# Kigali Amendment: Vienna Talks

## Challenges, opportunities and key actions for the phase down of HFCs

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

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## Challenges, opportunities and key actions for the phase down of HFCs

This document has been developed by The Montreal Protocol Division of the Environment Department of UNIDO.

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# Greeting message from UNIDO

The Kigali Amendment to the Montreal Protocol marks a significant breakthrough in the fight against climate change. Implementing the Amendment poses a new and exciting challenge, and it's a challenge that we at UNIDO are ready for.

For half a century, UNIDO has assisted developing countries to safeguard the environment and promote inclusive, sustainable industrial development. For quarter of a century, we've been an implementing agency of the Montreal Protocol, phasing out harmful substances while supporting the transition to environmentally friendly alternatives.

The Kigali Amendment requires the phasing down of HFCs, which are powerful greenhouse gases. In doing so, the Amendment extends the reach of the Montreal Protocol, making it an even stronger instrument to prevent global warming.

But the work is not done yet.

That's why we decided, soon after the Amendment was adopted, that we wanted to gather the countries together to talk through the task and challenges ahead. We wanted to hear from country representatives on how best to manage the transition away from HFCs, to understand each country's priorities and requirements, and how UNIDO can help along the way. This report gathers these voices together to highlight what will be most important in the task ahead.

Developing countries have unique needs for the phase down. Cutting the production and consumption of HFCs means finding the best sustainable alternatives, as well as successfully implementing them. It requires the analysis of the total environmental impact of the transition, including close attention to both direct and indirect emissions. Energy efficiency plays a crucial role here. UNIDO has been working towards greater energy efficiency for nearly three decades, and it continues to do so today, such as in the recent demonstration of energy efficient options in the refrigeration and air conditioning sectors.

The phasing down of HFCs is also part of our ongoing commitment to the circular economy, as we move towards inclusive, sustainable industrial development. Together, with the countries implementing the Kigali Amendment, we are determined to do all we can to reach a cleaner, more sustainable future.

**Stephan Sicars**

Director, Department of Environment

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# About this report

With the new Kigali Amendment, the Montreal Protocol will be an even more powerful instrument against global warming. The Amendment will phase down hydrofluorocarbons (HFCs) by cutting their production and consumption. For all countries, this presents many opportunities, but also challenges. UNIDO organized a conference and a series of surveys to identify the main emerging questions, as well as the responsibilities for developing countries regarding the ratification and future implementation of the Kigali Amendment. This report summarises the main results and offers some answers to these urgent questions.

## Kigali Amendment - Vienna Talks: Challenges, opportunities and key actions for the phase down of hydrofluorocarbons

From 13-15 June 2017, 75 participants from 55 countries accepted the invitation from UNIDO to join the Kigali Amendment - Vienna Talks. The event brought together mostly representatives from National Ozone Units in Africa, Asia and Latin America, but also experts from academia and the private sector to share their insights. The Vienna Talks aimed to support Article 5 countries to better address the upcoming challenges but most importantly to grasp the immediate and longer term opportunities offered by the Kigali Amendment to the Montreal Protocol. Over three days of presentations, interactive panels and two dedicated workshops, participants expressed their main priorities in tackling the phase down of ozone depleting substances and high global warming potential HFCs, while at the same time also considering economic development, energy efficiency and safety.

## Pre-event survey gathers voices from attendees

Just before the Vienna Talks event, a survey was conducted to gather direct feedback from those crucial to an effective implementation of the Kigali Amendment (KA). The 69 survey respondents were mostly representatives of National Ozone Units (59 per cent), other government representatives (15 per cent) or independent experts (8 per cent).* Participants came from Africa (45 per cent), Europe (29 per cent), Asia and the Americas (each 13 per cent). Results from this survey, as well as from the live polling conducted among the participants during the event, will be mentioned in the following chapters. They serve to highlight expectations, concerns or remaining needs for clarification for a more effective KA implementation.

## Participants expect support in immediate KA implementation

The pre-event survey asked participants about their expectations for the Vienna Talks event (see Fig. 1). The response showed their most urgent questions regarding the Kigali Amendment (KA) in general. Most expectations centred around the immediate challenges at hand, in terms of better understanding the KA focus areas and obligations for countries, and its impact on social, economic and environmental development. In addition, low-GWP** substances and technologies, standardization, and financing bodies and programmes featured prominently.

The following report aims to give answers to these emerging questions from Article 5 countries. It groups challenges and opportunities by topic, rather than by the chronological order in which they appeared during the event. We hope that this will assist in reading, and that the results will help guide countries in effective KA adoption, enforcement and full enjoyment of its benefits.

* Other participants included UNIDO Country Office (5 per cent), other (5 per cent), non-governmental sector (3 per cent), technology manufacturer / supplier (1.6 per cent), training / research (1.6 per cent), association / trade body (1.6 per cent).

** Please note that wherever the term "low-GWP" is used throughout this report, for reasons of simplicity it also includes "zero-GWP" substances with a GWP = 0 (like ammonia R717, water R718, or air R729 as a refrigerant)

CHAPTER 1

Be cool to be kind:

# The Kigali Amendment as a challenge... and an opportunity

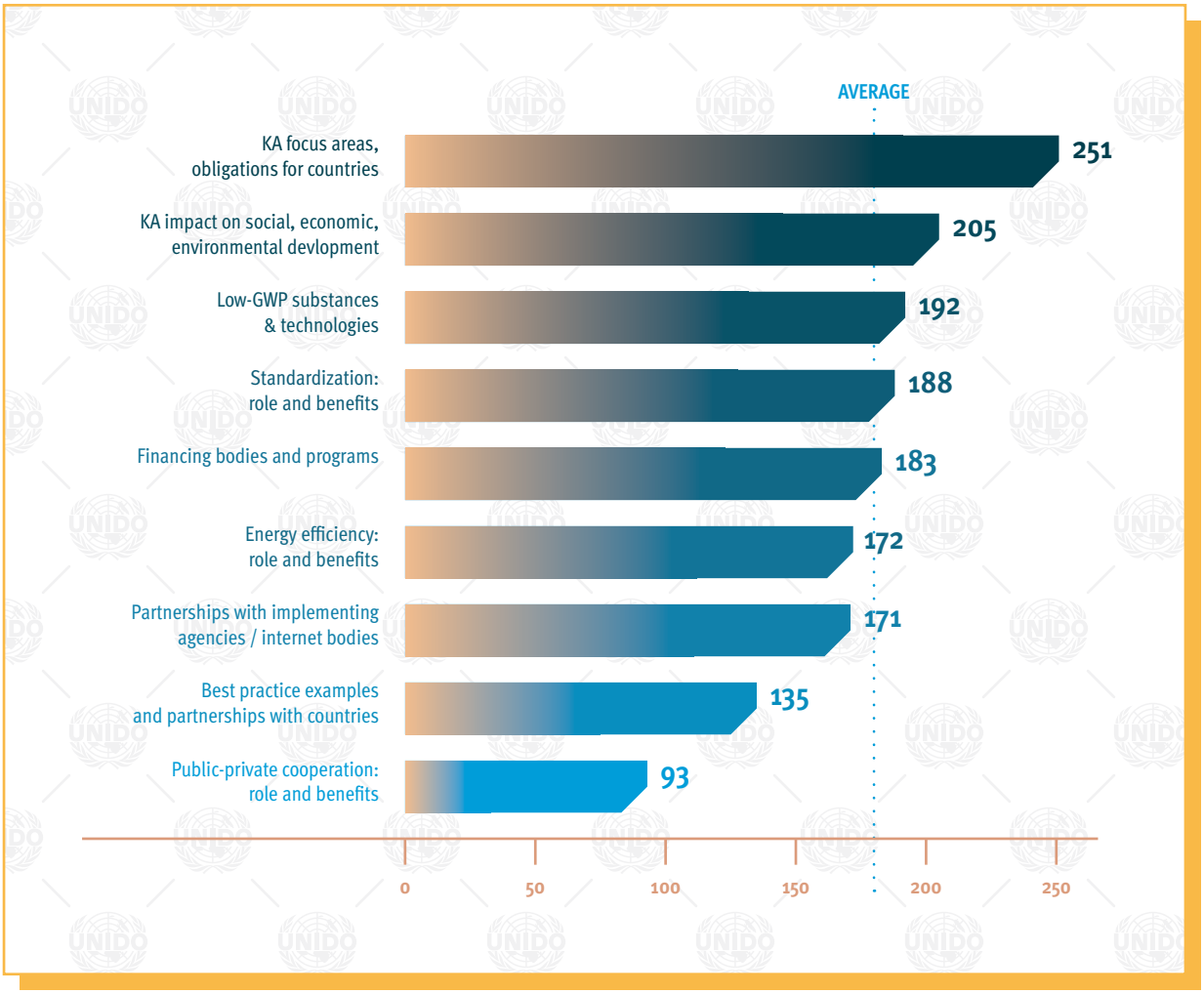
The Kigali Amendment (KA) – and its elements for effective ratification, implementation and enforcement – poses opportunities and challenges for Article 5 countries. Against the backdrop of political and administrative barriers slowing down the KA adoption, the need for enabling activities and institutional strengthening takes priority.

## KA impact on environment, social and economic development takes priority

When asked about their expectations regarding a KA-focused event, participants stressed that of the immediate challenges ahead, the KA focus areas and obligations for countries, as well as the KA's longer term impact on a country's social, economic and environmental development, were the two most important factors (see Fig. 1).

**Fig. 1: Expectations of the Vienna Talks**

The event should strengthen my understanding of:




Weighted average from ranking the items, highest value = highest importance across respondents.

The Vienna Talks hence kicked off with sessions about the opportunities for a country's development arising from the KA. UNIDO representatives highlighted the three major decisions under the KA which would have the greatest impact on countries in the coming years: the actual amendment of the Montreal Protocol to include HFCs (Decision XXVIII/1&2); the energy efficiency component (XXVIII/3); and the role of safety standards in effective implementation (XXVIII/4).

# KA will affect countries mostly on environment, policy and competitiveness

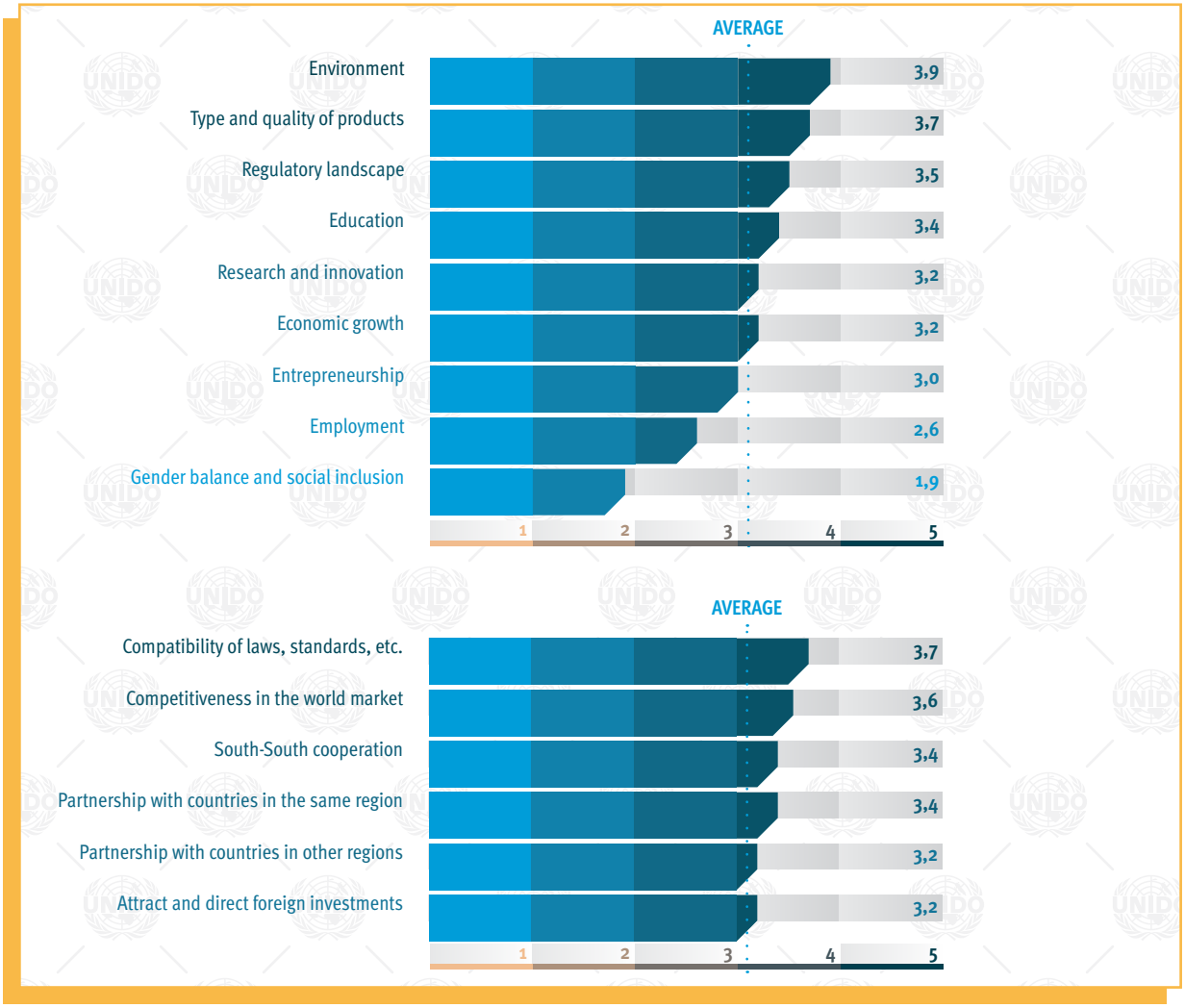
Reminding participants of the ultimate goal to avoid 0.5°C of warming by the end of the century, the talks also highlighted how positive effects could foster new and better products, save energy and thereby enhance competitiveness. A key focus was **integrated thinking on the KA to achieve the 2030 Agenda for Sustainable Development.** Issues such as poverty reduction, the eradication of hunger and food security, economic growth and better infrastructure, health, quality education, gender equality, sustainable production and consumption, and the access to affordable and clean energy featured in various sessions and discussion rounds.

> **"I would like to launch a call here on everybody that we cannot reach SDGs for 2030 as long as we do not put in place now the Paris Agreement or the Kigali Amendment. If we manage to have the same enthusiasm for the Amendment [...] I think we will be able maybe to save our planet."**
> Modibo Sacko, Mali

In the pre-event survey, participants had cited the environment, the type and quality of products, the compatibility of laws and standards, as well as the competitiveness in the world market as **areas for the KA to have a high impact on a country's development** (see Fig. 2). Regulatory and economic factors hence featured strongly, besides confirming that the KA could have a decisive impact on a country's environmental performance.

### Fig. 2: Effect of the KA on countries

In my country, the Kigali Amendment will have this degree of impact on the following areas:




Legend: 1 = Very low impact 5 = Very high impact

## 25 per cent expect difficulties in the KA ratification

A key element to move forward with concrete HFC phase-down measures is a prior timely and effective ratification of the KA. Interventions by UNIDO, UN Environment, Mali and Mexico at the Vienna Talks highlighted some key features for success in the ratification process, such as the access to financial support, the flexibility to prioritise HFCs and industry sectors to meet the agreed targets, or the available high ambient temperature (HAT) exemption.

> **"This [the Kigali Amendment] needs to be explained to the stakeholders, the components, the overall benefits. Of course we need to focus on the economic benefits that can arise when you go for the alternative refrigerants [...] We definitely have to take the lead in raising the awareness."**
> Juliet Kabera, Rwanda

Participants were asked if they expected any **difficulties in the KA ratification process.** 74 per cent said they did not, and that they expected a smooth ratification for their country. However, more than every fourth respondent could foresee difficulties due to slow or complex administrative processes, strong hierarchical structures and changes in leadership, political instability, or the non-availability of financial support. Participants, especially from Africa, mentioned a basic lack of incentives to ratify the KA at all, citing the unknown effect an HFC phase down would have on their socioeconomic development. Moreover, the non-existence of environmental legislation in some countries or the lack of enforcement after signing a treaty were mentioned as barriers.

When building an effective list of **measures for a smooth ratification, implementation and enforcement of the KA**, cooperation with other ministries, customs officials and the private industry sector take precedence. The identification of priority markets, their barriers and how to remove those barriers; and the synergies between the current HCFC phase out process on one side and a direct transition to low- or zero-GWP alternatives* on the other, were highlighted as areas where countries could already intervene early and effectively while all guidelines from the MLF were being finalized.

### Effective KA implementation

- ★ Carry out ODS alternatives surveys for data collection, monitoring and reporting requirements for HFCs
- ★ Designate ministries, steering committees and national coordination mechanisms for implementation and compliance
- ★ Increase synergies with energy and climate change policies and actors, cooperate with custom officials
- ★ Assess current regulatory framework; adapt laws and regulations
- ★ Extend ODS licensing and control system to cover HFCs
- ★ Prioritise sectors and technologies for the HFC phase down
- ★ Identify market barriers for low-GWP alternatives and foster dialogue with industry
- ★ Increase work with national safety standards bodies to include MP-related questions

* Please note that wherever the term "low-GWP" is used throughout this report, for reasons of simplicity it also includes "zero-GWP" substances with a GWP = 0 (like ammonia R717, water R718, or air R729 as a refrigerant)

## Cost guidelines and financial support keys to success

A subject of much debate was the role of the Excom – the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol – in terms of providing the necessary **guidelines on how to support enabling activities, finance the HFC phase down** of consumption and production, evaluate incremental costs for HFC-related projects in the manufacturing sector, develop procedures for A5 countries' flexibility in prioritising high-impact industry sectors, and how to enhance energy efficiency in low- or zero-GWP equipment. For the first time, there is potential for the Multilateral Fund (MLF) to widen its scope to support to the extent possible research and development activities in the future, in addition to or through continued financing of demonstration projects. However, the overall level of incremental operation costs (IOCs) and incremental capital costs (ICCs); the incremental costs for patents, the safety of flammable and toxic substances, and R&D; and the support for energy efficiency, HFC disposal or exemptions for high ambient temperature (HAT) countries, are still to be further negotiated.

As a result, participants were urged to prepare thoroughly for the upcoming ExCom negotiation meetings, to effectively represent their country's priority needs for a more informed definition of cost guidelines, procedures and early actions support.

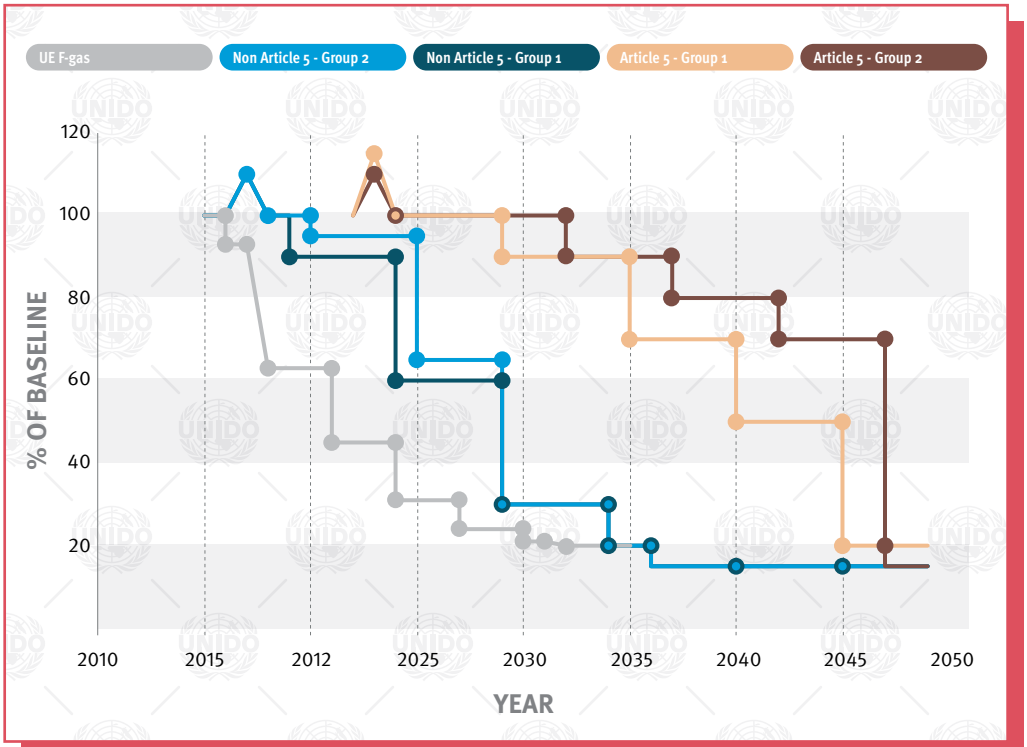
> **"You should try to influence what happens at the ExCom [...] so that you have a strong voice, because your voice is as strong as any Article 2 country. So please prepare yourself for this."**
> Ole Nielsen, UNIDO

## Funds available for enabling activities

The immediate focus now is on **enabling activities** where the support for the early ratification of the KA, the support for the institutional arrangements, the review of the licensing systems, the review of the data reporting systems and the preparation for national strategies would take precedence.

Finally, the KA with its direct impact on climate change and energy efficiency may also open the door to entirely **new funding sources outside the MLF scheme**. Bilateral agreements between individual countries, regional climate funds, supranational institutions, private sector initiatives or global grants for energy efficiency projects are among the options.

## HFC phase-down schedule for A5 and non-A5 Parties




## Baseline formula for all country groups

**Non-A5 Parties**

**Average HFC consumption for 2011-2013 + 15% of HCFC baseline**

**Non-A5 Parties Special Group***

**Average HFC consumption for 2011-2013 + 25% HCFC component of baseline**

**A5 Parties Group 1**

**Average HFC consumption (or production) for 2020-2022 + 65% of HCFC baseline**

**A5 Parties Group 2**

**Average HFC consumption (or production) for 2024-2026 + 65% of HCFC baseline**

Level of HFC consumption is expressed in $CO_2$-equivalent, which is calculated in the following way: Consumption = (import - export + production) x GWP




Keep the change:

# HFC control & low-GWP technologies

The Kigali Amendment prescribes recording historical and predicted consumption trends for ODS alternatives, by way of aggregated production and consumption data for HFCs in A5 countries. The ODS alternatives surveys will help define the individual country baseline of phase down steps, and form the basis for developing national strategies around priority industry sectors and application areas. Only then can HFC control and reduction measures take full effect. As a final piece of the puzzle, the selection of valid low-GWP substances and technologies according to a country's priority needs is the ultimate goal to make the transition happen in an informed, structured and effective way.

# HFC REDUCTION & CONTROL

## ODS alternatives surveys: getting the facts right

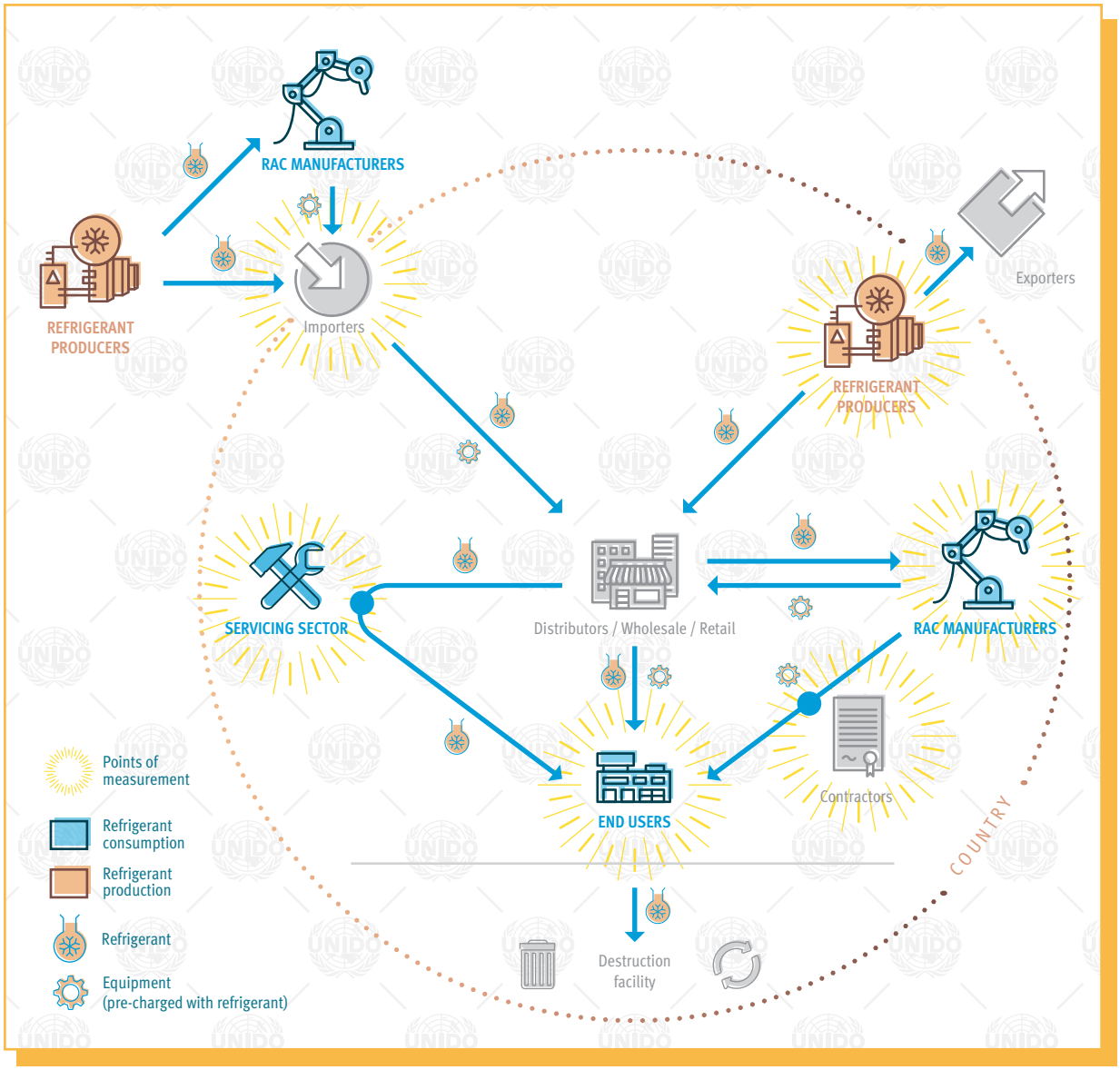
ODS alternatives surveys will be a guideline and measurement tool to help replace HCFCs and high-GWP HFCs with more sustainable substances. In 2015, the Technology and Economic Assessment Panel (TEAP) estimated that global HFC production had reached 314,515 metric tons or 1,220 Mt $CO_2$-eq, whereas consumption for A5 countries had reached 284,326 metric tons and 1,265 Mt $CO_2$-eq. Most HFCs were used in the A/C manufacturing sector, followed by refrigeration servicing and refrigeration manufacturing.

UNIDO highlighted that 127 countries prepared **pre-surveys on ODS alternatives** with the support of UN agencies, and applied different methodologies to estimate production and consumption of HFCs. Often, a top down approach was used, which led to problems related to availability and the update of data in official sources. Also the forecast of HFC emissions into the future proved difficult for most countries, due to a lack of historical data points. However, getting the data right will be crucial for countries to calculate their baseline values in the respective baseline period, forming the basis for the country's phase down targets and obligations.

## HFC inventories require national system to monitor the entire value chain

To establish an HFC inventory, details about individual **use sectors, producers of substances and manufacturers of prefilled equipment** are needed. Likewise, importers, distributors, end users, the servicing sector and destruction facilities are all necessary building blocks to create an effective inventory for the refrigeration and air conditioning (RAC) sector, and thereby an HFC monitoring and control system (see Fig. 3). Consistent data from such a system does not only satisfy requirements for the national communication of fluorinated gases' emissions to UNFCCC and for NDC preparation, but will also allow for nationwide awareness-raising campaigns, sector specific HFC reduction measures, or other tailored policy measures. For more details on the total climate impact arising from direct and indirect emissions, please also refer to Chapter 4 on energy efficiency.

## Fig. 3: Methodology to estimate production & consumption of ODS alternatives




### ODS alternatives reporting

- ★ Establish a national registration system, product databases and a legal obligation for equipment owners to submit periodic equipment records to competent authorities
- ★ Train customs officers in import trade control
- ★ Update current ODS reporting to include HFC consumption, to create an ODS alternatives bank and RAC inventory
- ★ Ensure proper registration of service technicians in national RAC associations
- ★ Better control pre-charged equipment at customs borders
- ★ Provide technical assistance to HFC end users, manufacturing and servicing sector, importers and distributors for data collection
- ★ Harmonise tariff codes according to HFC commitments (pure substances, blends)

Attendees showed some uncertainty on the question of whether the Montreal Protocol would control consumption and production or HFC emissions values, and in which unit this would need to be measured: in metric tons or in $CO_2$ equivalents. UNIDO emphasized that while countries were expected to continue their reporting in metric tons, it would be of crucial importance to understand the conversion to $CO_2$ equivalents, the unit in which the HFC phase down will be measured against target values. Participants were reminded that the precise **calculation method of HFC emissions** reductions will be prepared by the ExCom, and that countries should actively engage with the Ozone Secretariat as the ultimate recipient of national reports.

## Toolbox to control HFCs contains a variety of options

The **F-Gas Regulation in the European Union** serves as a successful example of an existing supranational scheme to control and phase down fluorinated gases. It is a legislative toolbox of measures to reduce the quantity of HFCs placed on the EU market by 79 per cent by 2030, as compared to 2009-2012 levels. With its quota system, emissions reduction and containment, and reporting, the F-Gas Regulation contains valuable elements and lessons learned for A5 countries to follow. Part of the toolbox is also mandatory recovery and reuse, education and certification schemes, the labeling of HFC-containing products, use restrictions in certain sectors, and overall HFC restrictions for placing on the market. By achieving the F-Gas Regulation's targets, mandatory and directly applied in all EU Member States, the EU will automatically implement and exceed the KA.

> **"The first comments we received from importers, exporters, producers and also from individuals about the quota allocation from the European Commission are promising. It seems that we are really on track to achieve this minus 37 percent [reduction in HFC quantity for the period 2018-20]"**
> Paul Krajnik, Austria
> (on the EU F-Gas Regulation)

Participants were especially interested in the function and effectiveness of the electronic registry for **quota allocation** where all suppliers of fluorinated gases to the EU must be registered. Reporting on production, imports, exports, feedstock uses and the destruction of HFCs could also serve as an example of how to build and maintain an effective system for controlling HFC use along various stages in the value chain. The close cooperation of customs authorities with inspection bodies would be, however, a prerequisite for the quota system to work properly.*

### Legislative, policy & economic options to control HFCs

- ★ Monitoring / control: HFC import quotas, licensing system, permits
- ★ HFC restrictions: record-keeping on HFC use, logbooks, strict servicing cycles for F-gas equipment
- ★ Economic: incentive schemes per industry sector (e.g. direct subsidies, tax returns)
- ★ Monitoring / control: product and refrigerants labeling
- ★ HFC emissions prevention: mandatory leak checks, penalties for illegal venting, obligatory refrigerant recovery
- ★ Economic: replacement schemes for consumers (e.g. change of old refrigerators to new ones)
- ★ HFC restrictions: phase-down schedule or bans for selected application sectors
- ★ Economic: HFC taxes or deposit schemes based on GWP equivalent of substance
- ★ Economic: minimum energy performance standards (MEPS) for new technology with lower direct and indirect GHG emissions

* More information about the EU F-gas Regulation: https://ec.europa.eu/clima/policies/f-gas/legislation_en ; and the legal text: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.150.01.0195.01.ENG

### Customs training and product labeling basis for strong HFC enforcement

The **labeling of HFC-containing equipment** in the EU has also proven to be effective for a control of F-gases. Croatia, formerly an A5 country, had to adopt all requirements of both the ODS and F-gases phase down after joining the EU. Country representatives stressed that the key to effective enforcement would lie in customs officers' training on various factors, including national legislation; the type of controlled substances, products and equipment; commonly used smuggling schemes and how to detect illegal transboundary movements of ODS.

The **illegal import of fake refrigerants** was the major concern of a UNIDO project in Tanzania, in which the quality of imported refrigerants was systematically checked with the help of refrigerant identifiers. This type of intervention is crucial to identify ODS substances, replace them with safer alternatives and ensure a safe and efficient use of refrigerants by technicians. Fake refrigerants are a topic of high concern, especially in the African region where mixed refrigerants, fake substances sold as refrigerants, improper drop-ins, or incorrectly labeled substances can be found. Moreover, many countries border several others, making control and enforcement of ODS and HFC regulations difficult, especially at porous borders outside official border crossings. Initiatives such as the project in Tanzania establish a system where customs officers can check the purity and proper labeling in testing centres, and if the source of origin is evident penalize the importer. Other major success factors are the training of trainers for skilled customs authorities (see also Chapter 3 on capacity building), cross-border cooperation for higher detection and enforcement rates, and increasing pressure on importers and distributors via stronger RAC associations.

## Low-GWP substances and technologies

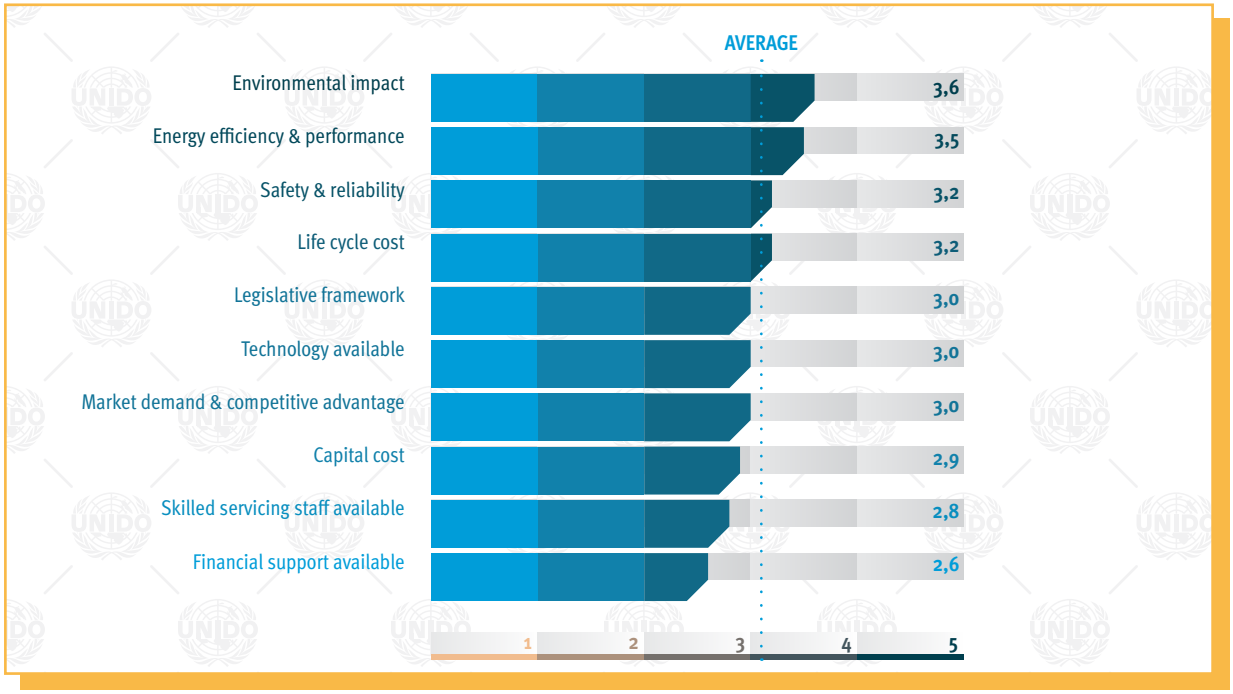
### Zero-GWP or low-GWP technologies already competitive

Before the event, participants were asked how competitive zero-GWP or low-GWP* technologies such as natural refrigerants were across a range of areas. Figure 4 shows that for the environmental impact, energy efficiency and performance, and life cycle cost, low-GWP alternatives were considered even more competitive than existing technologies (all items rated equal or higher than three out of five). Surprisingly, safety and reliability was also rated above average, suggesting that with proper training, the handling of such alternatives would constitute no problem.

* Please note that wherever the term "low-GWP" is used throughout this report, for reasons of simplicity it also includes "zero-GWP" substances with a GWP = 0 (like ammonia R717, water R718, or air as a refrigerant)

## Fig. 4: Competitiveness of low-GWP technologies

Today, how competitive are low-GWP technologies in the following areas?

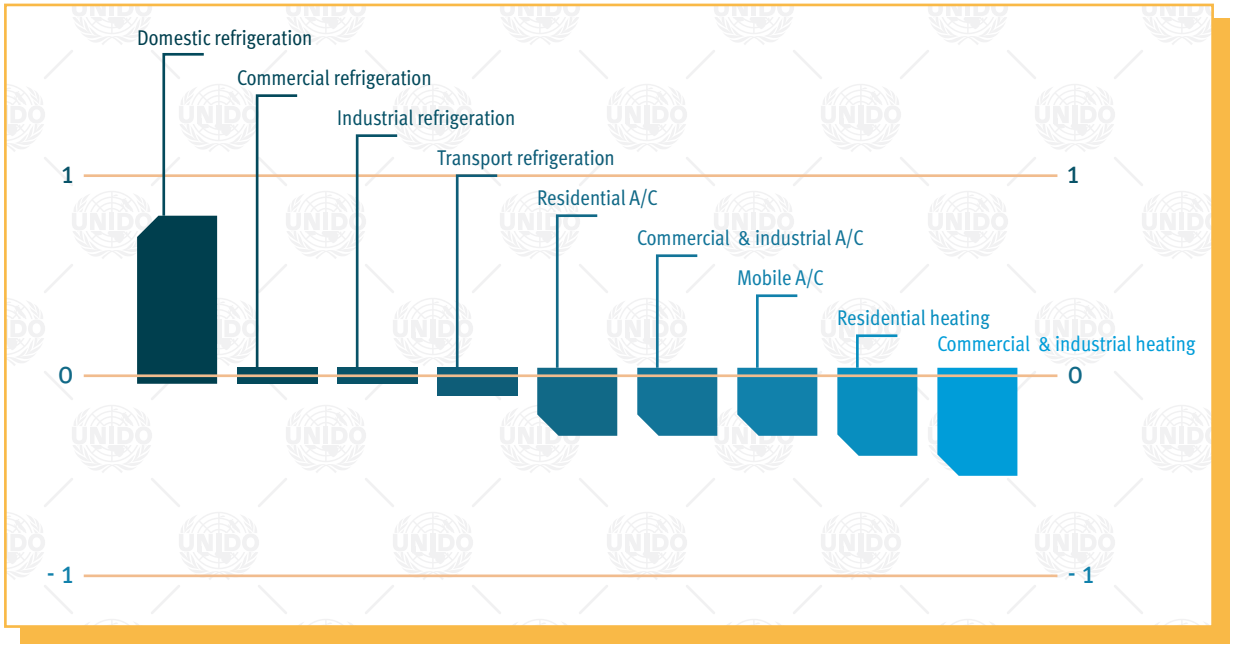



1 = Low-GWP alternatives are very weak 5 = Low-GWP alternatives are very strong.

Among the low-GWP alternatives already used in A5 countries, R600a, used in domestic refrigeration, is the preferred choice in 80 per cent of the world's refrigerators. Participants hence expressed the highest **confidence in low-GWP solutions** in this sector; this was the only sector where it was considered "rather easy" to find viable solutions. All other sectors received a "neither easy nor difficult" rating. Finding solutions for commercial and industrial heating tended towards "rather difficult" (see Fig. 5).

## Fig. 5: Challenges to find viable low-GWP alternatives per sector

How challenging is it to find viable long term low-GWP substances and technologies for the following application sectors?




-2 = Very difficult +2 = Very easy.

## Driving consumer change through innovative replacement-financing scheme

Commercial refrigeration (77 per cent of responses), domestic refrigeration (58 per cent) and residential air conditioning (50 per cent) are the three most important **sectors to focus immediate attention on for the use of low-GWP alternatives**, according to a live survey of attendees. All other sectors, especially heating applications, featured much less prominently. All three priority sectors are hence very closely related not only to the RAC manufacturing or servicing sector, but also to the consumer.

Mexico's **replacement scheme for domestic refrigerators** provides an excellent example of how the consumer can actively drive change, in partnership with a national energy provider. The scheme incentivized consumers to replace their old fridge with a new one with a more climate friendly refrigerant and better energy performance. Within four years, the higher cost of the new technology was recovered by the state energy company, which continued to charge consumers the same energy bill as before. The difference in energy cost between the old model and the new, more energy-efficient model, hence paid for the initial additional cost of the new model. With all parties satisfied, the scheme also allowed for the creation of new jobs in 100 scrapping centres across the country, as well as the update of the national energy efficiency standard for domestic refrigerators. So far, around 1.7 million inefficient refrigerators have been replaced, at a total project cost of US$6 million. Mexico is about to launch a second stage pilot project, where the new models will use natural refrigerant R600a (isobutane) instead of high-GWP HFC R134a for refrigerators, and R290 (propane) instead of R134a for stand-alone commercial refrigeration units.

> **"In principle, the main interest of the people is not to save energy or the environment, they look for savings in their economy. But for us there was this goal that we finally achieved: less energy, more environmental protection and consequently economic savings for the people. We can continue this programme in the next few years and it's an experience that we could share with all of you."**
> Agustín Sánchez, Mexico

## Market incentives for domestic industry a fast track to new RAC technologies

Participants agreed that their domestic **private industry sector would be ready and willing to implement the KA**, but that additional incentives and support measures from governments and the international community would be needed. One example is a UNIDO project in Egypt, where eight air conditioning manufacturers participated in a capacity building activity to build confidence in new low-GWP technology. The scheme used funds for enabling activities under the HPMP Stage 1 instead of new MLF funds for demonstration projects. Another example is an international workshop on design, production and installation with R290 in the air conditioning industry, that took place in April 2017 in China. The workshop was very successful in increasing familiarity with R290 among companies from high ambient temperature (HAT) countries, and attendees to these two activities stressed that demonstration projects testing new refrigerants, components and systems in real conditions would remain the most effective basis for defining a national strategy per industry sector. The term "cost-effectiveness" prevailed during interventions, where first investment cost but also cost of ownership would need to be first clearly defined for each low-GWP technology in different conditions, before moving ahead in the KA implementation.

## Natural refrigerants: A long term solution

For a smooth shift away from ODS and high-GWP substances, A5 countries can take different transition pathways. The EU F-Gas Regulation rules on refrigeration systems in supermarkets dictate that, in a business as usual scenario, EU countries can continue using HFCs until 2020, followed by only reclaimed substances until 2030. The reused HFC gas can then be used to service existing refrigeration equipment with otherwise good performance, while systems coming to their end of life can be directly replaced with new substances with a GWP <150. Decisive factors to make such a BAU strategy work, however, are the **price and availability of HFCs**. A strong trend today shows that HFCs are already getting scarce in supply with more and more national and regional HFC reduction schemes taking effect around the world. As a result, steep price increases on high-GWP HFCs can be seen in the market. This overall trend will also negatively affect the availability of common substances such as R134a, R404A or R410A for A5 countries. The resulting price hike will put a decisive burden on any economically sustainable development trajectory in line with the KA.

A second option is the early conversion to or retrofit with new synthetic low-GWP refrigerants, such as R1234yf or R1234ze.

> **"Today will give you hopefully alternative options, solutions, some ideas, and I hope you will take them, because I think you will be the ones who will bring us back to the future."**
> Fukuya Iino, UNIDO

A third option, the **direct switch to natural refrigerants** such as $CO_2$, hydrocarbons (HCs) or ammonia, promises a long term solution not affected by any foreseeable phase down schedule or regulation. In some solutions, the widespread use of HCs in domestic and light commercial refrigeration equipment, or the use of $CO_2$ in commercial refrigeration, have already led to a level playing field in terms of the price of the equipment. In fact, HCs are already being used extensively in domestic refrigeration. To date, an estimated 1.5 billion domestic refrigerators worldwide use hydrocarbons. By 2020, 75 per cent of all new domestic refrigerators are expected to use R600a or R290. While not every natural refrigerant is a perfect fit for every application, an informed selection of those solutions fitting a country's priority needs, climatic conditions and usage patterns is a valid strategy to ensure regulatory compliance and investment security. Moreover, given their longstanding use, the properties of natural working fluids are well known, and the fluids themselves can be handled safely if their characteristics (flammability, toxicity, high pressure use) are properly addressed.

## Taking a life cycle perspective leads to better refrigerant choice

Natural refrigerants offer a superior Life Cycle Climate Performance (LCCP) as compared to HFCs in many applications. During the discussions, countries were therefore urged to move away from considering only the GWP value to select a certain substance. Instead, a holistic perspective was recommended, considering both direct and indirect emissions in a cradle-to-cradle scheme, to discern a refrigerant's total environmental impact (see Chapter 4 on the different types of emissions). While this approach requires consideration of all emissions related to the production, distribution, use, leakage, recovery and reuse of the refrigerant, it results in the selection of truly sustainable substances.

## Successful examples with $CO_2$ and HCs in A5 countries, but lack of technology slows down market adoption

Experience in China has highlighted R290 as a valid alternative for the **room air conditioning sector**. With an effective mixture of proper risk assessment, R&D activities, financial support for the conversion of 18 room A/C production lines, market promotion and training, China encourages the domestic sector and export markets to adopt R290 in room A/C.

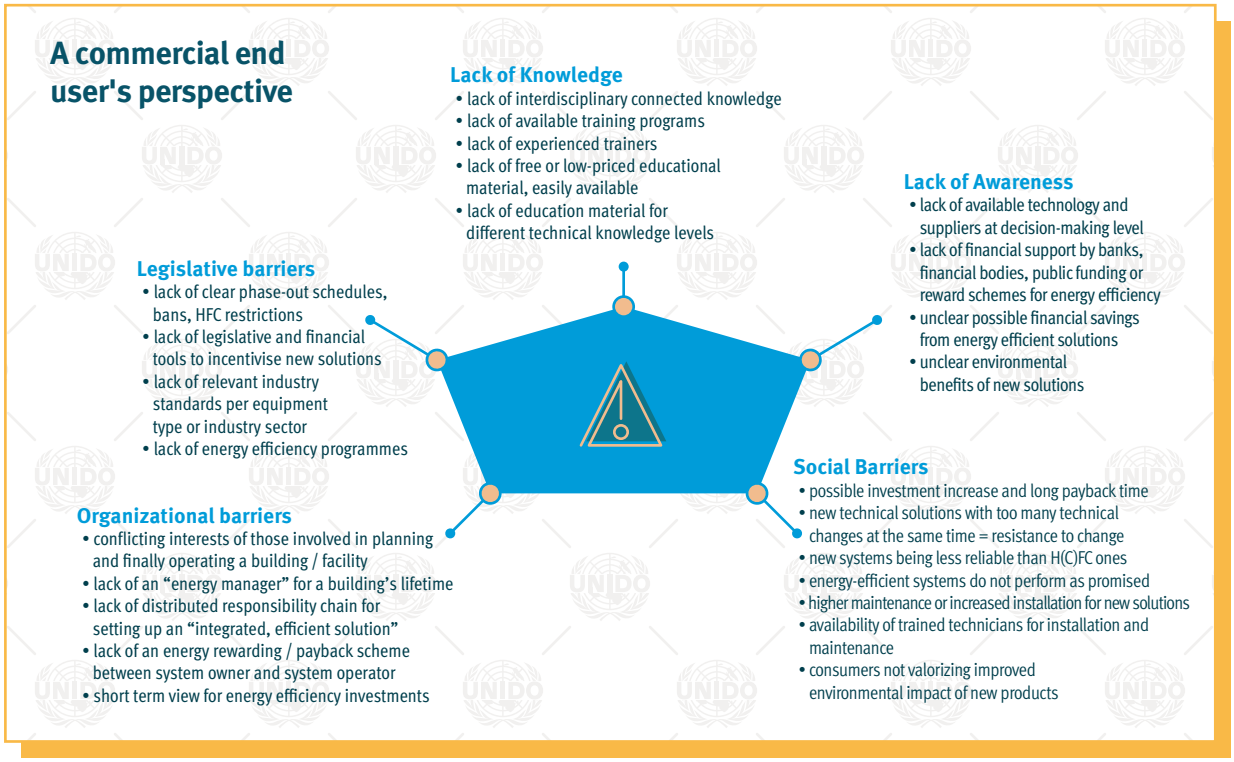
> **"We try to avoid a second conversion in the future, since it is not only related to costs of the conversion lines. It will take 5-6 years for an expert to become familiar with a refrigerant. If we change the refrigerant frequently the knowledge will need to be created again and again. That is why we promote R290 in room air conditioners in China."**
> Dou Yanwei, China Household Electrical Appliance Association

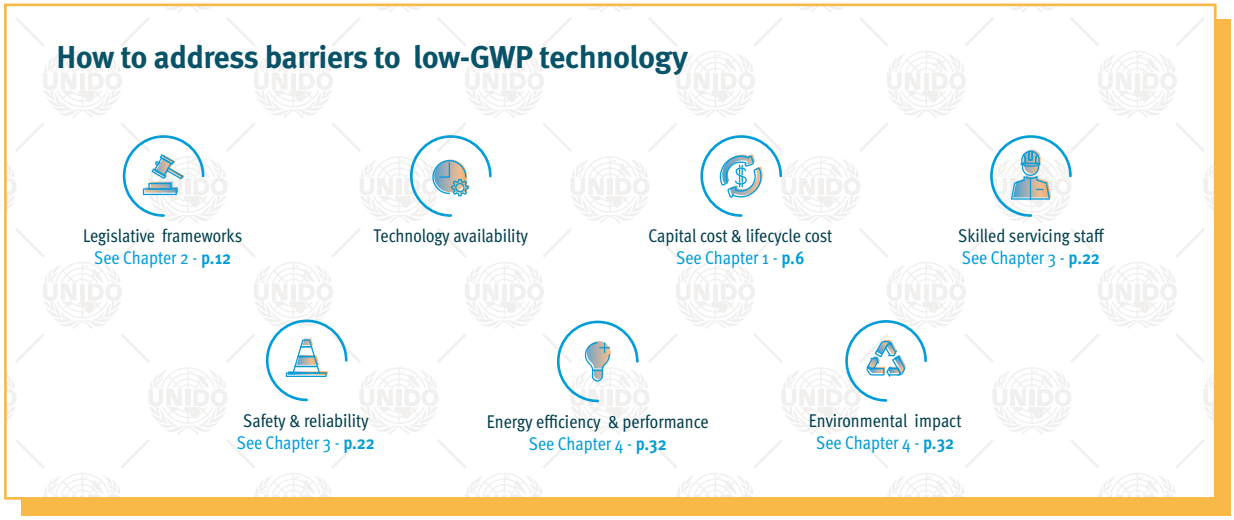
More and more demonstration projects initiated by UNIDO and other UN agencies in **high ambient temperature (HAT) countries** confirm that hydrocarbons, $CO_2$ or ammonia are a good choice, for example in the fisheries processing sector (the Gambia, Viet Nam) and on fishing vessels (outside Mauritania). An additional strong benefit of using an R290 or $CO_2$ system is that product quality, especially for export purposes, has increased due to faster deep-freezing time, less space required to reach the same cooling capacity, and in general better maintenance. Millions of heat pumps using $CO_2$ have also significantly contributed to improved safety and human health, allowing water temperatures to rise up to 90°C where legionella and other bacteria are removed. Moreover, in supermarkets using natural refrigerant-based refrigeration systems, such as in the 12 $CO_2$ stores in Indonesia, an increase in customer comfort and hence a longer shopping time has been recorded. This can make A5 countries adopting those solutions more competitive, and domestic end users more popular with consumers.

However, the **lack of availability** of components or refrigerants for such solutions poses a strong challenge to A5 countries. In the Gambia project initiated by UNIDO (see Chapter 3 on training), the refrigerant R290 had to be imported from Asia for training purposes. A plant in Nigeria producing high purity HCs is under way but has not yet started operation. Countries are therefore urged to explore existing sources of propane, $CO_2$ or ammonia as byproducts from agricultural processes, petrochemical plants, methane gas extraction, and other domestic industry sectors. As a second challenge, global refrigerant suppliers are often not willing to supply small refrigerant quantities to A5 countries with currently low consumption or still in the pilot testing phase. To become attractive markets for such suppliers, countries are encouraged to form buyers' alliances for higher order quantities, and hence stronger purchasing power among neighbouring countries. A third challenge is the dependency of many A5 countries with no RAC manufacturing facilities on technology imports. A possible solution is to strengthen public procurement so that bilateral agreements between the governments of the receiving country and the exporter would clearly specify the refrigerant type or minimum energy efficiency, putting the A5 country on track for KA implementation.

**Non-technological barriers** – related to the lack of awareness and knowledge, social and organisational barriers and the lack of effective legislation – prove to be in many cases stronger roadblocks than the technological factors when adopting new RAC technology (see Fig. 6). Prevailing commercial interests from those advocating for a business as usual approach or with higher market power considerably slow down the market transformation. Especially the "first movers," offering new low-GWP systems, often suffer from temporary lack of competitiveness if the surrounding market still offers cheaper but climate-damaging products. As a case in point, China confirmed that the conversion from R22 to R410A took ten years to reach a 50 per cent market share for R410A in room A/C. Similarly, for R290 to capture the market would again take time given the 100 million room A/C units produced annually.

## Fig. 6: Non-technological barriers to low-GWP technology



CHAPTER 3

Standard time:

# Capacity building, training & standards

Training, capacity building and standards are often mentioned as one of the highest priorities, along with securing financing for the transition, and an informed choice of next-generation technologies. Given that low-GWP alternatives are often flammable, toxic or need to work under excess pressure, the proper training of customs officers, RAC technicians, but also of manufacturers and end users is an immediate necessity. Moreover, policy makers need the appropriate expertise to develop national phase down strategies and exploit synergies with complementary areas to the fullest extent.

## Skills level of RAC servicing sector of highest concern

The **lack of appropriate technical skills in the RAC servicing sector** was the topic mentioned most during the talks, and it has strong implications for the KA implementation. First, it endangers human health when technicians work with refrigerants without proper instructions and standards. Second, technicians who are unfamiliar with low-GWP technology may be reluctant to service it, due to their lack of familiarity with its thermodynamic or chemical properties. This will effectively result in entire markets not adopting more sustainable refrigerants. Finally, proper training has a decisive impact on energy efficient installation, operation and disposal of RAC equipment. Hence, training influences direct GHG emissions into the atmosphere (through refrigerant GWP, refrigerant charge and recharge, leakage rates, recovery), and indirect emissions (through electricity saved from equipment running efficiently). This applies to new equipment entering the production and servicing sectors, but also decisively influences the maintenance of the existing stock of appliances containing ODS or high-GWP refrigerants. All this has increased in complexity with an influx of new HFC blends.

As for **best practice approaches**, participants are urged to focus their attention for training first on key sectors where the use of HFCs is widespread globally. Priority areas may therefore include the food cold chain, buildings, the fisheries sector and public procurement.

## Training: the cornerstone of scaling up technology change

In a project in the Gambia, supported by GEF and UNIDO, the NOU has closely worked with the national training institute giving it full responsibility for the establishment of a **national training scheme**. This Refrigeration and Air-Conditioning Support Scheme is active nationwide, and so-called "super technicians," the country's best RAC technicians, ensure that others are properly trained. The issue of illiteracy, common especially in rural areas in Africa, was solved by developing a range of stickers using pictograms on the refrigerant cylinders and the RAC equipment. That way, technicians can easily understand if a refrigerant is flammable or otherwise requires caution, if a system contains a pure substance, or when the last equipment check was performed or is due next. The **labels** will be applied to both newly imported equipment and existing systems.

In another UNIDO-supported scheme in the Caribbean, training activities for the RAC servicing sector directly ensured wider applicability of skills acquired through one **common curriculum** in the entire region. Concretely, a pilot training centre was established with a standard equipment package to certify technicians to handle the flammable natural refrigerants R290 and R600a. The scheme effectively combined regional four-day intensive training workshops with technology exhibitions. All project results were mainstreamed into the countries' HPMP. The scheme is innovative in that it provides initial **capacity building for NOUs**, who are subsequently responsible for developing the curricula for the training workshops together with skilled trainers. The project will enter a second stage where the knowledge provided in each participating country will facilitate pilot conversion projects under the HPMP. The entire approach can be replicated to other refrigerant groups and regions, hence providing a best practice method for other A5 countries to follow.

## Only certification ensures high safety and replication potential

As for the proper **training on alternative working fluids**, such as $CO_2$, hydrocarbons or ammonia, the Air conditioning and Refrigeration European Association (AREA) recommends the following minimum requirements in any curriculum: basic thermodynamics and physics, including identifying the differences between low-GWP refrigerants and HFCs; good practice on selecting typical applications for low-GWP substances; health and safety requirements in installation, maintenance and in case of an incidence; as well as knowledge on national and international regulations and standards. Together with UNIDO, AREA has already conducted training on alternative refrigerants in Eritrea, the Gambia, Saudi Arabia and Tunisia. The RAC association has also developed a universal training kit for future refrigerant alternatives that contains a toolbox to conduct certified and effective training.

> **"The certification and training scheme for technicians and to companies was difficult to establish, but it proved very effective once it was operational."**
> Paul Krajnik, Austria
> (on the EU F-Gas Regulation)

Building **national or regional certification schemes** for the RAC manufacturing and servicing sectors is the next step to take. In particular, the compatibility of existing or emerging training concepts in participants' countries with international certification schemes and standards was a subject of much concern. The EU F-Gas Regulation, the largest supranational scheme requiring servicing operations on RAC equipment to be conducted only by certified technicians, has chosen a nation-based implementation method. Each Member State is hence obliged to upgrade existing education schemes for RAC technicians to ensure training and certification requirements on HFCs and HFC alternatives are fully implemented.

The **EU's required competence level of personnel** consists of theoretical and practical knowledge in basic thermodynamics; the environmental impact of refrigerants and corresponding regulations; checks for refrigerant leakage; and proper handling of the RAC system and refrigerant during installation, maintenance, servicing or recovery. It also requires expert knowledge on the installation of certain components (compressors, condensers, evaporators, expansion valves); and on leak tight piping systems. The final certification gives the 500,000 F-gas certified technicians in the EU a proper professional qualification with automatic recognition in all 28 EU countries. Certification is given in different categories, where technicians are allowed to 1) service all RAC systems, 2) only systems up to 5 tons of $CO_2$ eq of refrigerant charge, 3) only do the refrigerant recovery, or 4) only manage leaks.

### RAC training & certification

- Train-the-Trainers schemes to establish a cascading system of highest qualified senior technicians to train medium and junior level staff
- Smartphone applications for technicians for on-site handling of flammable, toxic refrigerants
- Technology exhibitions and pilot conversions: use policy and technology capacity for a faster adoption of alternative refrigerant technology in real-life applications
- Study tours to neighbouring countries, case study sites, training institutes and exhibitions in other countries
- E-learning courses in national language, such as "REAL Alternatives" scheme in 13 working languages (EU-funded project with open access)
- "Refrigerants Driver's License": globally recognized minimum qualification scheme for sound refrigerant management
- Technology exhibitions and pilot conversions: use policy and technology capacity for a faster adoption of alternative refrigerant technology in real-life applications
- Universal RAC training kit with pre- and post-assessment of training and checklists, minimum teacher qualification and equipment, venue requirements for theoretical and practical training, text books, manuals, etc.
- "Refrigerant Literacy Course": for non-technical people, such as NOUs, energy efficiency or climate change-related personnel to interact with technical staff
- Use of labels with pictograms on RAC equipment and cylinders to involve illiterate technicians

## Safety standards important, but more progress needed

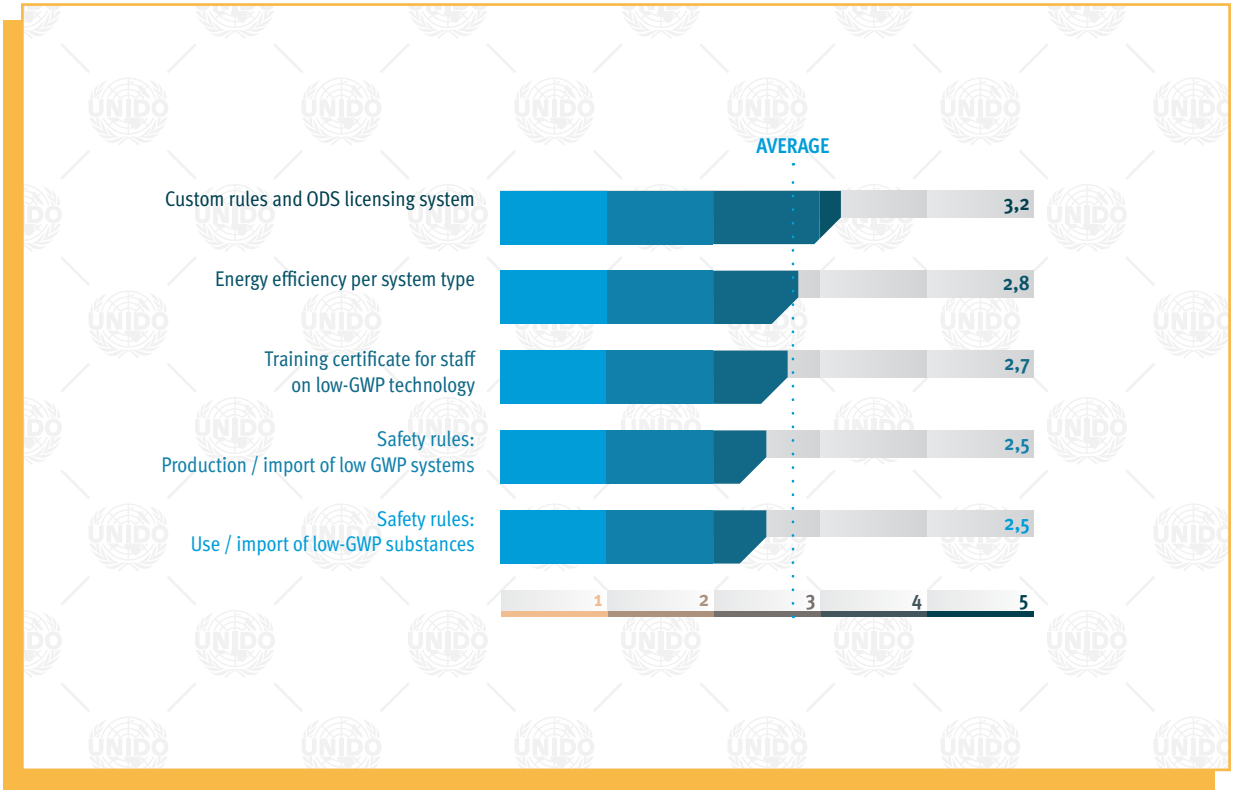
Safety standards are crucial measures to effectively implement KA obligations. The **standard-setting process** for defining refrigerant classifications, safety rules and charge limits for flammable or toxic low-GWP substances, however, is a laborious process. Countries therefore actively need to work with their national standardization bodies to have a say in international standard development. Otherwise, inappropriate standards could effectively hold back entire application sectors to move into more efficient and safe alternatives. As a case in point, TEAP will establish a standards task force. All countries are urged to actively engage in this ongoing work and as a priority **strengthen weak national standardization bodies**, a problem existent in some countries present at the Vienna Talks.

A presentation by China made clear that the **use of low-GWP flammable refrigerants**, such as natural refrigerant propane (R290) would not pose any serious challenge to technicians per se, provided that all safety standards and best practice guidelines would be followed. With R600a, another hydrocarbon, being accepted in 80 per cent of domestic fridges worldwide today, China has pledged to convert 18 production lines to use R290 in room air conditioners. It has also invested heavily in R&D and the revision of HC safety standards to increase the refrigerant charge to realistic safety levels. That way, the country allows its 1 million servicing technicians to handle the units properly.

Already in the pre-event survey, participants had rated **standardization as a matter of urgency and high importance**. All areas affected by standards got a "standardization will be important" mark (4.1 to 4.3, on a 1-5 scale): training certificates for staff on low-GWP technology; safety rules for the use and import of low-GWP substances and technologies; customs rules and ODS licensing system; and energy efficiency per system type. However, asked about how much progress had been made in those same areas, respondents admitted that most areas still lacked sufficient progress (see Fig. 7).

### Fig. 7: Progress on standardization

How much progress has your country made regarding standardization in the following areas related to the KA?




1 = My country has not yet started standardization 5 = My country has fully finished standardization.

## Capacity building for policy makers the first building block for effective action

The **complexity of the KA challenge ahead will require an entirely new set of skills, knowledge and cooperation.** Next to creating the necessary regulatory frameworks and engaging in institutional arrangements (see Chapter 1), this task ranges from identifying all relevant stakeholders in one's country and closing gaps in technological and non-technological areas, to establishing effective awareness-raising campaigns. In line with building training schemes, NOUs should evaluate regulations regarding the safety classification of refrigerants, building codes and other standards or use restrictions. As one example, propane has been used in most countries as fuel for cooking, so adapting laws and standards to the RAC sector would require close cooperation with the respective ministries responsible for handling such substances.

> **"I think the most important thing for the government is to establish standards, and focus on education. [...] The government has to control the overarching rules, the energy efficiency, the goals, the standards."**
> Ezzat Lewis Hannaalla Agaiby, Egypt

CHAPTER 4

## Keep a cool head:

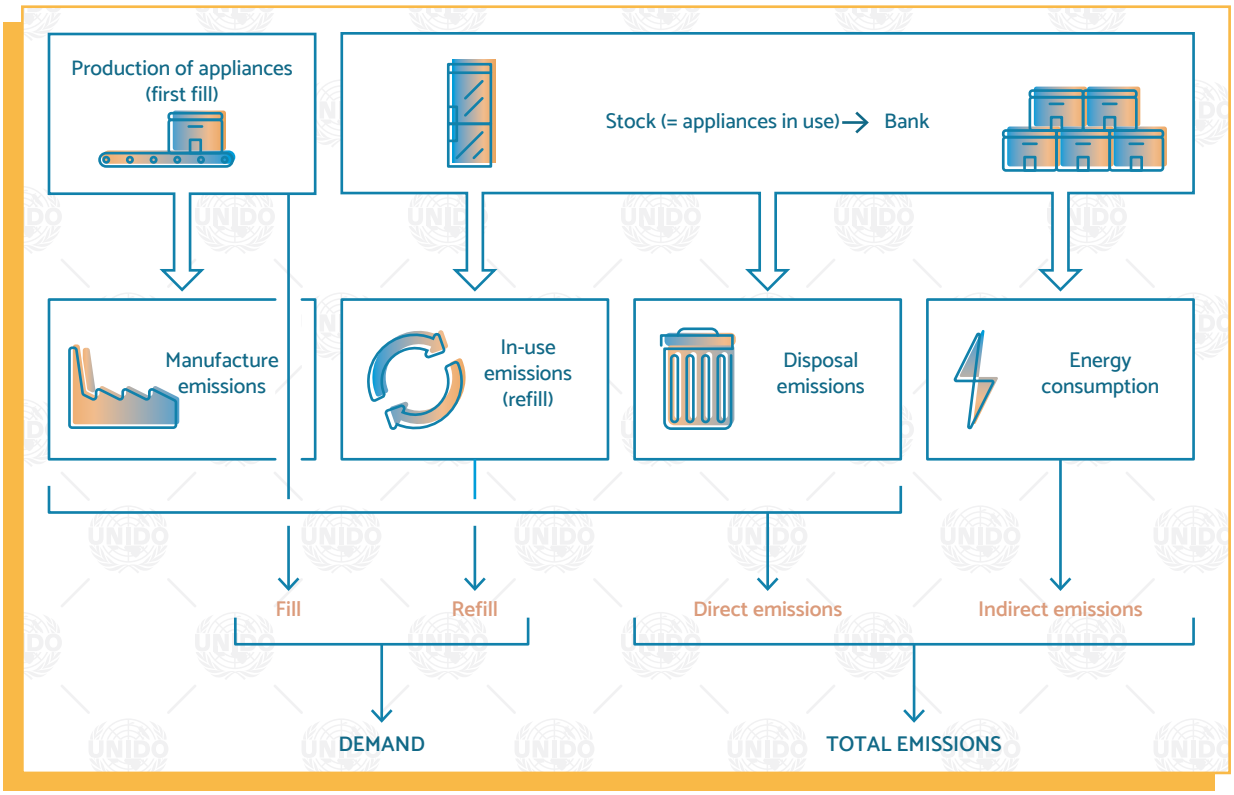
# Energy efficiency

Energy efficiency is a key component of the Kigali Amendment, to select not only technology solutions with low Global Warming Potential, but in terms of overall environmental impact. The RAC sector, as a major energy consumer, plays a strong role for every country to reach climate change targets, integrate renewable energies and save money.

## Direct + indirect emissions = total environmental impact

During the life cycle of RAC equipment, two types of emissions occur. **Direct emissions** negatively affect our climate through the Global Warming Impact of each substance released to the atmosphere. The higher the GWP (reference value is $CO_2 = 1$), the stronger the negative climate impact. Direct emissions of the refrigerant, meaning their release into the atmosphere through leaks or venting, might take place during the production of the appliance (first fill), the in-use emissions (refill) and the disposal emissions at the end of life (accidental release, venting). **Indirect emissions**, on the other hand, are produced when RAC equipment consumes energy, resulting in the emission of greenhouse gases (GHG) from power plants. Indirect emissions therefore also occur in the RAC sector during the energy intense production of the appliance (see Fig. 8). Often, however, they are only factored in as those emissions resulting from the electricity use of the appliance during its actual operation. The less energy a RAC system uses, the higher its energy efficiency and the lower its indirect emissions.

**Fig. 8: Direct and indirect emissions**




## Energy efficiency a main pillar of the Kigali Amendment

It is important to select technologies that are not only low in their direct emissions – through low-GWP substances – but are also more efficient than the technologies they replace. Energy efficiency is a key success factor for the KA because direct refrigerant emissions only make up 10 to 40 per cent of the total environmental impact, while the remaining 60 to 90 per cent of emissions are related to electricity consumption. As a result, only 20 per cent of total costs normally relate to the system investment cost whereas the remaining 80 per cent of operating costs hold the true potential for cost savings in any country. A decision for or against a widespread RAC solution should therefore always be guided by the Total Cost of Ownership (TCO) principle and the Life Cycle Climate Performance (LCCP).

> **"About 50 per cent of the emission reductions required to reach the Paris Agreement can be delivered through energy efficiency and it's really the cheapest form of energy to be deployed."**
> Rana Ghoneim, UNIDO

From an economic and social perspective, **energy efficiency is also at the heart of three Sustainable Development Goals:** SDG 7 dealing with affordable and clean energy; SDG 9 on industry, innovation and infrastructure; and SDG 13 on climate action. Energy efficiency promotes innovation and competitiveness, improves productivity and ensures job creation. The Technology and Economic Assessment Panel (TEAP) advising for MP-related matters is therefore currently reviewing potential energy efficiency opportunities. Participants at the Vienna Talks were asked to submit information on any innovation that would help improve efficiency. A report on the topic will be released during the 29th Meeting of the Parties in Montreal in November. Both before and after that date, NOUs are strongly encouraged to seek contact with their counterparts in energy departments and those dealing with energy labeling or Minimum Energy Performance Standards (MEPs). See also Chapters 1 and 2 for more details on KA implementation measures and the promotion of low-GWP technology.

## How to save energy in RAC equipment

With a hugely increasing stock of domestic RAC appliances and industrial equipment expected over the following decades, electricity demand is set to more than double. To offset the negative effects, there are various ways to effectively save energy during the operation of refrigeration and air conditioning equipment. The first is the **refrigerant selection**, in that refrigerants lead to different efficiencies, depending on their chemical and thermodynamic properties, as well as the applications and conditions they work in. A second way to improve RAC efficiency is to select either more efficient individual **components and/or improve system design**, to ensure that each step of the refrigeration process and the entire system work under optimal conditions. Of special importance is the choice of compressors and heat exchangers, but also the use of electronic devices to measure and optimise overall system performance. A third option is to select the right **insulation** to prevent the loss of heat or cold depending on the system's primary function. As an example, Vacuum Panel Insulation (VIP) prevents the penetration of air or moisture to the foam. Last but not least, the selection of **new system processes** has a decisive impact on energy efficiency. $CO_2$ systems, for example, operate at higher pressures, but the inherent properties of $CO_2$ (R744) refrigerant mean it can be used either alone or in combination with a second refrigerant in cascade systems to save on direct and indirect emissions. Examples include selected UNIDO projects funded by MLF and CCAC, which take place in three supermarkets in Argentina, Jordan and Tunisia. These supermarket refrigeration systems are being converted to $CO_2$ transcritical systems, and energy savings could reach up to 25 per cent.

Another important aspect is the proper installation, setup and maintenance of existing and new RAC equipment. Training – on how to select the refrigerant, lay out the equipment and optimize system performance – is therefore a direct contributor to major efficiency improvements (see also Chapter 3 on training). The servicing sector again plays a key role here, especially in applications with a more tailored setup of larger sized equipment in industrial and commercial refrigeration.

In summary, there is a variety of options to directly improve the efficiency of the system and establish a framework in which such technology can proliferate (see Fig. 9).

## More money available for efficiency programmes

Today, UNIDO-supported ODS alternatives surveys show that hardly any information on the energy efficiency of RAC equipment is available in A5 countries, let alone consistent **national standards on energy efficiency**. As the domestic refrigerator replacement scheme in Mexico shows (see Chapter 2), it is crucial to develop such standards once new efficient technology is readily available on the market. Standards are an effective driver for influencing manufacturers and consumers to opt for new technologies, offering a double win on efficiency and sustainable refrigerants. For Mexico alone, the "United for Efficiency" (U4E) 2016 country assessment has calculated that by 2030, the total energy savings from domestic refrigerators (36 per cent) and from room A/C (25 per cent) can lead to annual energy savings of 8.9 TWh. This saves US$792.5 million in 2030, and US$4.6 billion from 2020 to 2030*.

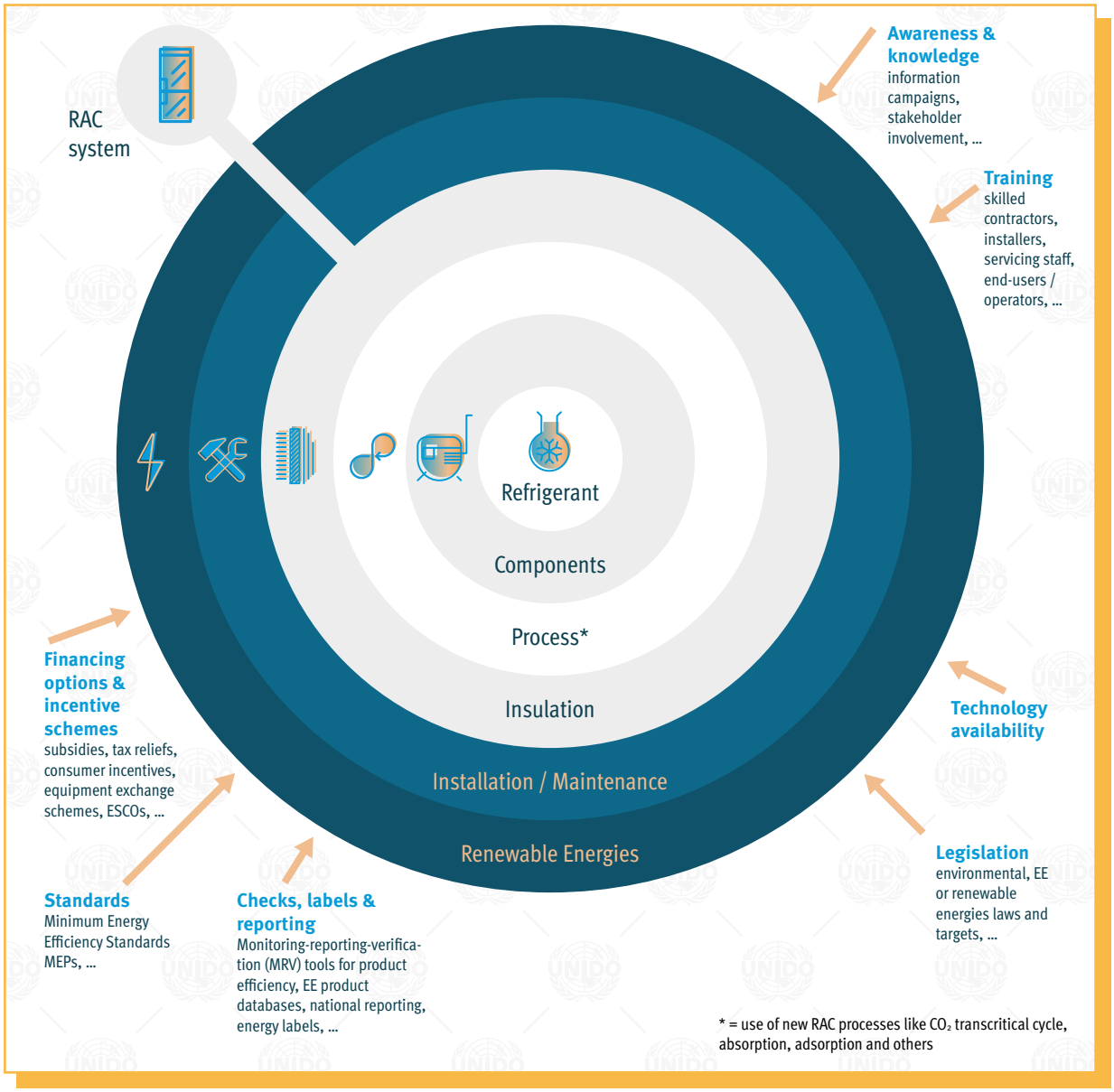
One of the schemes deliberately targeting the link between climate benefits and energy reduction is the **Kigali Cooling Efficiency Program (K-CEP)**. Funded by 18 foundations and individuals, this programme has pledged US$53 million to help increase the energy efficiency of cooling in developing countries. Its four programmatic areas are "Strengthening for Efficiency", "Policies, Standards, and Programs", "Finance", and "Access to Cooling". Recipients of its funds and support mechanisms are NOUs, energy efficiency policymakers, and the private sector. A5 countries can gain access to the funds via implementing agencies such as UNIDO.** Participants were encouraged to use the UN agencies to identify opportunities under this and other international schemes outside the traditional Montreal Protocol schemes, but also to enter into bilateral agreements addressing energy efficiency aspects in line with the HFC phase down.

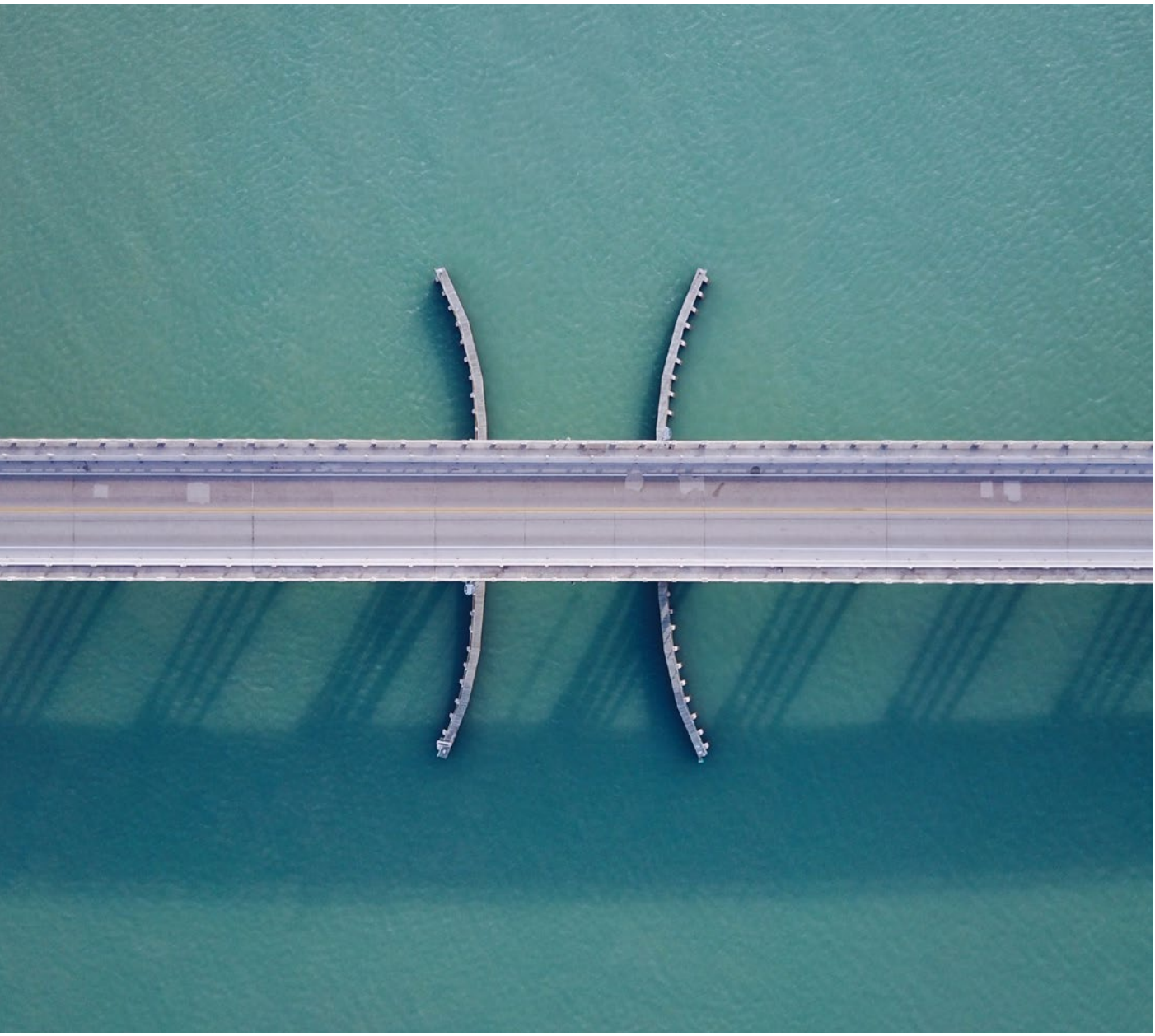
> **"There is much more money especially if you think about energy efficiency or climate change. [...] Many institutions are desperately looking for means to tackle energy efficiency and they don't know how to get effective initiatives off the ground. They will need to ask implementing agencies to get out there on their behalf and to try to get the funds."**
> Stephan Sicars, UNIDO

* See for more countries: www.united4efficiency.org/countries/country-assessments

** See: www.k-cep.org

## Fig. 9: RAC energy efficiency improvements





CHAPTER 5

## Cool, calm and collective:

# Partnerships

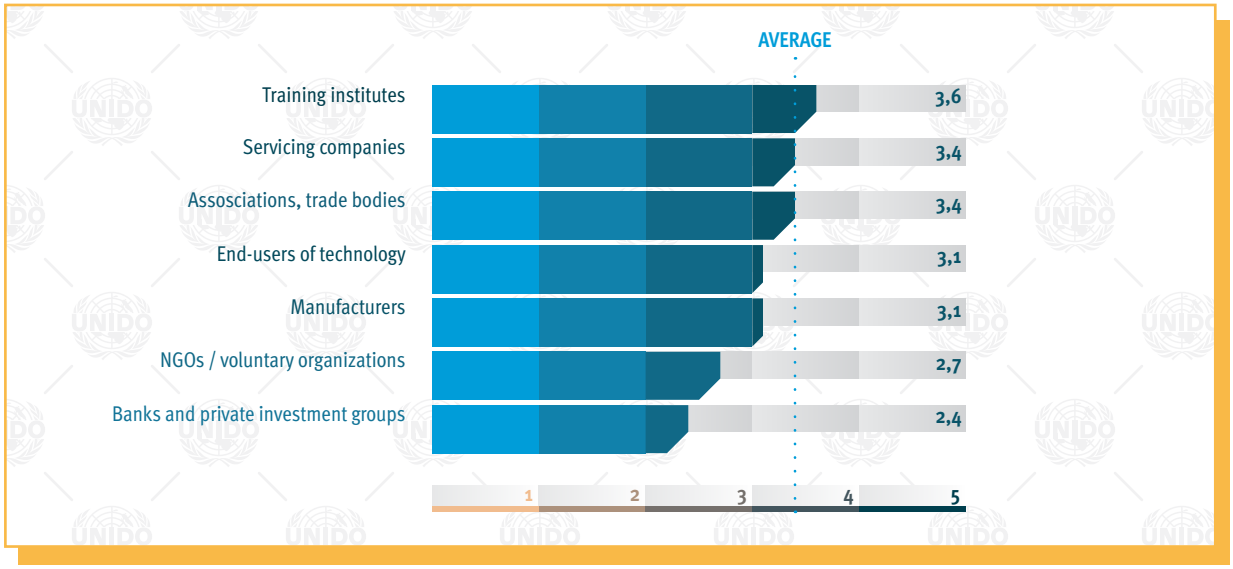
Partnerships between the government and private sector, South-South cooperation, and partnerships between countries and international agencies, cover all areas mentioned in this report. Naturally, partnerships are relevant whenever stakeholders work together for a better result. For the Kigali Amendment, partnerships must be addressed early in the process to effectively ratify and implement the Amendment. The crucial nature of partnerships for the KA means that they merit a separate chapter.

# Private sector is key, but partnerships with policy need more effort

The private business sector will continue to be one of the key partners to address the development challenges under the SDGs while at the same time considering energy efficiency and climate change matters. Participants agreed that end users of RAC technology, training institutes, servicing companies, manufacturers, as well as associations and trade bodies would all be "important" for making the Kigali Amendment a success (4.1 to 4.3, from a range 1 to 5). However, besides the cooperation with training institutes ("partnership rather strong"), all other partnerships would still need more efforts to become strong facilitators for the KA (see Fig. 10).

**FIG. 10: Partnership between government and KA actors**

How strong is the cooperation between the government and the following actors from the private sector in your country, in the context of making the KA work?




1 = Partnership does not yet exist 5 = Partnership is very strong.

> **"So here's an opportunity where government and the tourism sector can partner up –to provide incentives for those technologies that will help lower the cost per night for guests by lowering the energy consumption. At the end it will be a win-win for all of us."**
> Leslie Smith, Grenada

Attendees generally mentioned the **solid relationship with private industry built under the ongoing ODS phase out**. As the next priority for NOUs, each industry sector will now need to develop confidence in the KA's benefits and opportunities to be fully on board for the future conversion; identify and remove remaining market and technology barriers; and finally translate this willingness for change into concrete demonstration projects with support from the government and the international community. Capacity building and technical training are the basis for success (see also Chapter 3). Furthering the education of existing workers takes precedence, along with educating a new labour force to address future challengesd.

**Small and medium-sized enterprises (SMEs),** participants largely agreed, are often the most difficult to involve in any technology transition process. In a best practice example, the former Yugoslav Republic of Macedonia has invested in establishing strong RAC associations to work with mostly SMEs in the manufacturing and servicing sector. Concerns especially arise around the question of how the conversion to sustainable refrigerants – when this has already successfully taken place in a country's largest manufacturing companies – could be continued on the level of small enterprises. New effective ways to address SMEs need to be found fast, given their importance in providing employment and building a country's economic backbone. For most countries participating, the smaller-scale RAC import, distribution and servicing sector is of immediate priority in driving technology change.

## South-South cooperation and twinning use the power of a team

When participants were asked about the impact of the KA on their countries, **South-South cooperation, that is the exchange of resources, technology, and knowledge between A5 countries**, and partnership with countries in the same region both featured prominently (see Fig. 2, Chapter 1). This was echoed during the discussions, when attendees highlighted effective knowledge transfer between A5 countries as the most important type of partnership to invest in. Study tours or exchange visits are effective options to foster dialogue, as well as regular meetings of countries with similar climatic, political and economic conditions.

> **"The Kigali Amendment clearly presents us with a new opportunity to build partnerships, bringing governments, public sector, private sector businesses, and civil society and the development sector together. It requires a mindset change as opposed to business as usual. UNIDO is here to help you."**
> Ganna Onysko, UNIDO

Attendees also considered **regional network** meetings to be important. These meetings involve all relevant stakeholder groups from policy and non-governmental organizations to private industry, academia and even civil society. The keyword of "twinning" as a fixed legal, political, social or informal partnership between cities, regions or countries, is a possible strong format to address the KA challenges ahead and stay ahead of technology development. UNIDO, having developed the innovative Programmes for Country Partnership (PCP), called on participants to suggest new models of collaborating and working on the ground for tailored results for individual countries.

An immediate concern is the **effective work sharing between National Ozone Units and their national counterparts in energy efficiency and climate change** (see also Chapter 1). Participants were strongly encouraged to seek the expertise of existing regulators in these areas to develop and implement their national strategy, based on synergies between all relevant topics addressed by the KA. New funding schemes, such as the K-CEP, now provide support for integrated actions between NOUs and energy efficiency regulators in regional network meetings.

## Using UN agencies to seek innovative financing

With the KA addressing a variety of issues besides the priority phase down of HFCs, new approaches for financing mechanisms are also urgently needed (see also Chapter 1). UNIDO has already worked in partnership with the GEF (Global Environment Facility), the world's largest public funder of projects to improve the global environment. In cooperation with local executing partners, the NOUs and the private industry sectors projects for technology conversion and capacity building in the Gambia and Viet Nam were successfully implemented. In another example, to build the ECOWAS centres for energy efficiency, UNIDO is working with the Swiss Development Agency to foster cooperation between the Southern African region and the West African region. In summary, UN agencies and other international bodies are effective facilitators not only for suggesting effective strategies per industry sector, but also for identifying appropriate funds to finance their implementation.

### Partnerships and cooperation

- Intragovernmental cooperation to streamline available expertise on energy, climate, agriculture, urban development, health, economic growth, etc.
- Twinning as fixed longer-term legal, political, social or informal partnership schemes between cities, regions or nations to exchange knowledge and move forward faster
- Partnerships with implementing agencies as neutral brokers with expertise in maintaining cooperation and investment schemes in various industry sectors
- Use of innovative financing bodies and schemes, to fully exploit available resources for industrial development, energy efficiency, climate change, etc.
- Bilateral agreements between importing and exporting countries on state of the art refrigerants and technology
- SME innovation programmes to increase the competitiveness of small enterprises especially in the RAC import, distribution, manufacturing and servicing sectors
- Regional meetings, exhibitions, study tours, exchange forums to gather policy, NGOs, academia, industry and civil society for KA matters

CHAPTER 6

Gender matters:

# Gender balance & social inclusion

The Kigali Amendment requires the active participation of all civil society groups to achieve its full potential. Women, youth and disadvantaged groups are still significantly underrepresented in countries' national strategies addressing sustainable development, economic growth and technology change. To make the rapidly growing RAC sector work effectively in the future, countries urgently need to turn their attention to stronger social inclusion.

## Women's role in economic development largely underestimated

If women and men played an identical role in labour markets, another US$28 trillion, or 26 per cent could have been added to the global GDP by 2015, UN Women estimates. Moreover, the Fortune 500 companies with greatest representation of women in management positions delivered a total return that was 34 per cent higher than others. **Although women can and do make enormous contributions to economies, they remain disproportionately affected by poverty, discrimination and exploitation.** Reaching a majority of the 2030 SDGs is closely linked to the social and economic empowerment of women, but especially to SDG 5 on gender equality. SDG 5 aims to ensure women's full and effective participation and equal opportunities for leadership at all levels of decision making in political, economic and public life. One way to promote gender equality by means of sound policies is the UN System-Wide Action Plan (UN-SWAP), guiding UN entities in their endeavours towards gender mainstreaming, and establishing a framework to measure, monitor and drive progress in this field. The existing UNIDO Gender Framework already prescribes the consideration of women's economic empowerment in all UNIDO programmes, policies and practices. **The Kigali Amendment and the green economy offer new opportunities for gender mainstreaming and social inclusion.**

As one of the few UN entities invited by UN Women to pilot the next generation of UN-SWAP, UNIDO will launch a global project, Economic Empowerment of Women in Green Industry, from 2018 to 2023. UNIDO has helped women and disadvantaged youth take a leading role in waste collection and sorting, sanitation and the management of public spaces in Guinea. So far 4,500 youth and women have been able to earn a living through UNIDO support of individual economic initiatives. This project also improved efficiency in recycling, giving more market value to organic and plastic waste. In another project in Mexico, hundreds of women mostly under the age of 30 were trained to be grafters with special skills, higher salaries and hence higher economic stability. Both initiatives show that sustainable economic growth with resource savings, climate benefits and environmental protection can be more effectively reached if women gain access to cleaner production practices and technologies. **Representing men and women's distinct needs and priorities in the implementation of international agreements, local environmental regulations, technology transfer and capacity building is a key priority.**

> **"If you want to stay in business with the international community, if you want to have international money, you need to work on gender."**
> Stephan Sicars, UNIDO

This is particularly relevant for the KA, where tackling both ozone depletion and climate change will require an active participation from the entire civil society. Although participants ranked "Gender balance and social inclusion" as the item on which the KA would have the weakest expected impact (see. Fig. 2, Chapter 1), the event highlighted the close relationship between the KA and social inclusion. Participants were alerted that many bilateral donors or international financing bodies, like the Green Climate Fund or the GEF, would have social inclusion and gender equality as a mandatory eligibility criteria to obtain funding. NOUs should therefore take early action and contact their focal point dealing with gender issues at the governmental level, and prioritize environmental programmes that will integrate this aspect from the beginning.

# Future of RAC sector depends on active involvement of women and the new generation

> **"Role models are very important. We need to have people with a testimony showing that [the refrigeration industry] is a nice industry. People working inside it enjoy it and have a very high impact on society."**
> Ina Colombo, International Institute of Refrigeration

The success of the KA requires the **representation of women, youth and disadvantaged communities in the RAC sector.** Today, only 1.2 per cent of the heating, ventilation, air conditioning and refrigeration employees in the United States of America are women. Only 6 per cent are members of national RAC associations. Instead of showing an upward trend, the number of women in RAC associations has decreased from ten to five per cent in the last ten years. This is counterintuitive, given that there are three billion refrigeration, air conditioning and heat pump systems operating worldwide with a steeply increasing trend for cooling solutions for the decades to come. With 12 million people employed in the refrigeration sector alone, the IIR estimates that four workers out of 1,000 will have a job linked to the manufacturing, installation and servicing of refrigeration equipment. More importantly, the need for RAC engineering and technical staff is growing faster than in other professions. However, as in a cascading system, women are first underrepresented in science (30 to 40 per cent), then in engineering professions (10 to 20 per cent), and finally in the RAC sector (1 to 10 per cent).

A similar issue exists worldwide in the general encouragement of **younger generations** to work in the RAC industry. The lack of specific degrees in refrigeration is one reason why young people do not strive to take a course in thermodynamics in university. The remuneration and social status of refrigeration technicians is another reason, with manual labor declining in value in many societies. Role models of successful individuals in an RAC role are hence needed to convince young people to follow this career path. UNESCO estimates that today's growing shortage of engineers is a threat to global development, especially to face our biggest challenges from poverty to climate change. Participants were therefore urged to establish early and effective plans for national strategies around education, to involve minorities, and encourage the next generation to take an active role in the use of green technologies. Interventions at the basic schooling level are crucial to encourage girls to continue their education at the same pace as men. Finally, supporting the illiterate with visual clues on RAC equipment and refrigerant cylinders is an effective means to involve the disadvantaged often rural community in the handling of new substances and technologies.

### Empowering women, youth & disadvantaged communities in the RAC sector

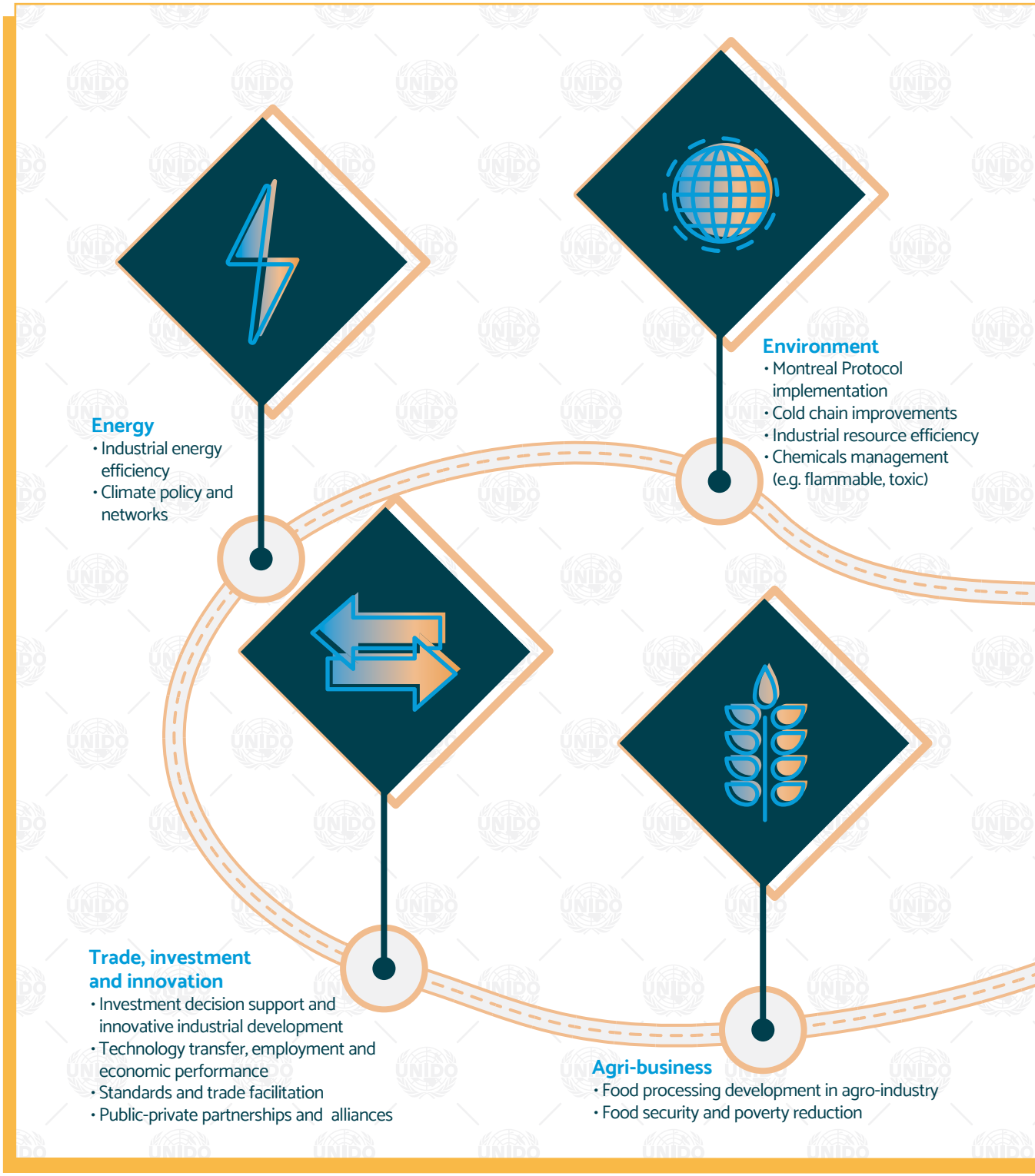
- ★ School promotional campaigns encouraging children from primary, secondary or higher schools choose a career in the RAC sector
- ★ National and global education campaigns linked to training and capacity building of technical and non-technical staff for the RAC sector
- ★ Labeling and visual pictograms for illiterate technicians to safely and efficiently handle RAC equipment
- ★ Awareness-raising and "rebranding" campaigns highlighting the benefits of RAC professions to women, youth and disadvantaged groups
- ★ Industry associations focusing on the interests of women, like the IIR working group "Women in Refrigeration" (global), or "Women in HVACR" (USA)
- ★ Lifelong learning programmes to encourage re-education, career changes and new entries into the RAC sector from minority or disadvantaged groups
- ★ Use of social media to reach younger generations and spread the news about green technologies
- ★ Regional databases of women in engineering and technology like the "Africa Catalyst Project" to guide in developing programmes for science and engineering

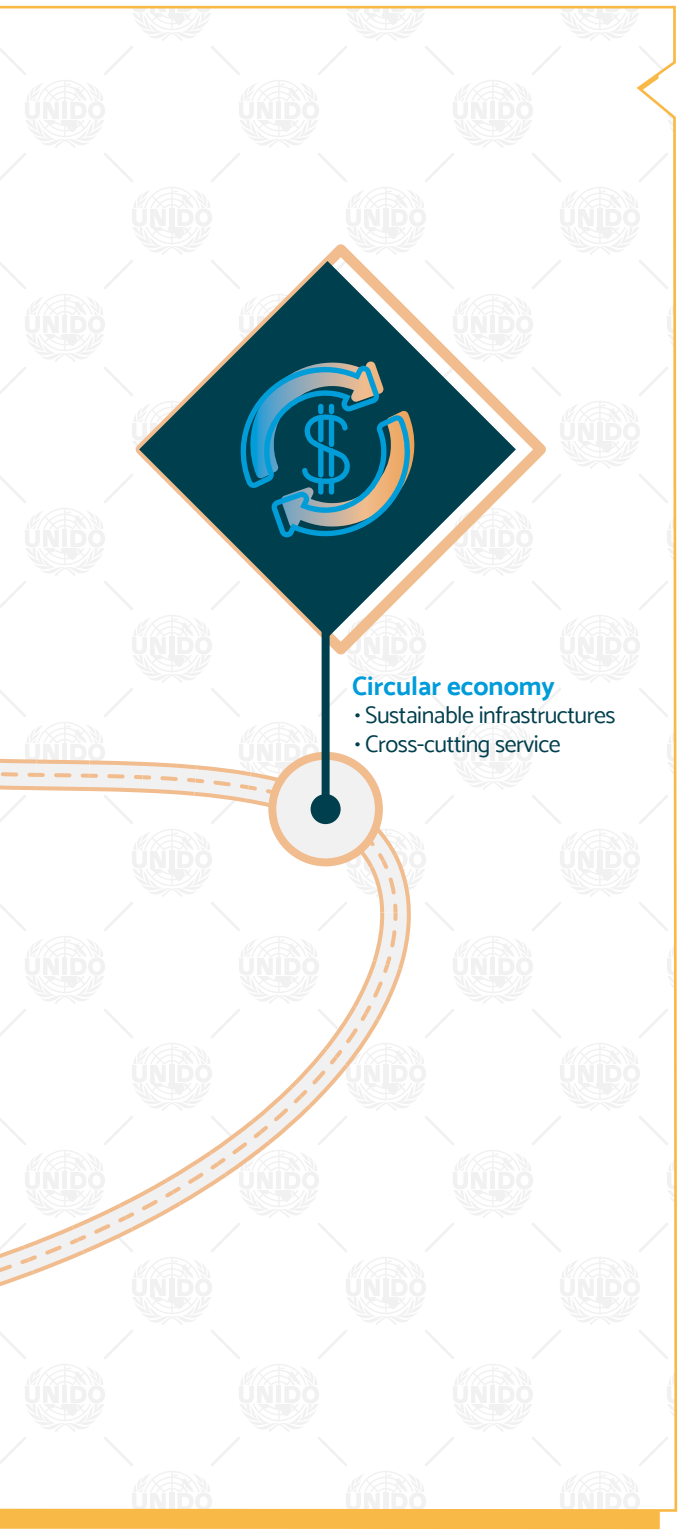
CHAPTER 7

## Why partner with UNIDO?

# The vision of UNIDO

UNIDO has implemented more than 1,000 projects to help developing countries and economies in transition to comply with their obligations under the Montreal Protocol. We have decades of experience working within most topics of the 2030 Sustainable Development Goals. UNIDO works with financial assistance by the MLF, the Global Environment Facility, bilateral contributions, or the private sector. Most of our work occurs in the refrigeration and air conditioning sector, which comprises from over 95 per cent of hydrofluorocarbon (HFC) consumption. Our other target sectors include 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 promote capacity building, and improve products, economic performance and employment opportunities.


Energy
• Industrial energy efficiency
• Climate policy and networks
Environment
• Montreal Protocol implementation
• Cold chain improvements
• Industrial resource efficiency
• Chemicals management (e.g. flammable, toxic)
Trade, investment and innovation
• Investment decision support and innovative industrial development
• Technology transfer, employment and economic performance
• Standards and trade facilitation
• Public-private partnerships and alliances
Agri-business
• Food processing development in agro-industry
• Food security and poverty reduction




## UNIDO and the Kigali Amendment

UNIDO specializes in the transfer to natural refrigerants (or alternatives) with low or zero global warming potential, as well as the safe management of flammable substances. We are experienced in promoting energy efficiency, and introducing low-carbon and low emission technologies and practices. UNIDO can be your integrated partner for any capacity building, institutional strengthening, technology transfer or demonstration projects. UNIDO is especially well-suited to the Amendment's following pillars:

### Pillar 1: Flexible implementation

The Kigali Amendment allows Article 5 countries the flexibility to prioritize HFCs, define sectors, select technologies and alternatives, and design and implement their own strategies for HFC phase-down. UNIDO aims to guide and provide technical assistance in order to maximize opportunities for successful implementation.

### Pillar 2: Financial and technical cooperation

UNIDO has extensive experience arranging effective financial and technical cooperation, which includes new vital funding opportunities for fast-start and enabling activities, particularly in technology transfer.

### Pillar 3: Energy efficiency (EE) and safety standards

UNIDO's expertise in energy efficiency leads to substantial investment potential for Montreal Protocol and climate action projects, opening up opportunities in RAC sector transition and supporting international standards for flammable, low-GWP refrigerants.

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# Kigali Amendment: Vienna Talks

## Challenges, opportunities and key actions for the phase down of HFCs