated by sex, age, and other social identifiers) on potential beneficiaries of such equipment.

**Practical result**: 10-20 sets of propan-based medium and small air-conditioning equipment will be installed at selected public sector facilities, collecting and analysing data (disaggregated by sex, age, and other social identifiers) on potential beneficiaries of such equipment, to demonstrate that hydrocarbons are also safely used as alternative refrigerants in room air conditioning systems.

**Outcome 2.3. Demonstrating refrigerant leakage prevention solutions**

**Output 2.3.1. Installation of ball valves in refrigeration and air-conditioning systems to prevent emissions of HCFC-22 into the atmosphere.**

Replacing filter driers and installing anti-acid filters in the refrigerant circuit is a common need during maintenance of RAC equipment. To install a filter in the system, it is necessary to depressurize the system (release or evacuate refrigerant), install filters, vacuum the system and refill it with refrigerant. This is especially true for the systems without refrigerant receiver, as well as when replacing the compressor. An effective way to avoid the release or evacuation of refrigerant is to install two ball valves with filling fittings in front and after the filter allowing to block refrigerant flow, replace the filter, locally vacuum and restart the system. This simple measure allows to significantly save maintenance time and prevent the release of refrigerant.

**Practical result:** Technical maintenance of chillers installed in 36 sports clubs in Kiev and Kiev oblast require the replacement of filters that in the BAU scenario will include the evacuation of refrigerant, vacuuming and charging of the system totaling about 9,000.00 UAH. In the alternative scenario these steps could be avoided by installing two ball valves (that will cost 1500.00 UAH \* 2 + installation costs 1647.00 = 6294.00 UAH) during the scheduled maintenance (+9,000.00 UAH) to save time and money in the future. The project could cover the cost of the valves to demonstrate this simple and highly scalable solution applicable to office centers, hospitals, clinics, shopping centers etc. with dozens of chillers running on R-22, R-407 or R-410. Data (disaggregated by sex, age, and other social identifiers) on potential beneficiaries of such equipment will be collected and analysed.

**Outcome 2.4. Greening transport refrigeration**

Transport refrigeration plays a key role in the food cold chain and that is essential for the economy. Many modern transport refrigeration applications have readily available, low-GWP foam blowing agent and refrigerant alternatives, however, in the case of Ukraine majority of refrigerator cars and railway refrigerator cars run of HCFCs or HFCs.

**Output 2.4.1. Supporting HCFC phase-out at Ukrainian Railways**

Ukrainian Railways monopoly “Ukrzaliznytsia” PJSC unites six subnational railways and about 140 other structural enterprises. It manages 21.6 thousand km of railroads and owns almost 4,000 locomotives and 123,000 railroad cars and is one of the largest employers in Ukraine providing jobs to over 300,000 people. The share of “Ukrzaliznytsia” PJSC makes about 60 % of all freight and 38 % of passenger traffic in Ukraine. Field survey and HCFC importers’ data show that annual HCFCs demand of “Ukrzaliznytsia” PJSC is in the range of 30-60 tons annually. Data for 2014 showed the total demand of 60.98 tons of HCFCs, including 15 tons of HCFC-141b, 7 tons of HCFC-142b, 25 tons of HCFC R-406А, 10 tons of C10M1A, 1.5 tons of HCFC R-408А.

**Practical result:** Because “Ukrzaliznytsia” PJSC is one of the major users of HCFCs in the country, the project will conduct a comprehensive technical audit to determine suitable technical measures to reduce emissions of HCFCs in a typical production unit of a selected railroad depot. The audit will help identify refrigerant leakage solutions along with technically feasible, low-GWP alternatives applicable to local conditions in a view of HCFC phase-out. Data (disaggregated by sex, age, and other social identifiers) on potential beneficiaries of this activity will be collected and analysed.

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**Component 3: Raising public awareness on ODP and strengthening capacity of key stakeholders**

**Outcome 3.1. Raised public awareness on HCFC phase-out and ODP alternatives having less impact or no impact on climate**

The importance of action in addressing HCFC phase-out challenges lays not only in terms of compliance, regulatory and technological barriers, but also in avoiding negative social and economic impacts, particularly on the general population and small commercial enterprises, that could result from the low availability of HCFCs for servicing. Despite continuous efforts, the HCFC phase out appears to have a low profile even with those most impacted, namely end-users, let alone the general public. The existing lack of awareness must be addressed by a focused campaign explaining the importance of the county commitments under the Montreal Protocol and stating the implications of having to eliminate HCFC use and ultimately HCFC based equipment.

**Output 3.1.1. Focused information campaign conducted**

An information campaign will be carefully tailored to various target audiences, taking into account different needs and experiences of women and men from diverse groups, and will include a range of information dissemination tools and involve partnership with the Ministry of Ecology and Natural Resources of Ukraine, RAC association, industry associations, consumer organizations, educational institutions and environmental CSOs, including those working on gender equality in the RAC sector. The campaign will include messages on eliminating bias against women in the RAC sector and empowering them to pursue career in this field. It will be designed and implemented in line with the principles of gender-responsive communications.

**Outcome 3.2. Strengthening capacity of the State Customs Service of Ukraine to control import/export of ODS/ODS alternatives and ODS-based equipment through improved laboratory and analytical base, training and skills development.**

The initial capacity building programme for the State Customs Service of Ukraine was implemented as part of the current UNDP-GEF project on HCFCs. It included provision of the up-to-date knowledge and sharing regional experience in the area of ODS and ODS alternatives import / export control. With regard to the physical control capabilities, the State Custom Service has also received modern analytical laboratory equipment (two chromatograph mass spectrometers and portable gas analyzers. However, to enable customs specialists to properly exploit analytical instruments for determining controlled (incl. prohibited) substances and/or confirmation of permitted substances, additional laboratory equipment, instruments and supplies are required.

**Output 3.2.1.** **Additional laboratory equipment, instruments and supplies purchased to strengthen control over** **import/export of ODS/ODS alternatives and ODS-based equipment**

These will include:

- sampling equipment to get a representative sample of the gas contained in aerosol container or large-sized containers;

- spare parts and consumables for servicing the purchased equipment;

-standard samples of controlled substances (necessary for the development of test methods and calibration of relevant equipment);

**Output 3.2.2. Training course developed to enhance skills of the customs specialists in the use of laboratory analytical equipment**

The training will include messages on eliminating bias against women in the RAC sector and empowering them to pursue career in this field. It will be designed and implemented in line with the principles of gender-responsive communications.

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**Outcome 3.3. Strengthening the capacity of refrigeration and air-conditioning technicians in maintenance and repair of equipment including those with new and alternative technologies.**

**Output 3.3.1. The majority of RAC technicians trained in handling new/alternative refrigerants**

A team of senior RAC engineers/technicians will participate in advanced training and knowledge transfer programmes abroad to further develop a programme and guidance for training of a broader range of national technicians on zero-ODS and low-GWP refrigerants that have good potential to substitute HCFCs, with a special emphasis on non-HFC solutions to be demonstrated within the project framework. By supporting this train-the-trainer approach, the project aims to reaching out to all 3,000 available RAC technicians working across the country.

**Output 3.3.2. Supply of equipment / tools for refrigeration technicians**

- Supply of 15–18 toolkits and portable refrigerant reclamation equipment to importers, RAC equipment service companies and field technicians to support the establishment of HCFC recovery, recycling and reclamations system (under Outcome 2.1.)

- Five to eight service-and-training centers will receive specialized equipment and special devices for servicing HCFC equipment running on low-GWP substances and serial technologies based on natural refrigerants.

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1. The baseline for CEIT countries is calculated by adding up 1989 HCFC consumption and 2.8 per cent of 1989 CFC consumption (in ODP weighted terms).  Ukraine’s baseline was calculated to be 164.20 ODP Tonnes. [↑](#footnote-ref-1)