OzonAction

OzonAction Kigali Fact Sheet 6

Next Steps: HFC Phase-Down Strategy

UN environment

Background: An important aspect of Kigali Amendment implementation is for each country to consider its optimum phase-down strategy. Numerous questions need to be considered to develop a good strategy. These include:

a) How is the current consumption of HFCs[1] and HCFCs split between market sectors?
b) How might these markets develop in a "business-as-usual" scenario, taking into account factors such plans to phase-out HCFCs and economic growth?
c) What type of actions can be taken to reduce future HFC consumption?
d) Which fluids and technologies need to be adopted to achieve the phase-down targets?
e) Which market sectors have the greatest potential for cost-effective actions?
f) Which industry stakeholders need to make a contribution to strategy development?
g) What support do industry stakeholders require for implementation (e.g. improved training)?
h) What is the best way of prioritising different actions over the coming years?

This Fact Sheet summarises actions that can be taken to develop a national HFC phase-down strategy.

Action 1: Understanding Consumption

The first action is to understand the current requirements for HCFCs and HFCs and to build a picture of how consumption might change over the next 10 years if there was no Kigali Amendment i.e. a business-as-usual (BAU) forecast. To do this you need to build a **national HCFC and HFC consumption model**. The more detail that you can make available through such a model, the easier it is to analyse an appropriate phase-down strategy. A national HCFC and HFC consumption model needs to be based on two distinct types of data:

1) Top-down data on the bulk consumption of HCFCs and HFCs. For HCFCs this is a simple process – the relevant data is already reported to the Ozone Secretariat on an annual basis. Data should be available for each individual HCFC over a period of many years. Similar data will need to be collected and reported for HFCs under the Kigali Amendment – although at this stage many A5 countries may have little historic top-down data on HFCs.

2) Bottom-up data on key market sectors and sub-sectors. Top-down data is useful, but it does not help understanding in detail the way that consumption is split between different market sectors and sub-sectors. Kigali Fact Sheet 2 provides an overview of the complex mixture of market sectors that make use of HCFCs and HFCs. It shows that the technical options for using low GWP alternatives vary significantly between different sub-sectors of the market. A bottom-up analysis requires the market to be split into appropriate sub-sectors. Each sub-sector is modelled based on the type of equipment used and the typical lifecycle of individual products. See Box 1 for an example.

Data from bottom-up modelling can be "calibrated" against top-down data to confirm that the input assumptions (e.g. annual leakage rates) are reasonable. When a model of this type has been created, it can act as a powerful tool to support analysis of future options.

Box 1: Bottom-up model of car air-conditioning

In 2015 a fictional A5 country had 0.5 million cars with air-conditioning. The market has grown rapidly, from 0.2 million in 2005 and is expected to reach 1 million by 2025. Each car can be represented by a "standard" car air-conditioning system:

- Refrigerant used: 0.7 kg HFC-134a
- Average annual leakage rate: 8%
- Average car life: 10 years

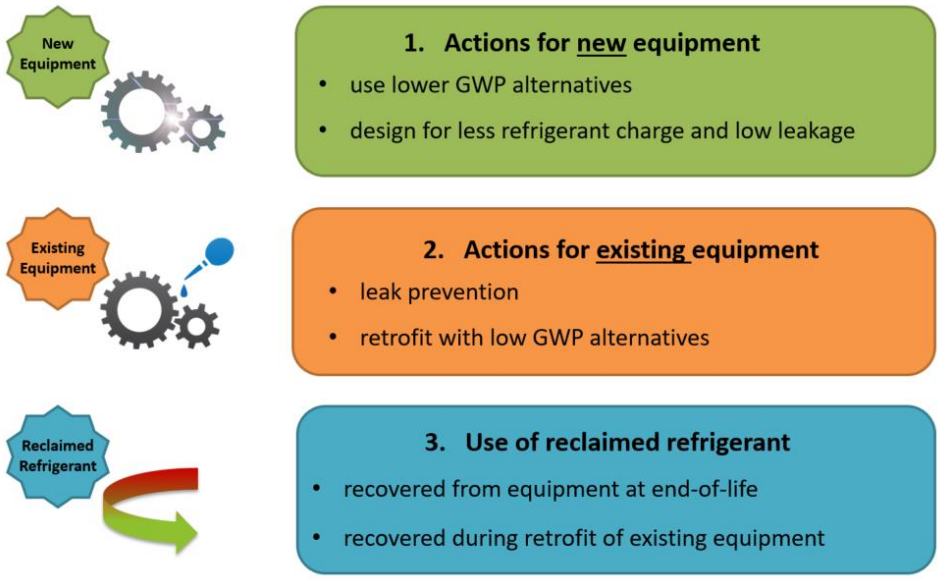
From this information, a bottom-up model can be created to show information such as:

a) The total bank of HFCs in all cars
b) Annual amount of HFCs for new cars
c) Annual amount of HFCs for servicing
d) HFC emissions in use and at end-of-life

[1] See Kigali Fact Sheet 14 for a glossary of all acronyms used

Action 2: Understanding "Core Actions"

There are a number of different ways in which future HFC consumption can be reduced. These can be treated as a set of core actions that can be considered for each market sub-sector.



The most important long-term core action is to use low GWP alternatives to HFCs in all new equipment. For example, if new supermarket refrigeration uses an ultra-low GWP refrigerant such as CO_2 (GWP=1) there are big reductions in HFC use compared to using the popular HFC, R-404A (GWP=3 922).

However, other core actions such as leak prevention measures are also worth considering as they may be the most cost-effective ways of reducing HFC usage, especially in the early years of the phase-down process. The most appropriate core actions vary across different parts of the HFC market. For example:

- In market sectors with high leakage rates and long equipment life (e.g. industrial refrigeration or large central supermarket refrigeration) it is important to consider the actions that apply to existing equipment e.g. leak prevention or equipment retrofit.
- In market sectors that use small sealed equipment (e.g. domestic refrigerators, stand-alone retail refrigerators) it is not practical or cost-effective to modify existing equipment. For these sectors the priority is to introduce low GWP refrigerants in new equipment as soon as possible.

Action 3: Development of future consumption scenarios

The national HCFC and HFC consumption model can be used to investigate future scenarios that forecast the national requirements for HFCs. The modelling assumptions for each market sub-sector can be adjusted to predict future HFC demand from that sector. For example, if the car air-conditioning market switches from HFC-134a to an ultra-low GWP alternative, the future demand for HFC-134a will fall, initially in new equipment and, over a period of time, in the car maintenance market. The total HFC forecasts for all market sectors can then be compared to the steps in the Kigali HFC phase-down schedule. For each scenario this shows:

a) Whether the Kigali Amendment targets are being met
b) The proportion of the cuts in HFC consumption being delivered by each market sector and by the different core actions.

This is very powerful information that enables national policy makers to identify different routes to achieving the phase-down targets and to assess which are the most practical and cost-effective ways of prioritising future action.

Box 2: Scenario Modelling for Car Air-conditioning

Using data such as that shown in Box 1, a national HCFC and HFC consumption model can indicate the annual demand for HFC-134a in car air-conditioning, both for the gas required to fill air-conditioning in new vehicles and for the gas required to top-up leaks from all existing cars. The model can then be used to forecast future consumption using different scenarios. In this example, three scenarios have been defined and used to calculate HFC demand. These scenarios are:

Business-as-usual: all new cars continue to use HFC-134a

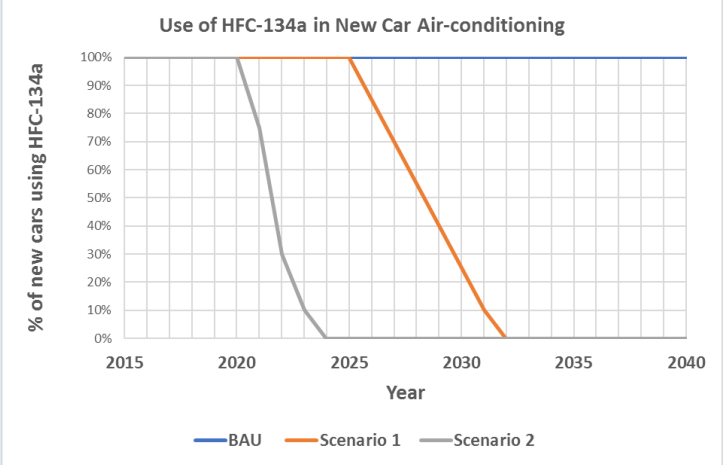
Phase-down Scenario 1: over a 7-year period from 2026, car air-conditioning in new cars switches from HFC-134a to an ultra-low GWP non-HFC alternative (e.g. HFO-1234yf). Scenario 1 can be considered as a "conservative" phase-down strategy, with a late starting date and a slow switch away from HFC-134a in new cars.

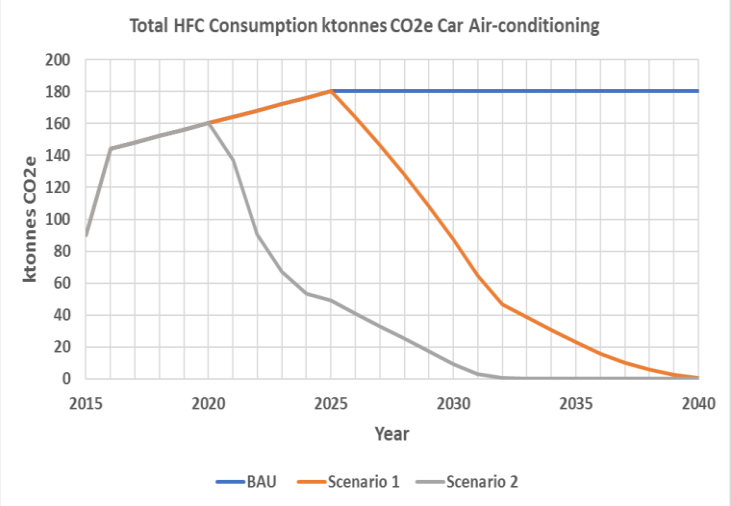
Phase-down Scenario 2: over a 5-year period from 2020, car air-conditioning in new cars switches from HFC-134a to a non-HFC alternative. Scenario 2 is a more aggressive scenario, with an earlier start and a faster switch to a low GWP alternative.

The first graph below illustrates the switch away from HFC-134a in new cars for each of the three scenarios. Based on the scenario assumptions, the second graph shows the results from the model: the annual HFC demand from this market sector, expressed in tonnes CO_2e (see Kigali Fact Sheet 3 for information about GWP and tonnes CO_2e).

The benefits of an early switch to a low GWP alternative are clear from the second graph. In the period to 2040, Scenario 2 saves around 3 million tonnes CO_2e whereas Scenario 1 only saves 1.8 million tonnes CO_2e.

It is interesting to note how the consumption of HFC-134a continues for 10 years after the switch away from HFC-134a in new cars – this is because there are older cars in the fleet that continue to need to be maintained using HFC-134a because of leakage.



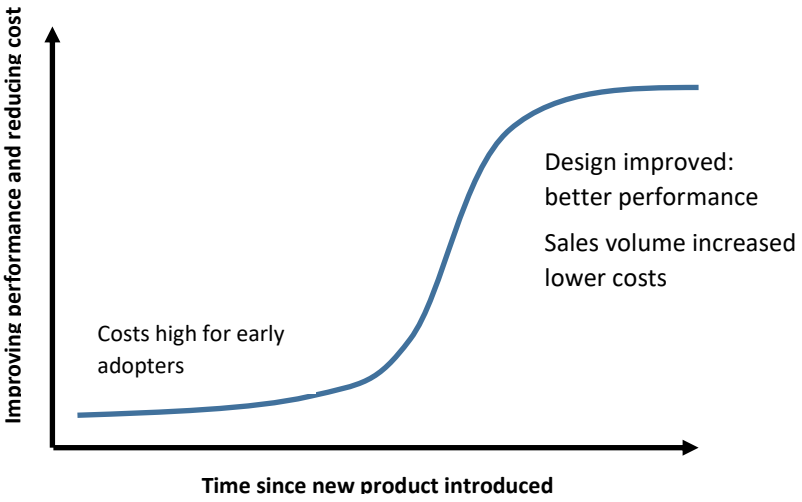


Scenario modelling provides very powerful insights into the usage of HFCs and alternatives. Individual assumptions can be made for each market sector or sub-sector, e.g. in terms of the date at which lower GWP gases are introduced. All the different core actions can be modelled, e.g. leak reduction or retrofit of existing equipment as well as switching to low GWP alternatives in new equipment. A range of different scenarios can be tested, helping to identify the actions that will have the greatest impact. The UN OzonAction team can provide National Ozone Units with further guidance on scenario modelling.

Action 4: Consideration of all technical options and timelines

Closely linked to Action 3 (the development of future consumption scenarios) it is necessary to consider the various technical options available in each market sector. Kigali Fact Sheet 4 provides a summary of many of the technical options available for new equipment. Other core actions must also be considered in some sectors (e.g. leakage prevention for industrial refrigeration and supermarket refrigeration). National circumstances must be considered e.g. will the new low GWP alternatives be available and does the workforce have the skills to use them.

The selection of an appropriate timeline is an important consideration as it is likely to influence environmental impact and cost. The analysis in Box 2 shows, in a fictional example, the benefits of an early start to the phase-down process. However, you also need to consider the potential cost impact of starting too early. The adjacent diagram illustrates the typical maturity curve for products and equipment. Early adopters pay more and may not get optimum performance. As a product becomes more mature it usually gets cheaper and provides better performance. Most of the early adopter costs are being absorbed in non-A5 countries. By the early 2020s there will be many products using low GWP alternatives that have reached maturity in terms of low cost and high performance. The car air-conditioning market is a good example. Regulations in the European Union mean that since January 2017 all new cars in the EU must use a low GWP alternative. Costs are still high, but over the next three to five years they are likely to fall rapidly.



It is worth noting that a "late start" to a phase-down action could create extra costs over an "optimum start". Most innovation by manufacturers will be directed towards products and equipment that use low GWP alternatives. Improvements such as higher energy efficiency will be made to these products, while the older products using high GWP fluids might "stagnate" and create higher running costs and worse environmental impact.

Action 5: Stakeholder input and support

National Ozone Units should carefully consider their engagement with stakeholders. This is a 2-way process:

- **Support from stakeholders:** some stakeholders can make a big contribution to the strategy development by providing insights into the current markets and opinions on the best technical options and timelines
- **Support to stakeholders:** some stakeholders need lots of support to help them understand the Kigali Amendment and the new products and technologies. There may be a need to support training and to assist in the setup of new infrastructure (e.g. national capability to recover and recycle refrigerants from old equipment reaching end-of-life).

Kigali Fact Sheet 8 provides further details about stakeholder engagement.

Action 6: Strategy reviews

The strategy needs regular review and updating. The availability of low GWP alternatives is changing rapidly. New alternatives are being introduced at a rapid rate by chemical producers and new products using these fluids are being commercialised by equipment manufacturers. The geographical availability of low GWP fluids and equipment is also changing rapidly. Currently the focus is to supply those countries with the most challenging HFC phase-down schedules – in particular, the European Union. However, with the Kigali Amendment in place this is likely to change rapidly and Article 5 countries can expect that access to low GWP technologies will quickly improve. The national strategy should be re-evaluated on an annual basis to assess whether any changes are required.