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Item 5 (c) of the provisional agenda*

Issues related to alternatives to ozone-depleting substances: information submitted by parties on their implementation of paragraph 9 of decision XIX/6 to promote a transition from ozone-depleting substances that minimizes environmental impact (decision XXV/5, paragraph 3)

Submissions by parties on the implementation of decision XIX/6

Submission by the United States of America

Note by the Secretariat

The annex to the present note contains a report entitled *HFC Policy Analysis Report: A Review of Country and Regional Policy Mechanisms and other Initiatives Targeting HFC Consumption and Emissions*, submitted by the United States of America. The report, on the country's actions to promote low-global-warming-potential alternatives, forms part of the submission of the United States in response to decision XXV/5 and provides information pertinent to decision XIX/6. It is reproduced as received by the Secretariat, without formal editing.

* UNEP/OzL.Pro.WG.1/34/1.

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Annex

HFC Policy Analysis Report

A Review of Country and Regional Policy Mechanisms and other Initiatives Targeting HFC Consumption and Emissions

January 29, 2014
Revised Draft Report

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Contents

1 Executive Summary

In mid-2013, the United States Environmental Protection Agency (U.S. EPA) consolidated information on efforts that countries, international organizations, and corporations were taking to address hydrofluorocarbons (HFCs). This effort included an internet search, and direct outreach to a regional economic integration organization (REIO), and over 50 countries or states representing both developed and developing countries. As a result, the U.S. EPA identified 24 countries, one region (the EU - encompassing 28 member countries), and one subnational state (California) that had implemented and/or proposed a policy targeting HFC consumption and/or emissions. This report analyzes the current state of HFC-related policy action and non-policy action that is being undertaken by those countries, REIOs, and states. It also examines work that is being undertaken by international organizations and corporations around the world to address the growth in HFC consumption and emissions. In reviewing related policies, several common features were identified, and as a consequence, the analysis presented in this document grouped HFC policies into five policy instrument categories: 1) Economic and Market-Based Incentives; 2) Prohibitions/Authorization; 3) Required Practices; 4) Import Licensing; and 5) Reporting/Recordkeeping Requirements.

The most notable finding of this review is that significant action is taking place in every region of the world. Further, several global and industrial HFC-related initiatives are complementing national and regional policy efforts. Taken together, a synergy is occurring in response to the increasing concern that the impact the projected growth of HFC emissions is expected to have on the Earth's climate system. Policy and voluntary initiatives are both shaping the markets that rely on HFCs and leading to the use of better practices. Additional findings from this analysis of the widespread movement on HFC awareness and action are summarized as follows:

- Countries are shaping their policies to address their specific circumstances and, as a result, there is no one size fits all policy or policy mechanism. On the other hand, the diversity of interventions presented in this analysis allows countries to consider a range of options for implementation for a specific policy.
- HFC policy design typically covers other F-gases and may expand on the existing regulatory frameworks that have enabled a successful phaseout of Ozone Depleting Substances (ODS).
- Multiple policy instruments can be used in concert to achieve emission reduction objectives.
- While policies are clearly having an effect, evaluating the extent to which HFC emissions are avoided or consumption is reduced as a result of the implementation of individual policies can be difficult to ascertain.
- Industry compliance and government enforcement is a common challenge associated with existing HFC policies.
- Non-policy initiatives such as implementation of projects designed to obviate the need for HFCs are widespread and are having an impactful change in developing countries.
- Corporate-based initiatives can influence competitors and fuel further action.

While action to address HFCs is clearly securing a global foothold, there is enormous opportunity for continued innovation, wider adoption, and further strengthening of HFC policies. Lessons learned from existing programs and policies, corporate action, and pilot projects have an important role to play in ensuring the thoughtful adoption and effective implementation of the measures that may be selected by countries to combat the growth of this class of potent greenhouse gases.

2 Introduction

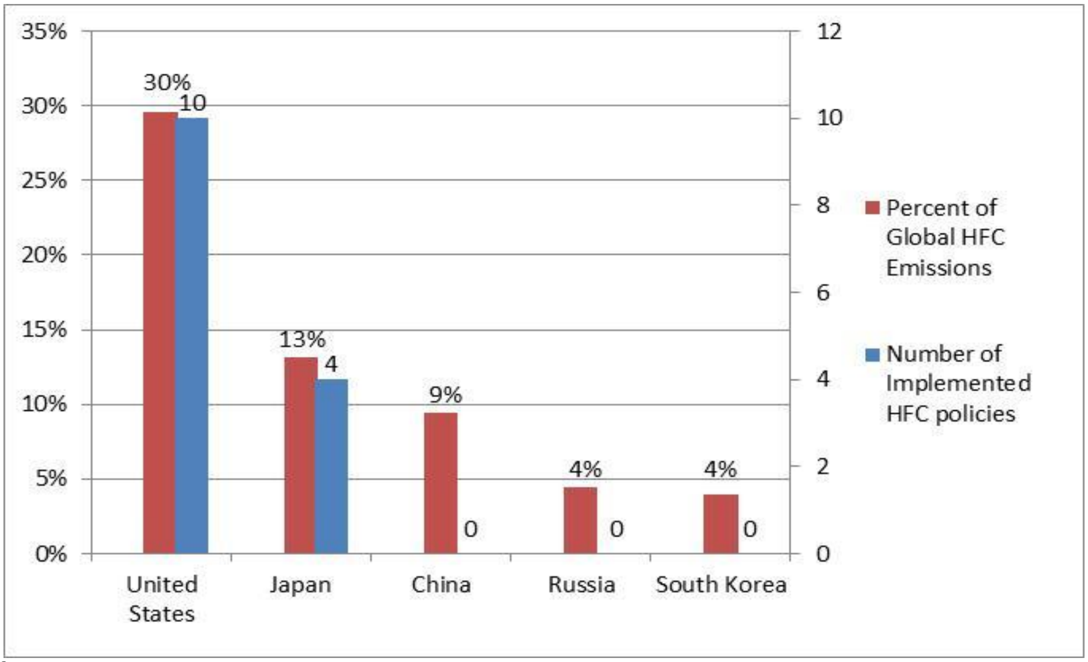
Hydrofluorocarbons (HFCs) are a class of potent fluorinated greenhouse gasses (F-gases) that are hundreds or even thousands of times more potent than carbon dioxide (CO_2). HFCs are receiving an increasing amount of attention recently, in part because HFCs are rapidly increasing in the atmosphere largely due to increased demand for refrigeration and air conditioning, particularly in developing countries. HFC use is also increasing because they are the primary alternative for ozone-depleting substances (ODS) that are subject to the phaseout under the *Montreal Protocol on Substances that Deplete the Ozone Layer* (Montreal Protocol). Globally, increased economic growth is a driver of this forecasted growth as sectors using HFCs such as comfort cooling and household refrigeration tend to increase in parallel with a nation's economic growth. The continued emissions of HFCs will have an immediate and significant effect on the Earth's climate system. The abundance of HFCs in the atmosphere is already rapidly increasing; left unabated, HFC emissions could rise to nearly 20 percent of CO_2 emissions by 2050.

Numerous policies, programs, and other measures have been initiated in all regions of the world to target the consumption and subsequent emissions of HFCs. Countries are engaging industry through various means and, in some cases, have developed policies to address HFCs. These efforts can be in part, in response to commitments internationally, as is the case for several European countries that have adopted domestic policy to ensure they meet not only regional policy implemented by the European Union but also their obligations under the UNFCCC and its Kyoto Protocol. In other cases, countries are addressing HFCs by expanding the scope of existing policies that address ODS. As listed below, the initial research undertaken for this analysis has revealed a total of 24 individual countries, one region (the EU - encompassing 28 member countries), and one subnational state (California) with existing or proposed policies that address HFCs. Together, these countries and regions represent approximately 60 percent of 2010 global HFC emissions (EPA, 2011).

- Australia
- Austria
- Belize
- Burkina Faso
- Canada
- Colombia
- Denmark
- Egypt
- France
- Germany
- Italy
- Japan
- Macedonia
- Montenegro
- Netherlands
- New Zealand
- Norway
- Poland
- Slovenia
- Sweden
- Switzerland
- United Kingdom
- United States
- California (United States)
- Yemen
- European Union

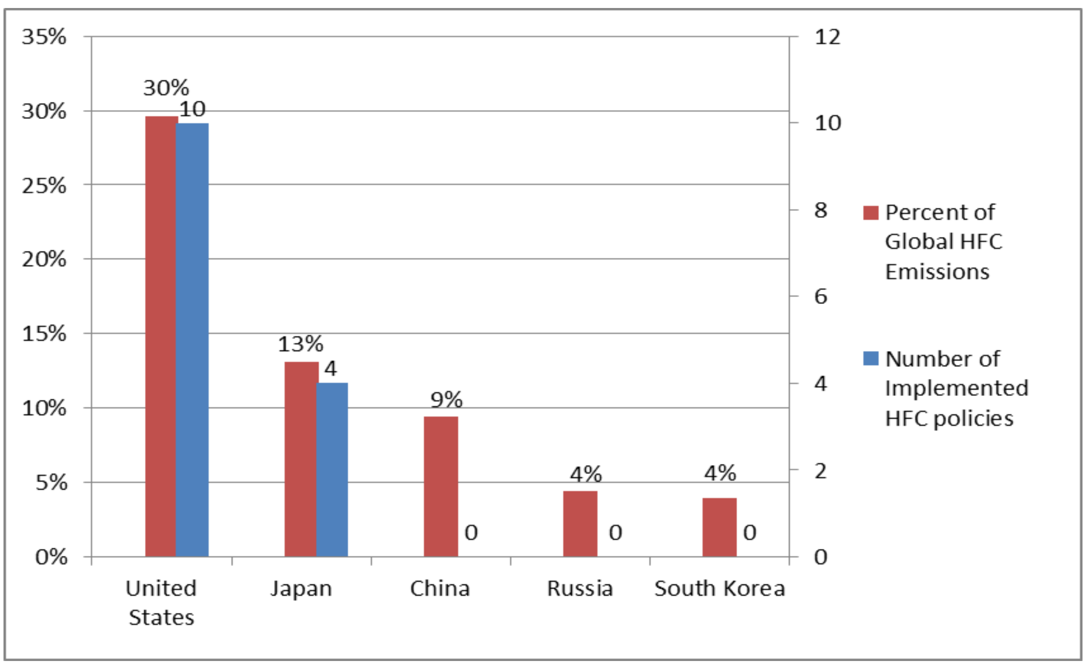
The countries that have implemented the greatest number of HFC policies and their relative contribution to global HFC emissions are displayed in **Figure 2-1**. Some of the major contributors to global HFC emissions, however, have yet to implement policy or are still in the process of developing HFC policy (see **Figure 2-2**). Given the preliminary nature of the investigative efforts that have gone into the preparation of this initial report, it is likely that many more countries also have HFC policies in place or in the planning stage.

Figure 2-1. Countries with the Largest Count of HFC Policies and their Percent Contribution to Global HFC Emissions in 2010[a]



[a]Global HFC Emissions Source: EPA 2011.

Figure 2-2. Number of HFC Policies Existing in Countries with the Largest Percent Contribution to Global HFC Emissions in 2010[a]



[a]Global HFC Emissions Source: EPA 2011.

Policies adopted by the countries and regions listed above vary in size and scope. Some policies target certain sectors (e.g., refrigeration and air conditioning (AC)) or applications within a sector (e.g., motor vehicle air conditioning) and other polices broadly cover all HFC uses. Additionally, governments around the world have chosen a variety of policy instruments to control and limit HFC consumption and emissions. Moreover, it is evident from this analysis that individual policies typically cover more than one policy mechanism; a

total of 79 policy mechanisms were identified in 48 policies. The relative presence of each policy mechanism identified as features to HFC policies is displayed in
Figure **2-3**.

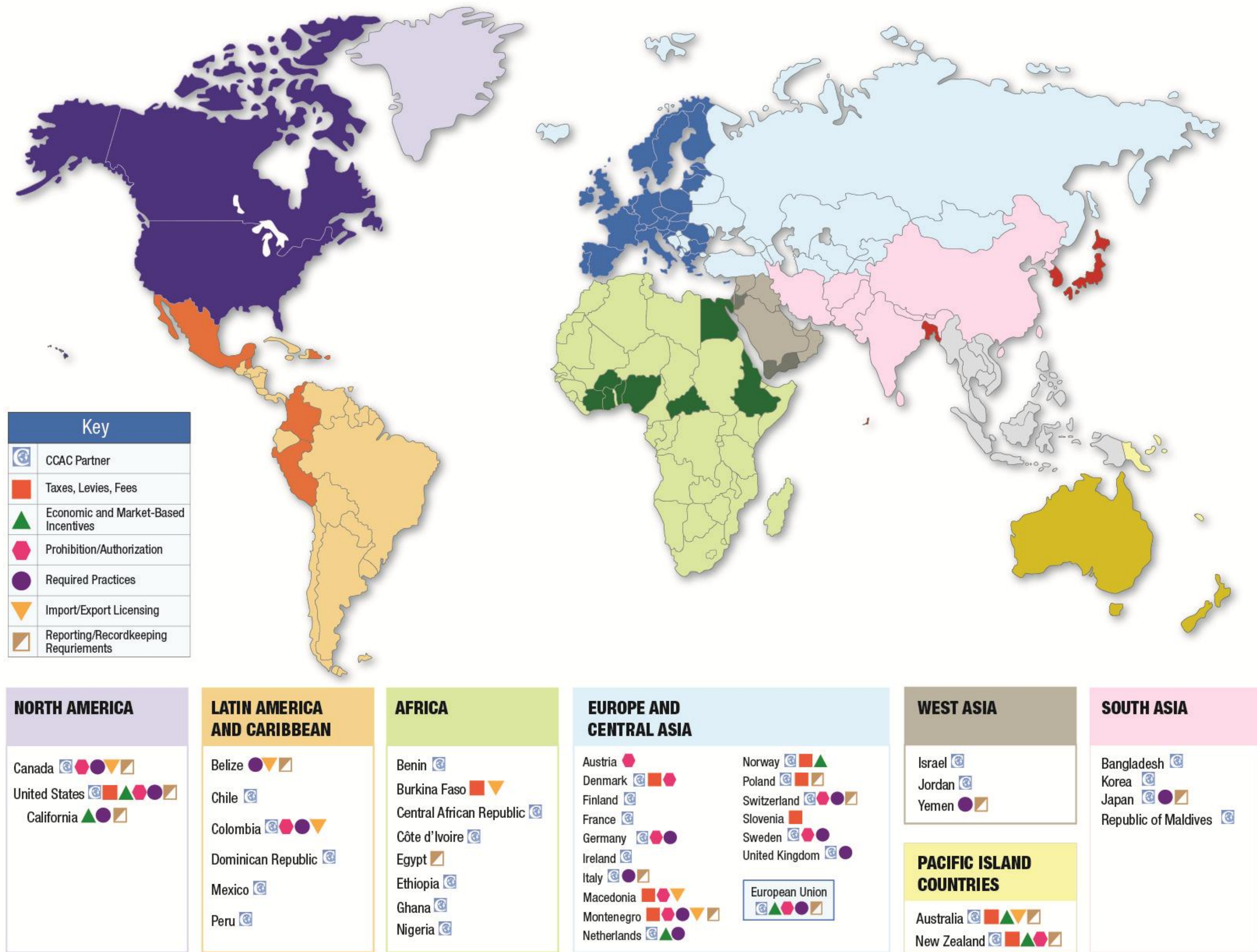
Policy Mechanisms adopted by Governments to address HFC Consumption and Emissions

- **Economic and Market-Based Incentives:**
  A tax, duty, levy, fee, or other similar type of charge: applied to the HFC, a blended substance containing the HFC, or a product containing HFC at the point of import or manufacture or at some other specified point (e.g., vehicle registration).
  - Refund programs: a system that provides a refund for the return and/or destruction of HFC gases.
  - Trading programs: may include carbon credit trading or permit trading.
- **Prohibition/Authorization:** A regulation that partially or fully restricts or prohibits or authorizes a certain activity such as the import, export, production, sale, venting, or use of HFCs, a blended substance containing the HFC, or a product containing HFC in some or all industry uses.
- **Required Practices:** A practice required by law. Examples include labeling requirements, training, certification, inspections, gas recovery during service and at end of life, and destruction. Required practices may include the application of standards that are adhered to by the end-user, manufacturer, or other relevant entity.
- **Import/Export Licensing:** A license or permit is required by a governing agency for the shipment or manufacture of HFCs.
- **Reporting/Recordkeeping Requirements:** A requirement by a governing agency to document and report on the import, consumption, destruction, or other activity involving HFCs.

Figure 2-3. Policy Mechanisms Adopted by Governments to Address HFC Consumption and Emissions

Figure 2-4 presents a geographic distribution of HFC policies along with countries participating in the Climate and Clean Air Coalition.

Figure 2-4. Global Coverage of HFC Policies[a]



[a]CCAC partners and countries with HFC policies are shaded in a darker color. Southeast Asia is noted in grey; there are no identified CCAC partners or HFC policies in this region.

Other Actions and Initiatives Addressing HFCs

- Climate and Clean Air Coalition
- Multilateral Environmental Agreements
- Demonstration or pilot projects funded by the Montreal Protocol's Multilateral Fund of Partnership Programs
- Corporate Responsibility Initiatives
- Research
- Smaller-scale Projects and Case Studies

The implementation of the vast number of policies is undoubtedly having a positive and direct impact on curtailing HFC consumption and emissions. Additionally, it is likely that these regulatory actions may be having an indirect impact by influencing innovation and spurring voluntary actions. While they are effective and increasing in global presence, domestic or regional policies serve as one component to a much larger, widespread movement on HFC awareness and action. Several initiatives are spurring this movement. At the international level, several multilateral environmental agreements are being used to elevate the concerns associated with growing HFC emissions. Most notably, countries are continuing to collaborate on joint proposals to amend the Montreal Protocol to address HFCs through a global phasedown in their production and consumption. The governments of Canada, Mexico, and the United States submitted a proposal on behalf of their governments. Separately, the government of the Federated States of Micronesia submitted a proposal that was then also formally sponsored by the Maldives and Morocco in 2013 and the serious consideration of action on HFCs under the Montreal Protocol has now been supported by more than 100 countries (Bali Declaration 2011). Other international groups are taking steps to address HFCs and commit to solutions. Notably, in February 2012, the Climate and Clean Air Coalition to Reduce Short Lived Climate Pollutants (CCAC) was formed. This initiative, consisting of more than 30 states and nearly an equal number of non-state partners, aims to raise awareness, enhance action, promote best practices, and improve the scientific understanding of short lived climate pollutant impacts and mitigation strategies. The heads of State and Government formally recognized "the phaseout of …ODS is resulting in a rapid increase in the use and release of …HFCs to the environment" and they formally supported, "a gradual phase-down in the consumption and production of HFCs" (the United Nations 2012). Additionally, members of The Arctic Council gathered on the May 15, 2013 and urged the Parties to the Montreal Protocol to take action as soon as possible, complementary to the UNFCCC, to phase-down the production and consumption of HFCs (U.S. Department of State 2013, "Arctic Counsel's Declaration: Kiruna"). In June 2013, China and the United States agreed, to work together and with other countries to phase down the consumption and production of HFCs through multilateral approaches that include using the expertise and institutions of the Montreal Protocol (The White House 2013a, "United States and China Agree to Work Together on Phase Down of HFCs"). Also in June 2013, President Obama announced the Climate Action Plan (CAP) to reduce GHG emissions, which calls for some of the GHG reductions to be achieved by curbing emissions of HFCs. To this end, President Obama directed the Environmental Protection Agency to "use its authority through the Significant New Alternatives Policy Program to encourage private-sector investment in low-emissions technology by identifying and approving climate-friendly chemicals while prohibiting certain uses of the most harmful chemical alternatives." (The White House 2013b, "The President's Climate Action Plan.")

Developing countries are receiving assistance through the Multilateral Fund for the implementation of the Montreal Protocol (MLF) for projects, most commonly in the foams, refrigeration, and AC sectors; many of these have supported the use of low global warming potential (GWP) alternatives in the transition away from HCFCs. Several valuable case studies and examples of successful projects demonstrating the use of new or innovative alternatives of HFCs are being prepared in developing countries through the support of the MLF, thereby demonstrating that a direct transition to climate-friendly technologies or alternatives in several key subsectors could lead to significant HFC reductions in the near term.

Recognizing the international community's mounting concern over the growth of HFC use and emissions, the increase in policies aimed at HFCs, and the potential for future additional controls, industry is also taking action of their own. Through corporate responsibility initiatives, several advancements in new climate-friendly technologies are increasingly penetrating diverse markets as replacements to HFCs. Such technologies include those that reduce HFC charge sizes and/or leak rates, as well as those that wholesale replace HFCs with lower GWP substances—while preserving or improving energy efficiencies.

The objective of this report is to analyze readily available information on policies being implemented or proposed by governments around the world as well as other initiatives undertaken by countries, international organizations, and corporations to further the reduction of HFCs. The information in this analysis is necessarily incomplete because the information available comes from a relatively small subset of the world's countries and is based on a changing dynamic with continuous activity. However, analysis of the information at hand can help readers understand the policy frameworks being considered, and their potential usefulness in individual circumstances. Toward that end, an examination of HFC policies is presented in Section 3. That section includes a consideration of market based incentives, such as taxes and levies, refund programs, trading systems, prohibitions/restrictions, required practices, import/export licensing, and reporting/recordkeeping requirements. The report then includes, in Section 4, a review of non-policy initiatives including multilateral environmental agreements, corporate responsibility initiatives, demonstration projects, research, and case studies. This is then followed by a section on concluding themes and findings.

3 HFC Policy Reviews

3.1 Prohibition/Authorization

Policy Mechanism: Prohibition/Authorization

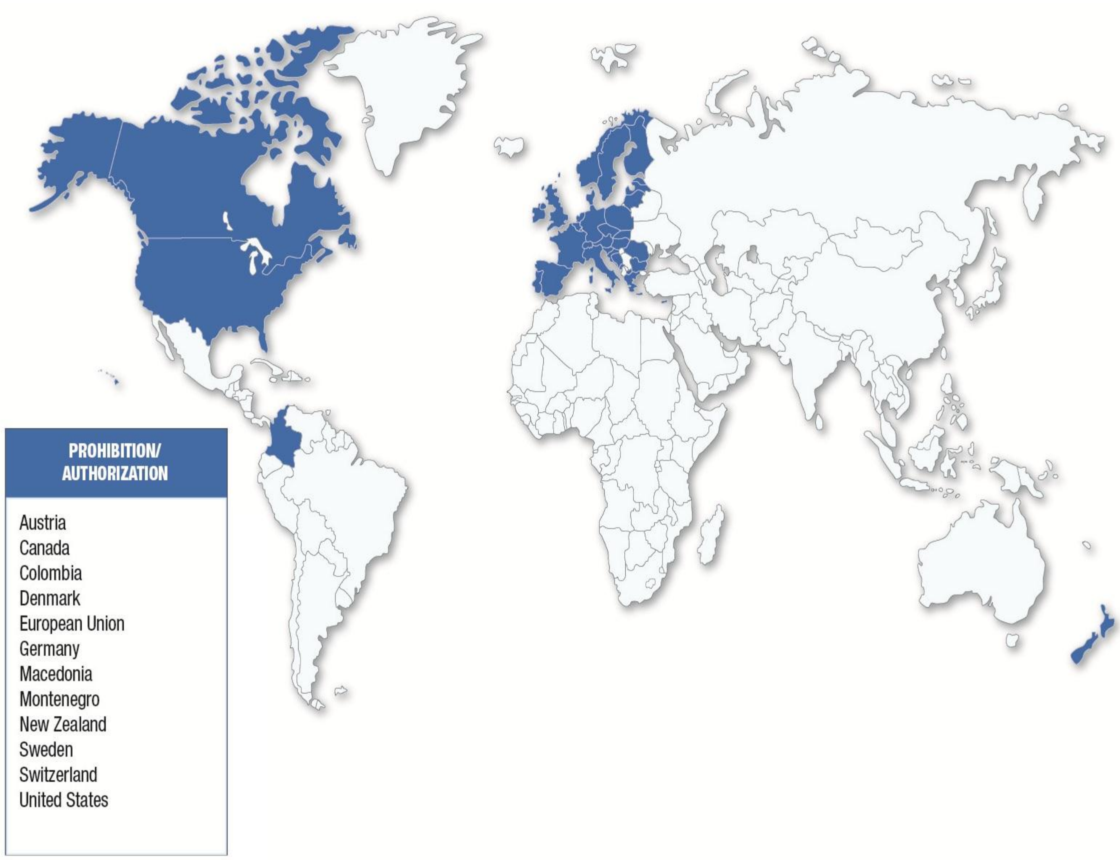
Policy Attributes:

1. A regulation that partially or fully prohibits or authorizes a certain activity
2. Examples include bans or restrictions on the import, export, production, sale, venting, or use of HFCs, a blended substance containing the HFC, or a product containing HFC in some or all industry uses

Notable Achievements and Observations:

1. Bans are found to be the most effective of the measures implemented under the EU F-gas regulation
2. Prohibitions can include certain exemptions to address end-use applications that do not have technically feasible alternatives
3. The EU took a phased approach to their complete ban of mobile ACs (MACs)
4. Bans should be periodically reviewed and updated based on availability of alternatives
5. Regulations that authorize the use of alternatives help to ensure that only alternative substances that offer lower overall risks to human health and the environment are introduced in the market place

Figure 3-1. Map of Countries Implementing Prohibition or Authorization Policy Mechanisms



More than a dozen countries and the European Union have implemented a regulation that partially or fully prohibits or authorizes a certain activity such as the import, export, production, sale, venting, or use of HFCs, a blended substance containing the HFC, or a product containing HFC in some or all industry uses. These countries include Austria, Canada, Colombia, Denmark, Germany, Republic of Macedonia, Montenegro, New Zealand, Sweden, Switzerland, United States, and member states of the European Union. Examples of regulations include bans on releasing or venting HFCs from certain refrigeration and air-conditioning equipment, prohibitions on the use of HFCs for refrigeration equipment based on the amount of refrigerant or its cooling capacity, and activity restrictions or controls on the import, export, or production of HFCs. The U.S. Significant New Alternatives Policy (SNAP) Program is an example of policy that authorizes the use of a substance that is an alternative to an ODS potentially with conditions on its use. As discussed further below, governments use this policy mechanism to encourage the use of alternatives and to minimize the risk of HFC emissions.

Canada and the United States have implemented regulations to address releases of HFCs from refrigeration and AC equipment.

- **Canada**: The federal, provincial, and territorial governments have shared responsibility over the control of HFCs. Currently, all but one province has implemented recovery/recycling and emissions control measures. For some provinces, these control measures include the prohibition of releasing HFCs from certain equipment—e.g., refrigeration and air conditioning equipment (Environment Canada 2013).
- **United States:** Under the Clean Air Act, it is prohibited to knowingly release refrigerant (including HFCs) during the maintenance, service, repair, and disposal of refrigeration and AC equipment. This venting prohibition went in effect on November 15, 1995 (US EPA 2010c).

Several countries have implemented regulations that prohibit or ban the use of HFCs in certain equipment. Other countries have gone a step further to restrict the types of equipment using HFCs by cooling capacity and charge size. Some countries taking these measures include:

- **Austria**: The use of HFCs in fire extinguishing systems, non-medical aerosol products, and as solvents (except when used in closed systems) has been banned since July 1, 2003. In addition, the use of HFCs for new fixed air conditioners and freezers, domestic refrigerators, freezers, and mobile air conditioners, and for the production of foam, are prohibited by the end of 2007 (Austrian Government 2007).
- **European Union**: The EU has proposed placing similar bans to Austria on new equipment containing HFCs. Specifically, their 2012 proposal includes a provision that would ban the use of HFC-23 in fire protection systems and fire extinguishers after January 1, 2015. It would also ban the use of HFCs with a GWP of 150 or more in domestic refrigerators and freezers after January 1, 2015; the use of HFCs with a GWP of 2500 or more in hermetically sealed refrigerators and freezers for commercial use after January 1, 2020; the use of HFCs with GWP of 150 or more in hermetically sealed movable room air-conditioning appliances after January 1, 2020. Finally, the evolving EU proposal would disallow the recharging of existing refrigeration equipment with a charge size over five metric tons CO_2 eq. ($MTCO_2$ eq.) with HFC of GWP higher than 2,500 after 2020 (European Commission 2012a).

Under the EUs Directive 2006/40/EC (i.e., the "MAC Directive"), the EU implemented a complete ban of MACs designed to use HFCs with a GWP higher than 150 within new types of vehicles. The Directive is enforced in two phases:

- Phase 1: Beginning in 2008, manufacturers are prohibited from obtaining "a type approval for a new type of vehicle if it is fitted with MACs designed to contain F-gases with a GWP higher than 150 leaking more than 40 grams per year (one evaporator systems) and 60 grams per year (dual evaporator systems)." Starting in 2009 "this also applies for all new vehicles having been type-approved in the past."
- Phase 2: Beginning in 2011, MACs designed to use the above mentioned gases are completely banned for new types of vehicles. Beginning in 2017, the ban will apply to all new vehicles and new vehicles with these systems cannot be registered, sold, or enter into service (European Commission 2013).

- **Switzerland:** Starting in December 2013, Switzerland will ban HFCs in a series of air-conditioning and refrigeration applications. For example, HFCs are banned in AC systems with a cooling capacity of more than 600 kW. The Swiss F-gas regulations also include bans (with some exemptions) on HFC-based solvents, foams, refrigerants, fire extinguishing agents, and spray cans containing HFCs (Swiss Federal Council 2003).
- **Sweden:** The maximum HFC refrigerant charge for any system is restricted to 200 kg in Sweden. The maximum refrigerant charge allowed in a supermarket refrigeration system is restricted to 20 kg for medium temperature applications and 30 kg for low temperature (IOR 2010).

Another common approach to controlling HFCs is placing regulations on the import, manufacture, and sale of HFCs or equipment containing HFCs.

- **Austria**, for example, has put in place regulations that prohibit the import and use of HFCs in certain devices, systems, and products (Austrian Minister of Agriculture, Forestry, Environment, and Water 2007).
- In **Denmark**, the import, sale, and use of new products containing HFCs and the import, sale, and use of new and recycled HFCs have been prohibited since January 2006. The ban, however, does not apply to the import, manufacture, and sale of products exclusively for export (Danish Ministry of the Environment 2005). In the Republic of Macedonia, the import of used refrigerators, freezers, and other cooling and freezing devices that rely on HFCs is banned as of 2007 (Republic of Macedonia Ministry of Environment and Physical Planning 2009).
- **Switzerland** bans the manufacturing and import of spray cans containing HFCs (with some exceptions); the distribution and use of synthetic foams manufactured with HFCs; and the manufacturing, import, distribution, and use off solvents containing HFCs and products and objects containing HFC solvents (Swiss Federal Council 2003).

As demonstrated by **Denmark's** F-gas ban (Statutory Order, no.552), prohibitions can be a very effective policy instrument. Since the introduction of the Danish regulation, a number of alternative technologies have been developed and placed into use in Denmark, including transcritical CO_2 refrigeration systems, hydrocarbon beverage coolers, chillers, and domestic refrigerators, and domestic freezers (Danish Ministry of the Environment 2012a). In the EU, bans were found to be most effective of the measures implemented under the EU F-gas regulation (Schwarz et al 2011). Moreover, bans are simple to administer and are met with general support when safe, efficient, and affordable alternatives already exist (Ammonia21 2012).

Authorization is another component to this policy mechanism—both in terms of restricted authorization of use of an HFC, and/or authorization of the use of an HFC alternative. An example of a policy that uses this feature is the SNAP Program in the **United States**—U.S. EPA's program to evaluate and regulate the use of and transition to ODS alternatives. Under SNAP, substitutes for ODS that are used in various industrial, commercial, and military sectors—including but not limited to refrigeration and air conditioning, foam blowing, cleaning solvents, fire suppression, and aerosols—are evaluated to ensure they offer lower overall risks to human health and the environment. In reviewing the proposed alternatives, consideration is given to the climate impacts of the substitutes as part of the review of environmental impacts. The SNAP program has helped to ensure a smooth and timely transition away from ODS across all U.S. sectors and represents the largest source of information on ODS substitutes. Findings of the SNAP program are also relevant globally and have been used by many countries as they consider transitioning to alternatives.

3.2 Economic and Market-Based Incentives

Policy Mechanism: Economic and Market-Based Incentives

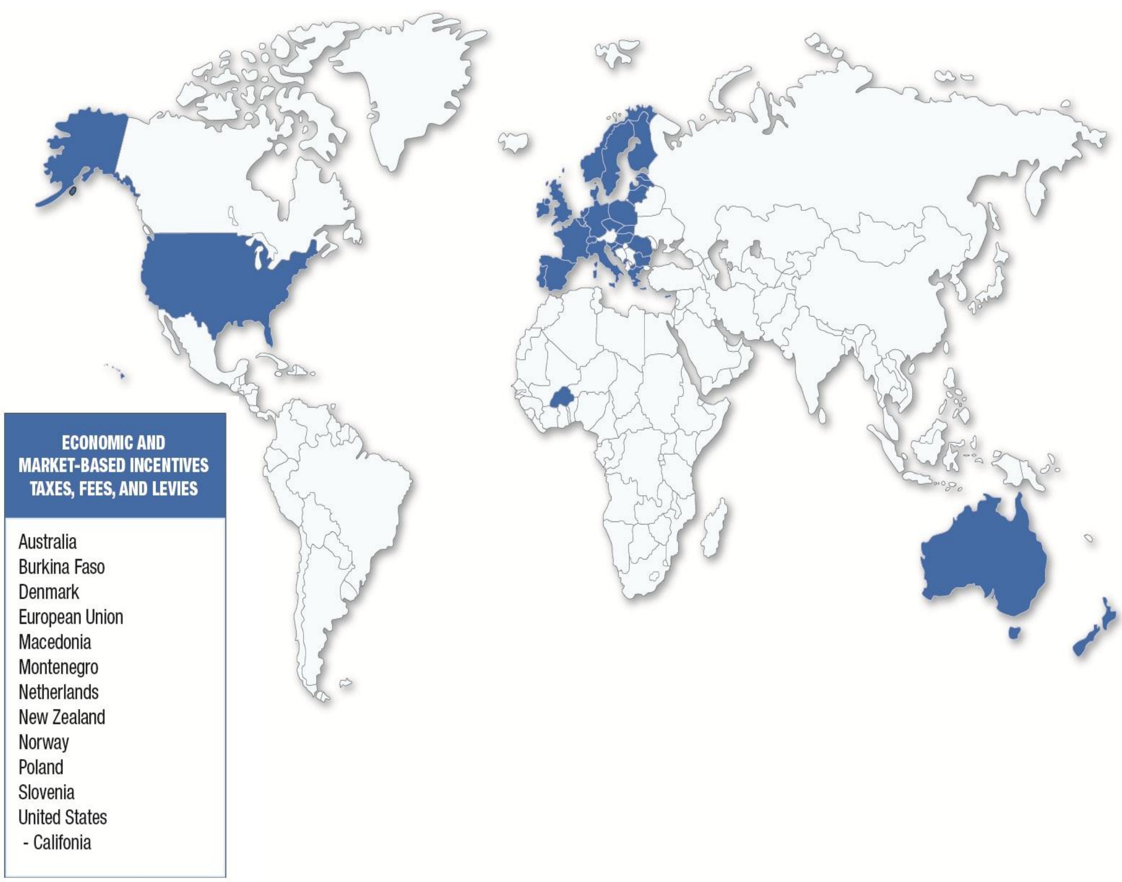
Policy Attributes:

1. Tax-refund programs can be used to further incentivize recovery and recycling
2. Flexible design (e.g., adjusting taxes or re-allocating allowances) is important to ensure effectiveness over time

Notable Achievements and Observations:

1. Denmark's tax revenue was reinvested back into the refrigeration/AC industry through the establishment of the Knowledge Centre for HFC-free Refrigeration
2. Taxes can be easily implemented using existing tax policies and programs
3. In order for taxes to be effective, it is important to set a charge rate that is not too burdensome for industry but is sufficient for incentivizing innovation
4. The introduction of a tax, levy, or fee can be met with opposition and concerns regarding the economic impacts
5. Trading systems are subject to market volatility and have a certain level of uncertainty, thus require close administrative oversight
6. Trading systems allow firms to comply at low-cost

Figure 3-2. Map of Countries Implementing Economic or Market-Based Incentives



Economic and market-based incentives are currently employed or being considered by 13 countries and the European Union, as discussed further in the sections below. For the purposes of this analysis, economic and market-based incentives are divided into two sub-categories: (1) taxes, levies, and other types of fees; and (2) trading systems, compliance credits, refund programs, and other financial incentives. In theory, economic and market-based incentives reduce HFC consumption and emissions by encouraging industry to adopt low-GWP alternatives and technologies. Taxes, levies, and fees rely on the recoupment of environmental externalities, while refund programs and trading systems rely on financial rewards to achieve the same objective.

3.2.1 Taxes, Levies, and Other Types of Fees

Several countries are limiting the use of HFCs and therefore emissions of HFCs by imposing taxes, levies, and other types of fees including: Australia, Burkina Faso, Denmark, Republic of Macedonia, Montenegro, New Zealand, Norway, Poland, Slovenia, and the United States (California). Of these countries, three are considered developing countries and seven are considered developed.[1] To date, fees are the most commonly used of these mechanisms (e.g., in Australia, Republic of Macedonia, Montenegro, Poland, and the United States (California)), followed by taxes (e.g., in Burkina Faso, Denmark, Norway, and Slovenia), and levies (e.g., in Australia and New Zealand). Governments have chosen this type of policy mechanism for a variety of reasons, including to deter industry through financial disincentives and to apply the generated revenue toward other environmental objectives. In many cases, governments are also aiming to limit or control the use of other greenhouse gases (GHGs) and ODS with the same policy instrument. For example, **Australia's** Ozone Protection Act was amended in 2003 to cover HFCs and other GHGs listed under UNFCCC and its Kyoto Protocol (Australian Government 2013a).

Highlights from the Danish HFC Tax

- HFC tax on imports since 2001
- From 1994-2011, the Danish tax on HFCs (as well as CFCs, PFCs and SF_6) raised nearly USD 104 million in revenue (OECD/EEA 2012).
- Tax and other regulations have resulted in a total estimated emission reduction of
  - 49,000 $MTCO_2$ eq. in 2001;
  - 150,000 $MTCO_2$ eq. in 2005; and
  - 370,000 $MTCO_2$ eq. in 2010

  as compared to a business as usual scenario (Danish Ministry of Environment 2009).

Denmark's Experience

Taxing HFCs is a relatively new approach—most countries that currently impose an HFC tax have only had the tax come into effect in recent years (i.e., 2012-2013). The exception is Denmark, which placed a tax on HFCs at the point of import (and manufacture) in 2001 (Danish Ministry of Environment 2001).[2] As such, Denmark is often used as a model for other countries that are considering implementing a similar tax. Denmark has previous experience with a tax on CFCs that was introduced in 1989 in response to the Montreal Protocol that helped pave way for its "Law on Tax on certain ozone depleting substances and certain industrial greenhouse gases (Schwarz et al 2011)." Under the tax system, companies that import or manufacture HFCs must register with the Danish Tax and Customs service and pay monies based on the GWP and quantity of substance being imported or manufactured.

Despite initial fears that the Danish tax would present too great a burden for industry, the policy spurred the uptake of non-fluorinated compounds and development of alternative technology (Danish Ministry of the Environment 2012b). Denmark has also seen a significant decrease in the import of HFCs since the tax was implemented. By 2009, the quantity of HFCs being imported decreased by 65 percent since 2000—i.e., one year prior to when the tax was implemented (Schwarz et al 2011). Despite the benefits associated with the decline in HFC imports since the HFC tax was introduced, HFC emissions are increasing primarily due to the amounts of R-404a and R-134a used in large refrigeration and air conditioning systems.[3] Concerns emerged that the level of taxes might have been set too low to provide sufficient incentive for actors to adopt alternatives (Schwarz et al 2011). In 2011, Denmark increased the tax by 50 percent to further push industry

[1] As classified by Parties to the United Nations Framework Convention on Climate Change.

[2] Denmark does not domestically manufacture any HFCs or F-gases.

[3] Leakage rates of existing bank is contributing to the increase in overall HFC emissions.

away from use of HFCs. Consequently, a tax of DKK 195 per kg (USD 33.15)[4] is now imposed on R-134a—one of the most frequently used F-gases (Danish Ministry of Environment 2012b).

Key Design Features to Consider When Implementing a Tax, Levy or Fee

When implementing taxes, levies, or fees, it is evident that countries have considered several key factors, such as deciding at which point the charge will be applied and the charge rate. Typically, the charge is applied to the HFC, a blended substance containing an HFC, or a product containing an HFC at the point of import or manufacture or at some other specified point (e.g., vehicle registration). Charges are also commonly applied when importers, exporters, and manufacturers are required to obtain licenses or permits to import, export, or manufacture HFCs. In general, the purpose of the charge is to provide an economic incentive for various actors (e.g., importers, exporters, manufacturers, end-uses) to adopt HFC-alternatives. In order for this policy measure to be effective, countries have aimed to set a charge rate that is not too burdensome for industry but sufficient for incentivizing innovation. Countries have used various methods for calculating tax rates and other fees, most commonly including rates based on GWPs or market value of emission reductions. Some notable examples include:

- **Norway:** The HFC tax is calculated based on quantity of gas (kg) and GWP (Norwegian Customs and Excise 2013):[5]

$$HFC\ Duty\left(\frac{NOK\ (USD)}{kg}\right) = \frac{NOK\ 0.225\ (USD\ 0.04)}{kg} \times GWP$$

After the introduction of the tax in 2003, the growth rate of imports of HFCs and PFCs halved in Norway (Statistics Norway 2007). Taxes based on GWP result in high penalties for the most potent gases, which further encourages the adoption of low-GWP alternatives. The tax rate is adjusted on an annual basis to account for inflation and other market changes.

- **Australia** and **New Zealand:** These countries use a market-based methodology for calculating an equivalent carbon price. Australia's import and manufacture levy, which was implemented in 2012, commences with a three-year fixed price period and then will be set every six months based on the average carbon price at the time of import/manufacture.[6]

In addition, fees and other types of charges are also commonly used by governments to generate revenue to cover administrative costs for the program, or to be put towards other HFC emission reduction projects. In **Poland**, for example, a fee is collected by the government and is submitted to a fund for managing F-gases, both through the maintenance of reporting databases and other F-gas emission reduction projects. Similarly, **Australia** collects a levy at a prescribed rate per metric ton of the HFC imported or manufactured to cover the administrative costs of the government's Ozone Protection and Synthetic Greenhouse Gases (SGG) management program, and **Montenegro's** law on administrative taxes stipulates a 5 EUR (USD 6.67)[7] administrative fee for each application for import/export of HFCs.

Revenue generated from an HFC-based tax or similar fee can be invested back into the industry. For example, the Danish HFC tax revenue was invested back into the refrigeration and air conditioning industry through the establishment of the "Knowledge Centre for HFC-free Refrigeration," which provides free advice and assistance on deciding what kind of refrigeration systems to use. Using revenue generated from the tax, the Research Centre provides tools for calculating refrigerant charges and equivalent warming impact, a systematic collection of Danish and international literature on climate-friendly refrigeration systems, and other free information related to climate-friendly refrigeration systems (Danish Ministry of the Environment 2013).

The introduction of a tax, levy or fee, can be met with opposition and concerns regarding the economic impacts. For example, the refrigeration and air conditioning industry in Australia has expressed two primary concerns related to the new HFC levy. First, they are concerned that the new levy on HFC refrigerant gases will result in a 300 to 500 percent increase in their prices. Affected parties must decide to incur the costs,

[4] Taxes expressed in Danish Krone (DKK) and USD. The exchange rate applied is 1 DKK = 0.18 USD (August 2013).

[5] Fees expressed in Norwegian Krone (NOK) and USD. The exchange rate applied is 1 NOK = 0.17 USD (August 2013).

[6] The Australian Government has drafted legislation that proposes abolishing the levy starting 1 July 2014. Draft legislation includes transitional provisions for importers of HFCs imported after 1 April 2014. This transitional approach is intended to reduce the risk of shortages of HFCs in the period prior to 1 July 2014 that is anticipated due to a lower levy.

[7] Fees expressed in Euro (€) and USD. The exchange rate applied is 1 Euro = 1.33 USD (August 2013).

adopt alternatives, or pass the costs on to customers. Second, they are concerned that serious health and safety issues will arise without further training, education, and introduction of standards regarding the use of non-fluorinated alternatives. To minimize health and safety concerns associated with transitioning to the use non-fluorinated alternatives, the Australian Institute of Refrigeration, Air-conditioning, and Heating (AIRAH) has formed a stakeholder working group to adopt safety codes used in the UK and adapt them to Australian legislation and regulation. Further, Australia's refrigeration and air conditioning industry estimates that they will be contributing nearly AUD 300 million (USD 271,470,000)[8] in HFC levy payments, and therefore, believe that the generated revenue should be redirected in part back to the industry to help the transition and ease the burden of costs (AIRAH 2012). Other documented successes such as the reduction of HFC imports from use of an HFC tax in Denmark support the efficacy of this type of revenue-sharing policy mechanism.

Putting a carbon price on HFCs is proving to be a highly effective way to reduce emissions from HFCs and other F-gases. Currently, **France** and **Sweden** are considering this type of policy instrument to help meet targets under Europe's F-gas Regulations. The French Ministry for the Environment is proposing to introduce a tax on HFCs with a GWP greater than 150. Four different options are being considered for the tax, with rates ranging from 2.5€ to 60€ (USD 3.33 to 79.96)[9] per $MTCO_2$ eq., depending on the GWP. The Ministry for the Environment estimates that the French HFC tax could lead to reductions in HFCs of up to 50 percent by 2020 and 80 percent by 2030 (The French Environmental Taxation Committee 2013). The Swedish Ministry of Finance also recently published a proposal on introducing an HFC tax. The proposed tax in Sweden is expected to decrease HFC emissions by approximately 100,000 $MTCO_2$ eq. by 2020 (Swedish Ministry of Finance 2009).

3.2.2 Trading Systems, Compliance Credits, Refund Programs, and Other Financial Incentives

Trading systems, compliance credits, refund programs, and other financial incentives, are also very effective instruments for reducing HFC emissions with a focus on financial rewards instead of penalties. Understanding how these policies are implemented in various countries can help inform other governments that are considering this type of mechanism.

Trading Systems

Although trading systems vary by design, scale, and application, "cap-and-trade" emission trading schemes (ETS) to reduce GHG emissions are the most commonly used approach. Approximately 30 countries have launched a national GHG emissions trading system, while a number of other countries are piloting systems with plans to launch them in the coming years. Typically, they include a government-controlled emissions cap on the amount of GHGs or other pollutants that may be emitted during a specified period. Polluting firms receive allocations in the form of emission permits, which can be transferred or traded to other firms. Under the system, firms that reduce their emissions below their allocated amount may sell their surplus permits to other firms. The method for initially distributing allowances and a few other design components (e.g., compliance periods, verification, offsets, banking, and borrowing allowances), however, may vary from system to system.

Emission trading systems that cover HFCs are implemented in the European Union and New Zealand; both of these systems were established to meet obligations under the UNFCCC and its Kyoto Protocol.

- **European Union:** The European Union Emissions Trading Scheme (EU ETS) was enacted before the UNFCCC's Kyoto Protocol had entered into force (Ellerman and Joskow 2008). The EU ETS was created under Directive 2003/87/EC in 2005, and is the largest system in the world, covering all 27 EU member states and three non-members (i.e., Iceland, Lichtenstein, and Norway). The EU ETS is also the first cap-and-trade program in the world for GHG emissions and, therefore, provides useful perspectives for other national emission trading systems. Under the directive, an emissions cap is placed on operators emitting HFCs and other GHG gases. A set number of tradable allowances are issued to operators each year, and will decrease in a linear manner starting in 2013. The absolute allowances are calculated on the basis of the national plans accepted by the Commission and were introduced between 2008 and 2012 to align with the first commitment period of the UNFCCC's Kyoto Protocol. Participating operators must measure and report their emissions and surrender an allowance for every $MTCO_2$ eq. emitted during a compliance period. By design, operators have the

[8] Revenue expressed in Australian dollars (AUD) and USD. The exchange rate applied is 1 AUD = 0.90 USD (August 2013).

[9] Taxes expressed in Euro (€) and USD. The exchange rate applied is 1 Euro = 1.33 USD (August 2013).

choice to either reduce their emissions or purchase allowances on the European carbon market—whichever is the cheaper option for their particular circumstance. By achieving emission reductions over and above those required for compliance, facilities may profit by selling surplus allowances to facilities that exceed their allocations (European Commission Directive 2003/87/EC). Operators in developing countries may also earn emission reduction credits through the UNFCCC and its Kyoto Protocol's Clean Development Mechanism (CDM) and Joint Implementation (JI).

- **New Zealand:** The government of New Zealand chose the New Zealand Emissions Trading Scheme (NZ ETS) as its primary tool to reduce emissions and meet commitments under the UNFCCC and its Kyoto Protocol. Regardless of the future post-Kyoto, the ETS Review Panel states that there will be other compelling drivers to reduce emissions in New Zealand (Emissions Trading Scheme Review Panel 2011). Regulations for reporting HFCs emissions under the NZ ETS came into force on January 1, 2011. Under the regulations, importers of HFCs and other SGGs, either in bulk or in products, and manufacturers of HFCs and other SGGs, are required to give the government one emission unit for each $MTCO_2$ eq. their imports amount to each year. The emissions trading system also covers exports of these gases and destruction, where credits may be earned based on the amount of emissions "removed" through these activities (Government of New Zealand 2008). Eligibility to receive emission credits began on January 1, 2013 (Government of New Zealand 2013b). In the NZ ETS, firms that have a surplus of emission units—achieved by reducing emissions—may sell them through a carbon market broker. In addition, firms may earn emission units from government-approved emission removal activities (Government of New Zealand 2013a).

Although it is too early to fully assess the effectiveness of the NZ ETS, many lessons can be learned from the EU ETS, which has been subject to a wide range of literature review since its launch in 2005. One feature that has been central to the success of EU ETS is its flexible design that was adapted over time in response to lessons learned and new information. For example, too many allowances were issued in the pilot phase (2005-2007), which resulted in little demand and low prices for offsets (Schwarz et al 2011). Administrators were able to adjust and limit the allowances allocated during the second period (2008-2012) to ensure real emission reductions. Research suggests that the EU ETS has led to emission reductions in some sectors (e.g., power), but the impact on all sectors is inconclusive (Martin et al 2012).

Emission trading systems can be an attractive policy instrument due to their flexibility and ability to facilitate the achievement of low-cost emission reductions. They must be carefully designed, however, to avoid pitfalls such as over-allocation, windfall profits, perverse incentives, and loopholes related to emission reduction measurements, reporting, and verification. As witnessed with HFC-23 credits, perverse incentives can also emerge with trading systems. Because of its high GWP of 14,800, significant carbon credits were earned through the destruction of HFC-23; yet the monetary incentive to destroy HFC-23 resulted in an increased production of HCFC-22 and thus, HFC-23 as a waste byproduct—an alarming situation since both product and byproduct contribute to global warming, in addition to ozone depletion from emissions of the product. While the utility of "emission" trading systems as a policy mechanism to address HFCs may be limited given that HFC emissions are not always immediate in the applications that use HFCs, trading systems relating to HFC imports and/or production may serve a similarly useful purpose.

Compliance Credits

The **United States** introduced a credit trading system that provides an incentive for the reduction of HFC emissions from vehicle air conditioning systems. Under the 2012 to 2016 Model Years Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy (CAFE) Standards, manufacturers are required to meet the first-ever national GHG emission standards under the Clean Air Act. The standards apply to new passenger cars, light-duty trucks, and medium-duty passenger vehicles, covering model years 2012 through 2016. The EPA GHG standards require these vehicles to meet an estimated combined average emissions level of 250 grams of CO_2 per mile in model year 2016, equivalent to 35.5 miles per gallon (mpg) if the automotive industry were to meet this CO_2 level solely through fuel economy improvements. The program includes a flexible component where manufacturers can meet the GHG emission standards through a system of averaging, banking, and trading (ABT) credits. One option for earning credits to comply with the new standards is reducing HFC emissions from the vehicle's AC system. For example, manufactures may earn credits by applying technologies that reduce the system's HFC refrigerant losses (i.e., system leakage), improve the system efficiency, or adopt a system that uses an HFC-alternative or an HFC with a lower GWP than HFC-134a (U.S. EPA 2012a).

Refund Programs

HFC reclamation is a complex, technical process that currently often involves costs that are higher than the cost of virgin gases. As such, refund system can help offset the relatively high cost of reclamation, and thereby create a financial incentive where one had not previously existed (Schwarz et al 2011). Refund programs can be applied in a number of ways—e.g., on products involving HFCs, as a subsidy for investing in new technologies, and payments for proper disposal at end-of-life. For example, Denmark, Norway, and Australia offer some type of refund or other incentive payment to encourage additional recycling and reclamation:

- **Denmark:** The first deposit-refund program covering HFCs was implemented in Denmark in 1992 (Schwarz et al 2011). In the Danish system, end users pay a fee for HFC refrigerants charged into equipment, of which certain shares remain with: 1) the service company to offset expenses for training and recovery equipment; and 2) the government to fund the program and refund the service companies when returning used HFCs and other controlled substances to a destruction or reclamation facility. The refunded amount depends on the purity of the recovered refrigerant (Schwarz et al 2011).
- **Norway:** In 2004, Norway introduced a refund system similar to Denmark's that also provides a refund at the time of destruction. However, unlike the Danish system, the Norwegian system refunds the amount paid in taxes to the license holder that imported or manufactured the HFCs (Norwegian Customs and Excise 2013). Although data on recovery of HFCs for reuse and recycling on-site are not available, preliminary data suggest a stable share of returned refrigerants for reclamation and destruction compared to refrigerant sales in Denmark (Schwarz et al 2011).[10]
- **Australia:** In May 2013, the Australian Government announced details of their Destruction Incentives Program. Instead of providing a deposit-refund as seen in Denmark and Norway, the Australian Government will provide an additional incentive payment of AUD 1.50 (USD 1.35)[11] per kilogram of HFC destroyed to refrigerant contractors starting in July 2013. This is an additional 50 percent to the AUD 3.00 (USD 2.70)[12] per kilogram payment by Refrigerant Reclaim Australia that operates the existing industry system.[13] Then, starting in July 2015, the Australian government will provide an additional destruction incentive and will increase the total amount paid to 70 percent of the equivalent carbon price.[14] The Destruction Incentives Program was designed to help Australia meet their commitments as signatories to the Montreal Protocol and the UNFCCC's Kyoto Protocol (Australian Government 2013b). Australia has also implemented an export refund system where importers who subsequently export HFCs and other SGGs may, in some cases, be able to claim a refund of the whole or part of the carbon charge component initially paid to hold an import license. Both of Australia's refund and incentive systems came into effect in July 2013, and therefore, information on the outcomes is unavailable at the time of this report (Australian Government 2013b).

Other smaller-scale initiatives have also come into effect, such as California's deposit system for HFC containers. In January 2009, the U.S. California Air Resources Board approved the mobile air conditioning (MAC) regulation to reduce emissions associated with the use of small containers—i.e., those that are charged with less than 2 lbs. of the automotive refrigerant HFC-134a. A recycling program for used containers was established requiring a USD 10 deposit for each container of HFC-134a at the time of purchase. When containers are returned within 90 days of purchase, the Board will refund the deposit (CARB 2013).

[10] Approximately three to five percent of synthetic refrigerant sales were returned for reclamation and destruction in 2010.

[11] Payment expressed in Australian dollars (AUD) and USD. The exchange rate applied is 1 AUD = 0.90 USD (August 2013).

[12] Ibid.

[13] Refrigerant Reclaim Australia is a private not-for-profit organization that was created by industry in 1993 to manage used refrigerants.

[14 The] equivalent carbon price is calculated by multiplying the quantity of HFC gas with its GWP by the carbon price (i.e., AUD 24.15 in 2013-2014).

Other Financial Incentives

The Netherlands has taken a different approach than the aforementioned, and promotes HFC-alternatives by providing subsidies to develop and introduce innovative energy –efficient low-GWP alternatives through the Reduction of Other Greenhouse Gases (ROB) program. In addition, they have been performing feasibility studies for the adoption of alternatives in the following applications: supermarkets; datacenters; ships; hospitals; refrigerated transport (trucks and vans); and the food industry (VROM 1999).

It is difficult to evaluate the effectiveness of different refund systems. HFC collection rates are hard to quantify because increases in HFC collection can be attributed to both government incentives (e.g., refunds and payments) and an increasing number of HFC-containing equipment reaching end-of-life.

3.3 Required Practices

Policy Mechanism: Required Practices

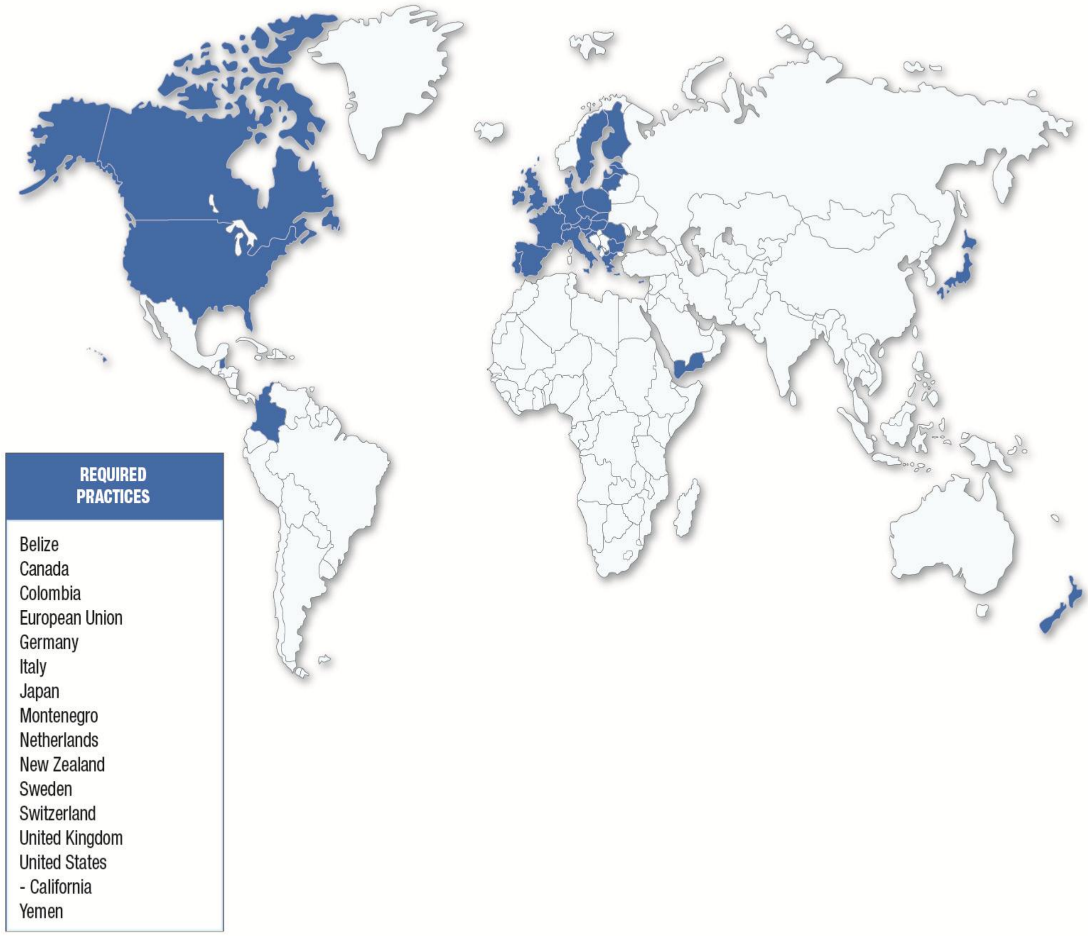
Policy Attributes:

1. Disposal, Recovery, and End-of-Life Management for HFCs and HFC Equipment
2. Leak and Emission Control
3. Training and Certification Requirements
4. HFC Container and Equipment Labeling Requirements
5. Installation and Plant Permits and Education

Notable Achievements and Observations:

1. As a result of accelerated efforts under the End-of-life Vehicle Law in Japan by companies within the Japan Automobile Manufacturers Association (JAMA), the End-of-Life (ELV) recycling rate for vehicles exceeded 95% in 2010, which increased from 80% in 2004
2. Entities within EU Member States that perform regular leakage check on the basis of technical standards, voluntary commitments, or legal obligations typically have higher compliance.
3. Approximately 43 percent of companies within the EU have met the EU certification requirements as of July 2011
4. Compliance can be a challenge; a lack of economic incentives for HFC recovery , a lack of proper and adequate resources such as training facilities, or language barriers are some of the noted reasons
5. Required practices can inspire voluntary action, as was demonstrated by the labeling requirement in the EC regulation

Figure 3-3. Map of Countries Implementing Required Practices



Eleven countries and the European Union have policies implementing a range of required practices pertaining to HFCs. Examples of required practices for HFCs include labeling requirements, training, certification, inspections, gas recovery during service and at end of life, and destruction. Required practices may also include the application of standards that are adhered to by the end-user, manufacturer, or other relevant entity. Many of the HFC policies include multiple required practices (e.g., disposal recovery and leak emission requirements).

3.3.1 Disposal, Recovery, and End-of-Life Management

Requiring proper end-of-life management for equipment containing HFCs (e.g., disposal, recovery) and for used HFCs (e.g., recycling, destruction) is a common feature in many HFC policies. Policies regarding end-of-life management of HFCs help reduce emissions of HFCs by ensuring that HFCs are not simply vented to the atmosphere during servicing or released during disposal. These policies can also lower demand for HFC production by recovering and recycling HFCs during servicing and disposal that can be used to charge and service other HFC equipment. Notable examples of policies are presented below.

- **European Union:** The EU Regulation (EC) No 842/2006 on certain F-gases requires recovery of HFCs from stationary refrigeration and AC equipment at end-of-life and recovery from mobile refrigeration and AC equipment to the extent that it is technically feasible and does not entail disproportionate cost (European Commission 2006). A review of the EU F-gas regulation in 2011 revealed a slight increase in recovered quantities of HFCs as a result of this requirement. Recovery, recycling, and destruction of HFCs as fire extinguishing agents was a required practice before the EU F-gas regulation was implemented, so there was no additional recovery, recycling, or destruction of HFCs in fire extinguishing as a result of the regulation (Schwarz et al. 2011).

- **Japan** has three HFC policies with provisions related to end-of-life management for HFCs, including requiring proper disposal of and recovery of HFCs contained in equipment (including MVACs) during servicing and end-of-life (Japan METI 2001, Japan METI 1998, Japan METI 2005). In response to Japan's End-of-Life Vehicle Law, Toyota was able to collect 705,000 vehicles for CFC/HFC recovery in 2007 (Toyota 2013). As a result of accelerated efforts under the End-of-life Vehicle Law by companies within the Japan Automobile Manufacturers Association (JAMA), the End-of-Life (ELV) recycling rate for vehicles exceeded 95 percent in 2010, which increased from 80 percent in 2004 (JAMA 2011).

The **Netherlands**, **Montenegro**, **Sweden**, the **United Kingdom**, the **United States** (and California), and **Yemen** also implement requirements for recovery and recycling or destruction of HFCs from refrigeration and AC equipment. In **Canada**, all but one province to-date has implemented recovery and recycling measures for HFC contained in equipment (Environment Canada 2013).

The extent to which recovery, recycling, and destruction as a required practice is an effective means to reducing the risk of HFC emissions is being examined. For example, a report evaluating the effectiveness of the EU F-gas Regulation found that a lack of economic incentives for HFC recovery from products and equipment, particularly for small companies, is a limiting factor in promoting compliance with HFC recovery and recycling requirements. Within the European Union, commitment from industry to remain compliant with the EU F-gas regulation is essentially the only driver in HFC recovery. As of July 2011, 23 Member States had notified the EU that they established rules regarding penalties for non-compliance at the national level (Schwarz et al. 2011).

HFC recovery in the EU, which falls on Member States, taxpayers, and end-users rather than HFC producers, may be more costly than previously realized and could be a contributing factor to lower compliance (EIA 2011).

Entities subject to HFC recovery or destruction requirements that send HFCs off-site could face challenges in sending HFCs to these facilities in a cost-effective manner, which varies depending on distance, quantity, and location (i.e., within or beyond state borders), which has been identified as a challenge for entities that collect ODS and send it off-site for destruction (ICF International 2008). An additional challenge for countries that send HFCs to other countries for destruction could be ensuring that the import and export regulations for all countries involved are adhered to (e.g., labeling requirements, import/export restrictions, hazardous waste restrictions) (World Bank 2010). For countries that have regulations on ODS recovery, there could be an opportunity for those countries to extend their ODS requirements to include HFCs, because reclamation and destruction of ODS and F-gases often take place in the same facilities or by the same companies. This could help countries promote HFC recovery and lower HFC emissions in a more feasible and cost-efficient manner than creating new HFC destruction facilities (Schwarz et al. 2011, World Bank 2010).

3.3.2 Leak and Emission Level Controls and Inspection

Leak and emission level controls are one of the most common HFC required practice mechanisms, as they allow entities to continue to use HFCs, but directly lower overall emissions from HFC equipment so countries can meet emission targets. Seven countries and the European Union have implemented 13 HFC policies that require that equipment of a certain size do not exceed a particular leakage rate and mandate regular leakage checks to ensure leaks can be quickly identified and repaired.

- **European Union:** As of July 2007, the EU F-gas regulation (EC No 842/2006) requires leakage checks once every three, six, or twelve months by certified personnel depending on the amount of HFCs contained in each piece of equipment. A 2010 questionnaire to different entities within the stationary refrigeration and AC sector revealed that major supermarkets, large commercial applications (e.g., hospitals and public buildings), and industrial applications (charge sizes from 3 kg to greater than 300 kg) are mostly compliant or more likely to comply with leakage checks. Compliance with leakage checks in private sector entities using large commercial applications vary, depending on whether other regular checks are compulsory. Smaller supermarkets and small commercial applications (charge sizes from 3 kg to more than 30 kg) are less likely to be compliant with leakage check requirements and generally perform limited regular checking of equipment (Schwarz et al. 2011). Entities within Member States that perform regular leakage checks on the basis of technical standards, voluntary commitments, or legal obligations (e.g., Germany and the Netherlands) typically have higher compliance. Industry stakeholders assume that the frequency of leak checks has increased to some extent since the F-gas Regulation came into full force but with considerable differences between Member States. Quantitative information supporting this assumption is not available (Schwarz et al. 2011).

For the fire protection sector in the EU, a comparably high level of compliance is reported; however, leakage checks have already been carried out for a long time on the basis of specific technical requirements (e.g., ISO 14520) and hence an increase of the frequency specifically caused by the F-gas Regulation is not observed (Schwarz et al. 2011).

The EU IPPC Directive (2008/1/EC) requires installations using HFCs to meet certain emission limit values based on best available techniques for the installation site. Approximately 50,000 installations are covered by the IPPC Directive within the metal production, chemical manufacture, poultry and pig farming, waste incineration, and large combustion plant sectors (Schwarz et al. 2011).

- **United States:** The U.S. CAFE Standards for 2012-2016 Model Years regulation requires improved leakage rates for HFC MVAC systems in these model years. EPA estimates, through utilization of leakage-reducing technologies, that it will be possible for manufacturers to reduce HFC leakage by 50 percent, relative to the 18 gram per year baseline level. Over the five model years at issue in this rulemaking, 2012-2016, EPA projects that 85 percent of entire fleet of light-duty vehicles will have gone through a redesign cycle. If the technology to control GHG emissions is efficiently folded into this redesign process, then by 2016 almost the entire light-duty fleet could be designed to employ upgraded packages of technology to reduce emissions of HFCs from their air conditioner (U.S. EPA 2010b).

Canada, **Colombia**, **Montenegro**, **New Zealand**, the **United States**, and **California** (United States) have limits and bans on the environmental releases from HFC equipment from particular sources and activities.

In general, emission reduction targets for larger equipment (with higher leak rates), can have a larger impact on overall national emission reduction, and entities employing large commercial refrigeration and AC equipment are more likely to perform leakage checks, as evidenced in the EU (Schwarz et al. 2011). Stakeholders and several non-government organizations (NGOs) recommend strengthening the containment and allowable emission rates under the F-gas Regulation, prompting a proposed addition to the EC F-gas Regulation that would set more aggressive emission reduction targets if implemented (European Commission 2012b, EIA 2011).

3.3.3 Training and Certification Requirements

Five countries implement training and certification requirements for handlers of HFCs and HFC equipment (e.g., persons involved in the maintenance, repair, and decommissioning of HFC products). Proper training and certification requirements for service technicians are intended to ensure that HFCs and HFC equipment are properly handled in order to minimize emissions during all stages of equipment life.

- **European Union:** The EU F-gas Directive (EC No 842/2006) identifies the personnel who have to be trained and sets training requirements for personnel to be certified to handle HFC equipment during manufacture, servicing, and disposal. Japan, Montenegro, and the U.K. also have similar requirements for service technicians and handlers of HFC equipment.

As of July 2011, there were approximately 230,000 personnel in the EU within the stationary refrigeration and AC sector who were subject to certification requirements, and approximately 48 percent were considered fully certified (only 15 Member States had a 50 percent or greater share of certified personnel). Of this total, 30,000 personnel could be certified without additional training, due to training and certification requirements already in place in some member states (i.e., Austria, Germany, Denmark, and the Netherlands) (Schwarz et al. 2011). Approximately 65,000 companies within the EU are subject to certification requirements, of which 43 percent have received certification as of July 2011 (Schwarz et al. 2011). In the Mobile Air Conditioning sector, 43 percent of 160,000 identified personnel had, by July 2011, been fully certified and within the fire protection sector, approximately 4,500 personnel are subject to the EU F-gas regulation's certification requirements, of which 24 percent had received certification as of July 2011 (Schwarz et al. 2011).

A lack of training facilities and providers and the time and effort to establish them has hindered some Member States' ability to meet the training and certification requirements of the EU F-gas regulation, particularly for smaller Member States. Meeting certification requirements within smaller sectors (e.g., fire protection) can also be burdensome, because there is lower demand for training. Additional issues with meeting training and certification requirements included language problems for certifications that take place abroad and insufficient transparency regarding certifications that were earned abroad (e.g., whether the certification truly meets the EU minimum requirements) (Schwarz et al. 2011).

- **United States:** Under the U.S. Clean Air Act Requirements for MVACs, there are Technician Training and Certification (TT&C) programs across the country that provide adequate training on the service and repair of MVACs and MVAC-like appliances, refrigerant containment, refrigerant handling equipment, refrigerant purity, environmental consequences of refrigerant release, adverse effects on stratospheric ozone layer depletion, and anticipated future technology developments in the MVAC sector (U.S. EPA 2012b).

Although meeting training and certification requirements may be considered burdensome for some companies, these requirements are necessary to ensure that HFC equipment is properly handled to improve leakage during servicing and promote efficient recovery, disposal, and destruction. For countries with current training and certification measures in place for technicians handling ODS, it may be a potentially easier transition for these countries to adopt HFC-focused training and certification policies because of the often significant overlap between the ODS programs and those for handling HFCs and HFC equipment (Schwarz et al. 2011).

3.3.4 Labeling

Three countries and the European Union have implemented labeling requirements as a part of their overall HFC policies. HFC equipment or container labels are used to raise awareness about the contents and quantity of HFCs within the product and to ensure that the equipment is properly handled (e.g., through handling instructions). HFC container and equipment labeling also allows customs, environmental inspectors, and suppliers to quickly identify the contained HFC and assess if it is subject to additional restrictions.

- **European Union:** The EU Regulation (EC) No 842/2006 on certain F-gases requires that all equipment containing HFCs must have a label identifying the HFC and the amount of HFC that they contain. The label must also state that the product or equipment contains a F-gas covered by the UNFCCC's Kyoto Protocol. Equipment that is not labeled per this requirement is not allowed to enter the market (European Commission 2006). Within the stationary refrigeration and AC sector (including heat pumps), these labeling requirements affect approximately 50,000 companies and approximately 100 F-gas suppliers (including suppliers of cylinders for fire protection) as of July 2011 (Schwarz et al. 2011). Currently an industry effort is underway to harmonize labels, particularly within sectors where products are marketed across Europe. Within the Member States of the EU, there is high compliance of labeling requirements for large manufacturers; however, some importers still remain non-compliant, which is likely due to lack of awareness of the labeling requirements. In addition, this aspect of the regulation has spurred a voluntary action among industry to label household products (Schwarz et al. 2011)

> In addition to generally high compliance, labeling requirements has spurred a voluntary action among industry to label household products. (Schwarz et al. 2011)

Montenegro's Law on Air Protection has the same labeling requirements as the EU F-gas regulation, and **Yemen's** Ozone Regulations require labeling of HFC equipment by importers (Montenegro EPA 2010). In the **United States**, small containers containing HFCs for MVAC refrigerants must be labeled in the states of **California** so that end-users know that it is illegal to destroy or discard the contents of the container. The labels also provide improved instructions for use (CARB 2012). California's labeling requirements for small containers of HFC-134a MVAC refrigerant are also anticipated to stimulate the transition away from HFC-134a to more sustainable options that are not subject to these stringent requirements (CARB 2013).

HFC equipment and product labeling may be considered burdensome to some entities (e.g., in the EU where there may be differences in labels or language barriers across Member States on equipment that is sold in multiple countries); however, this burden has encouraged entities within the EU to support adding improved labeling provisions to the EC F-gas regulation in order to improve their ability with the regulation (European Commission 2012b).

3.3.5 Miscellaneous

Some HFC policies have additional required practices that are less common, such as installation and plant permits and education programs, as highlighted below.

Installation and Plant Permits

The **European Union** has implemented two policies requiring permits for installations and plants. The EU ETS requires that all equipment within the energy; iron and steel production and processing; mineral and wood pulp; paper; and board industries are in possession of an appropriate permit. The permit must detail the installation, activities and technology used; materials used that could emit HFCs; sources of emissions; and measures planned to monitor and report emissions of HFCs (European Commission 2003). The EU's IPPC Directive requires that operators of these installations have an environmental permit that identifies the environmental performance of the plant (e.g., emissions to air, water and land; waste generation; energy efficiency) and an emission limit value based on the best available techniques for the plant (European Commission 2008). These permits help the EU track which installations are using HFCs and their emission rates to ensure that they are complying with relevant equipment or plant leakage restrictions.

Education

California implements a regulation that includes a requirement for an education program that is designed to emphasize best practices in vehicle recharging. Manufacturers and producers of HFCs and MVACs containing HFCs are responsible for developing education brochures for distribution to consumers through retailers and maintaining an informative website.[15] The brochures and website help inform consumers about the importance of reducing HFC emissions and use through enhanced leak repair and recovery. The content must include instructions on how to identify and repair system leaks, best practices, environmental hazards information, potential risks, and details about the HFC recycling program (CARB 2013).

3.4 Import/Export Licensing

Policy Mechanism: Import/Export Licensing

Policy Attributes:

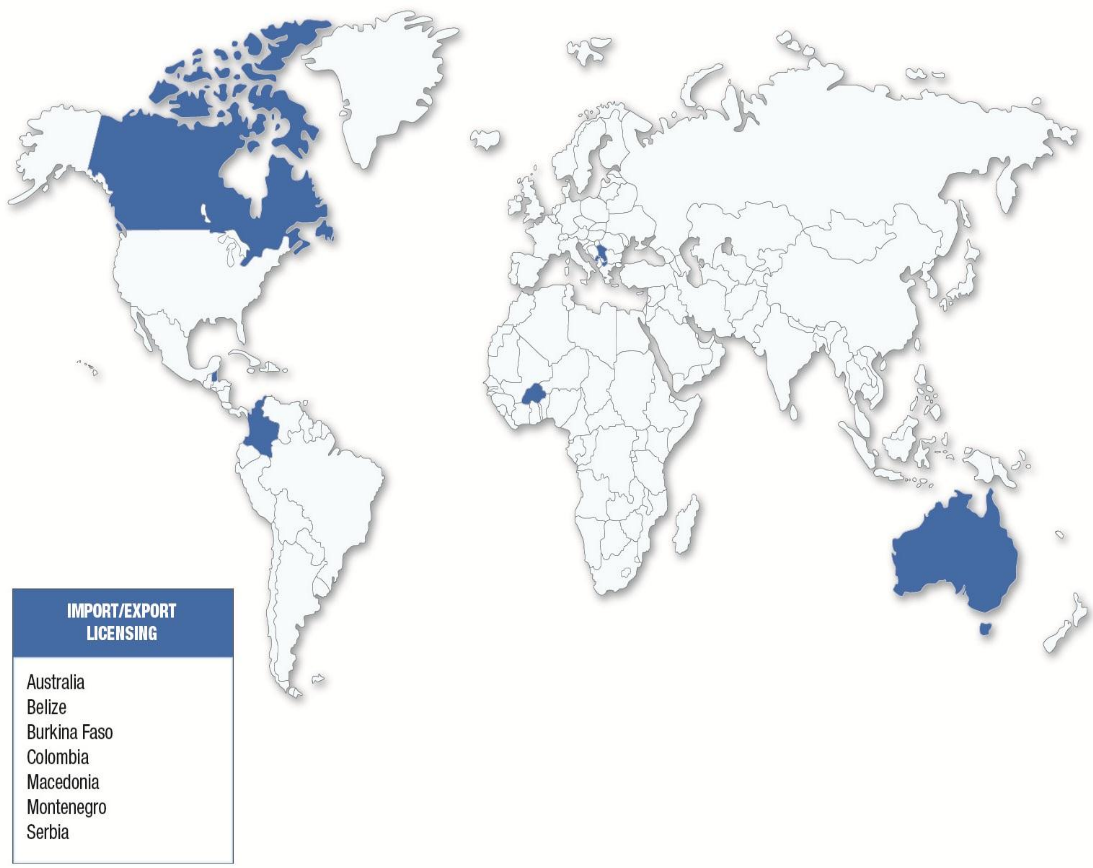
1. Countries issue licenses for importers and exporters of HFCs to manage and control the amount of HFCs entering the market

Notable Achievements and Observations:

1. The Australian Government had issued 900 importer licenses for equipment containing HFCs and other SGGs
2. Import licenses can be a method in which countries ensure compliance with HFC restrictions and prohibitions

[15] A sample HFC equipment label, brochure, and placard can be found at http://www.arb.ca.gov/regact/2009/hfc09/hfcappe.pdf.

Figure 3-4. Map of Countries Implementing Import or Export Licensing Requirements



Five countries implement regulations with requirements for licenses or permits for the shipment or manufacture of HFCs. These licensing requirements serve as a method for the governing agency to control the amount of HFCs entering into their market; penalize entities who continue to use HFCs; or to create incentives for entities to move away from HFCs. Australia and Montenegro have policies regarding import/export licensing as part of larger policies on HFC management and air protection.

- **Australia:** To help ensure Australia can meet its obligations under the UNFCCC's Kyoto Protocol, Australia's government extended their 1989 Ozone Protection Act in order to cover HFCs and other GHGs in December 2003. One objective of the Act is to minimize avoidable emissions of HFCs by regulating their import and export. The import and export of HFCs, and the import of certain products containing or designed to containing HFCs are prohibited without the proper license. The Act is projected to account for 3.5 million $MTCO_2$ eq. per annum of GHG abatement over the 2008 to 2012 Kyoto period and for 4.9 million $MTCO_2$ eq. per annum by 2020 (Australian Government 2013d). As of August 2012, the Australian Government granted approximately 900 equipment licenses for importers of products and equipment containing HFCs and other SGGs (Australian Government 2012b).
- **Montenegro:** As part of Montenegro's commitment to gradually reduce their consumption of HFCs, all imports and/or exports of HFCs must be approved by the Montenegro Environmental Protection Agency. Each individual shipment of HFCs must be approved separately.

Other countries that also require a license to import HFCs include **Colombia** and the **Republic of Macedonia**. **Canada** is considering adding an import/export licensing requirement for HFCs in the Canadian Environmental Protection Act.

Import and export licensing for HFCs and HFC equipment are an important feature of policies that aim to reduce the use of HFCs, and allow countries to control the amount of HFCs that are entering (or leaving) their market, particularly for countries that have additional limitations on the amount of HFCs that can enter their market.

3.5 Reporting/Recordkeeping Requirements

Policy Mechanism: Reporting/Recordkeeping Requirements

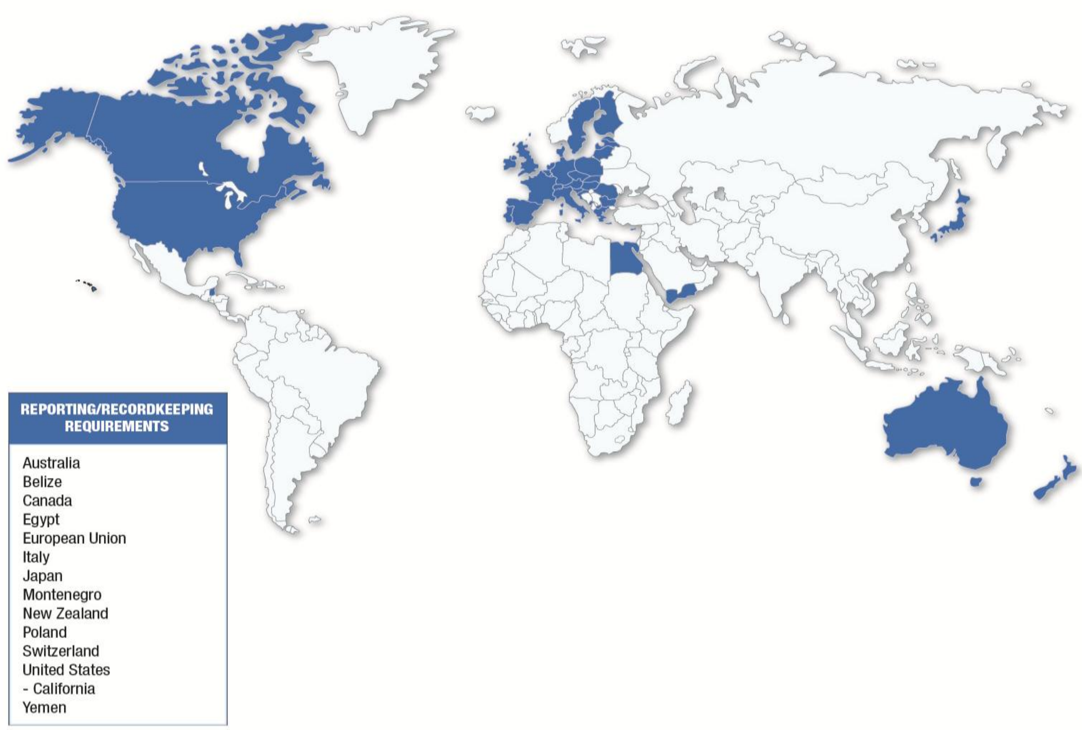
Policy Attributes:

1. Ensure implementation of HFC policy and track compliance
2. Track HFC equipment and products
3. Determine quantity of HFCs in market and annual emissions
4. Inform future policy, business, and regulatory decisions

Notable Achievements and Observations:

1. The United States and California use reported information to ensure that properly certified technicians are handling MVAC systems and HFCs in MVACs are being recycled
2. Between 40 and 80 percent of larger industries, supermarkets, and other operators of large commercial equipment keep records on HFC installations in the EU
3. In 2011, 54 facilities reported a total of seven million $MTCO_2$ eq. in HFC emissions under the U.S. Greenhouse Gas Reporting Program

Figure 3-5. Map of Countries Implementing Reporting or Recordkeeping Requirements



Nine countries and the European Union implement reporting and recordkeeping requirements for HFCs, which require entities to document and report on the import, consumption, destruction, or other activity involving HFCs to their governing agency. Reporting and recordkeeping requirements are an important piece of many HFC policies. The information collected and recorded can be used to ensure other aspects of a policy are being implemented correctly (e.g., reporting and recordkeeping of service technician certifications); to develop a database of information on products and equipment containing HFCs for use in potential future HFC reduction policies; or to provide method in which to track or estimate the amount of HFCs emitted to the atmosphere or entering the market place (e.g., reporting emissions, imports, exports, production, or destruction of HFCs).

3.5.1 Reporting/Recordkeeping to Implement HFC Policies

Three countries or regions have implemented reporting and recordkeeping regulations as a method to either implement an HFC policy or ensure that the HFC policy is properly implemented, including New Zealand Emissions Trading Scheme (NZ ETS), the EU Emissions Allowance Trading Scheme (EU ETS), the U.S. Clean Air Act Section 609 Requirements for Motor Vehicle Air Conditioning, and California (United States) Regulation for Small Containers of Automotive Refrigerant. Both New Zealand and the EU's HFC Emissions Trading systems require reporting and recordkeeping as a method to track HFC emissions and determine each entity's eligibility for emission allowances for trading.

- **New Zealand:** In New Zealand, all importers and manufacturers of HFCs (operating as of January 1, 2013) are mandatory participants in the NZ ETS. Exporters and destroyers of HFCs can participate in the ETS voluntarily (Government of New Zealand 2013c).
- **European Union:** In the EU, each installation covered by the EU ETS must have a permit outlining the operator's plan to monitor and report emissions, and operators must report their verified emissions of HFCs after each calendar year. As of 2009, 11,000 installations in the EU are included in the EU ETS (European Commission 2009).
- **United States:** Both the U.S. Requirements for Motor Vehicle Air Conditioning and the California HFC Regulation for Small Containers of Automotive Refrigerant require reporting and recordkeeping as a method to ensure that entities are implementing all aspects of the regulation. The United States requires all MVAC service shops to submit to EPA information indicating that they have approved HFC recovery and recyling equipment and maintain on-site records of the name and address of the reclaimer where recovered HFC refrigerant are sent (U.S. EPA 1997). California's policy requires recycling of HFCs in MVACs; to track this element of the policy, manufacturers, distributors, retailers, and recyclers also must report sales data, number of returned containers (as part of a deposit program), and amount of refrigerant recycled annually. In addition, manufacturers must submit an application to the California Air Resources Board in order to certify products for sale. The program has a target recycle rate across all small automotive refrigerant containers of 90 percent, which increases to 95 percent starting January 1, 2012 (CARB 2013). Both governing agencies use the information reported under these two HFC policies to ensure that properly certified technicians are handling MVAC systems and HFCs in MVACs are being recycled.

The reporting and recordkeeping aspect of these regulations provide countries with a mechanism to improve tracking compliance and implementation of these policies and, in the case of the NZ ETS and EU ETS policies, entities would not be able to properly track their emissions and uses of HFCs in order to participate in the trading systems without reporting and recordkeeping.

3.5.2 Reporting/Recordkeeping to Track HFC Equipment and Products

In 2007, seven of 76 companies, and in 2008, 25 of 80 companies, represented more than 95 percent of the total HFC sales to the EU market. The remaining companies accounted for less than five percent of sales and exports (Schwarz et al 2011).

Three countries and the EU have regulations requiring operators of equipment or products containing HFCs to report and maintain records of on operations performed on equipment (e.g., installation, servicing, leak checks, or decommissioning) or the total quantity of HFCs being used (e.g., added to the equipment or recovered from the equipment). Information gathered from these HFC records can be used to develop a national inventory or develop estimates of national banks of HFCs and other GHGs.

- **European Union:** The EU F-gas Regulation (No 842/2006) requires recordkeeping of HFCs and other F-gases installed, added or recovered during maintenance, servicing and final disposal. In preparation for an evaluation of the EC F-gas Regulation, a survey of stationary refrigeration and AC industry members in early 2010 revealed that the frequency and quality of recordkeeping varies strongly by type of company and region. Supermarket operators, major public institutions (e.g., hospitals), and larger industries (e.g., chemicals, pharmaceuticals, cold storage) are more likely to keep logbooks about their installations, whereas smaller supermarkets, light commercial equipment owners (e.g., bakeries, restaurants), and office buildings are significantly less likely (Schwarz et al 2011). Between 40 and 80 percent of larger industries, supermarkets, and other operators of large commercial equipment keep records on HFC installations, whereas the percentage of small commercial equipment operators keeping records was reportedly much lower (Schwarz et al. 2011).

  Reported data in the EU is providing useful trend information regarding market size and representation of market players; although many smaller companies are less likely to comply with reporting obligations, given the results from the data collected and reviewed, it can be concluded that their activities are not significantly contributing to total sales and emissions of HFCs in the EU (Schwarz et al 2011). However, other trends on smaller companies could be gleaned if the compliance rate from this segment of the industry was higher.

- **Poland:** In Poland, starting in 2014, operators must report on any operation performed on equipment (e.g., installation, servicing, leak checks, decommissioning) and reasons for leaks. These HFC reports will be used to compile a central database of all stationary refrigeration and AC equipment with charges greater than three kilograms. In this way, it is possible to determine the refrigerant bank in the country (Schwarz et al 2011).

- **United States:** In California, the SEMP Regulation requires reporting and recordkeeping through submitted reports or through the “Refrigerant Registration and Reporting” (R3) tool. The R3 tool is intended to lessen the burden of reporting, because it saves time by saving previous entries so entities do not have to re-enter company information. Information on the R3 tool is also available to the public,[16] and Air District Inspectors within California can access the R3 tool to record facilities inspections (CARB Undated).

In general, policies that include reporting and recordkeeping requirements for HFC equipment and products can be used to generate national inventories of equipment and track the implementation of inspection requirements or leakage rates. Some entities are suggesting that established monitoring and more consistent enforcement are necessary for higher compliance of reporting and recordkeeping requirements; whereas some organizations believe that the best way to lessen the burden of reporting and recordkeeping requirements is through sectoral bans on HFC use (European Commission 2012b).

3.5.3 Reporting/Recordkeeping of HFCs in Market and Emissions

This initial effort has identified seven countries that implement reporting and recordkeeping requirements for suppliers of HFCs (i.e., producers, importers, or exporters), including Japan, Canada, United States, Montenegro, Switzerland, Poland, and Yemen. Three of these countries require annual reporting of emissions and supply activities (i.e., production, imports, or exports) from entities that meet a certain threshold (e.g., facilities in Japan must reach an emissions threshold of 3,000 $MTCO_2$ eq. across all GHGs and must have at least 21 employees in their overall business). Data reported to the United States and Canada is intended to be used to inform future policy decisions related to HFCs. Governing bodies in Japan and the United States make some reported information available to the public in order to raise awareness of HFC consumption and emissions.

- **United States:** Under the U.S. Greenhouse Gas Reporting Program (GHGRP), all suppliers of HFCs that reach a certain emissions threshold are required to report their supply activities via an online tool[17] (U.S. EPA 2010c). The purpose of this program is to allow the U.S. EPA to better understand the sources of HFCs (and other greenhouse gases) and to help inform future policy, business, and regulatory decisions. Aggregated HFC emissions data are also available

[16] R3 Tool available at https://ssl.arb.ca.gov/rmp-r3/.

[17] The electronic greenhouse gas reporting tool (e-GGRT) is available at: https://ghgreporting.epa.gov/ghg/login.do, and publicly reported data is available at: http://ghgdata.epa.gov/ghgp/main.do.

to the public. In 2011, 54 facilities reported a total of seven million $MTCO_2$ eq. in HFC emissions (U.S. EPA 2013c).

- **Canada:** Similar to the United States, Canada has required annual reporting of releases of HFCs from large industrial and commercial facilities (above a certain threshold) since 2005 for the purposes of conducting research, creating an inventory of data, formulating objectives and codes of practice, and issuing guidelines or assessing or reporting on the state of the environment (Environment Canada 1999). Japan has required that entities report annual emissions of HFCs (above a certain threshold) since 1998. The purpose of this program is to encourage entities to reduce their use of HFCs by promoting awareness of their annual emissions across all greenhouse gases.

Additionally, four countries require recordkeeping and reporting on HFC supply activity without meeting a certain threshold. For example, **Poland** requires entities that import or export; use; recover, recycle, reclaim, or destroy; and manufacture, import, or export products and equipment containing HFCs to report annually on information on installation, leakages, leakage checks, decommissioning, imports, exports, etc. Reports are submitted to Poland's Ministry of the Environment. Aggregated data, including data on total quantities and types of HFCs imported/exported annually and total emissions from a particular type of equipment will be made available for entities who submitted data. In addition, reported data may also be used to inform a national F-gas emission inventory for Poland (Schwarz et al. 2011).

4 Other HFC Initiatives

In addition to regulatory frameworks to address HFCs as discussed in Section 3, a growing number of non-policy initiatives targeting the reduction of HFC consumption and emissions are underway involving governments, the private sector, or both. Several existing multilateral environmental agreements (MEAs) and international organizations are being used to elevate the concerns associated with growing HFC emissions. At the international level, groups such as the Climate and Clean Air Coalition (CCAC) are forming to raise awareness, support emission reduction activities, promote best practices, and improve scientific understanding of short-lived climate pollutant impacts. At the national level, eligible developing countries are receiving assistance through the Multilateral Fund for the implementation of the Montreal Protocol (MLF) to implement HCFC phaseout projects. In preparing their HCFC Phaseout Management Plans (HPMP), many countries have made a conscious effort to design their projects to avoid using high GWP GHGs, including HFCs. At the industry level, there are HFC reduction activities occurring at many different scales. Industry activities include public-private partnerships, cross-industry forums, company policies, corporate pledges, and single pilot projects.

Multilateral Environmental Agreements

MEAs and other initiatives undertaken through international organizations can serve as a platform from which countries can collectively recognize the climate concerns related to forecasted HFC growth and serve as forces of action either through binding commitments or facilitating funding, or other means. MEAs, studies, declarations, and/or international organizations that have addressed HFCs to-date include the UNFCCC and its Kyoto Protocol, the Montreal Protocol, the UN Rio +20 process, the International Maritime Organization GHG Study, and the Arctic Council (Kiruna Declaration). Notably, countries are continuing to collaborate on joint proposals to amend the Montreal Protocol to address HFCs through a global phasedown in their production and consumption. In April 2013, the governments of Canada, Mexico, and the United States, along with the Federated States of Micronesia, submitted proposals to phaseout HFCs under the Montreal Protocol. Since the end of 2011, over 100 Montreal Protocol Parties have signed a declaration to address HFCs under that treaty. The North American and Micronesia proposals will be discussed at the Meeting of the Parties to the Montreal Protocol in October 2013.

Additionally, under the Montreal Protocol, the MLF has supported developing countries in the implementation of HCFC phaseout projects designed to avoid using high GWP GHGs, including HFCs. To support the transition to low-GWP alternatives, the MLF allows additional funding up to a maximum of 25 percent above the cost effectiveness threshold for projects that introduce low GWP alternatives. To date, 294 HPMP and HCFC phaseout project preparation activities have been approved for 144 eligible countries (UNEP 2013b). Within those HPMPS, 41 of 43 Article 5 countries with rigid PU foams producers have opted to convert from HCFCs to non-HFC alternatives. Six countries also included projects for adapting locally-owned systems houses for manufacturing non-HCFC 141b pre-blended polyol systems and, through them, converting large numbers of downstream foam enterprises (Ganem 2013). To date, these projects have been aimed largely at avoiding HFCs in the foams, refrigeration, and AC sectors. In addition, the MLF has sponsored a number of low-GWP pilot programs. Several valuable case studies and examples of successful demonstration projects are resulting in developing countries, a promising signal that a direct transition to climate-friendly technologies or alternatives are currently possible in some sectors, and may be feasible soon in many more.

Partnership Programs

Partnership programs unite stakeholders within an industry and provide a forum for collaboration on an issue or topic (i.e., HFC emissions reductions). Unlike national policies, partnership programs are voluntary, and while program effectiveness is monitored by some entity, it is driven by the membership. Partnership programs offer an opportunity to actively engage industry members in decision-making, reduction activities, and knowledge-sharing. GreenChill and the Responsible Appliance Disposal (RAD) Program are two prominent partnership programs that have made significant HFC reductions in the United States.

The GreenChill Partnership program is a government-industry partnership that works to reduce refrigerant emissions through the promotion of alternative refrigerants; reduction in charge sizes and leak rates; and the adoption of advanced technologies, strategies, and practices. The Partnership, established in 2007, has grown to 54 members, making up over 20 percent of U.S. supermarkets across all 50 states and the District of Columbia (EPA 2013a). In 2011, 4.12 million $MTCO_2$ eq. of HFCs were avoided as a result of the Partnership (EPA 2013a). Transparency of emissions reductions and alignment with business objectives are two key elements to GreenChill's success. The Partnership supports quantifying emission reductions and measuring successes against an industry standard. GreenChill actively recognizes any achievements, thus providing Partners with opportunities for both environmental and publicity benefits.

EPA's RAD Program was established in 2006 to promote the recovery, reclamation, or destruction of refrigerants from appliances; the recovery and destruction of foam and foam blowing agents; metal recycling; and the recovery and disposal of PCBs, mercury, and used oils. RAD, like GreenChill, is a voluntary government-industry partnership and includes 43 utilities, four retailers, one manufacturer, and two state affiliates. The RAD Program focuses on knowledge sharing and partnership rather than quantification of reductions; program activities include facilitating discussion amongst partners to share best practices, obstacles, and lessons learn; enhancing partnerships between RAD utilities, retailers, and manufacturers; and innovative publicity campaigns. Appliance recycling programs covered by RAD utility partners covered a territory of 30.7 million households across 26 states, equivalent to approximately 26 percent of U.S. households (EPA 2013b). In 2011, RAD Partners collected and processed 890,473 appliances (EPA 2013b). From these appliances, Partners reclaimed or destroyed 146,722 $MTCO_2$ eq. of HFC-134a and 2,850 $MTCO_2$ eq. of HFC-245fa (EPA 2013b). As more appliances using HFC-refrigerants or foams come to end-of-life, the RAD program can continue to reduce loss of gas to the atmosphere through the extensive reach of its partnership program.

Nationally Appropriate Mitigation Action (NAMA) Strategies

Some countries have introduced efforts to promote energy efficiency and low or no-GWP refrigerants in their Nationally Appropriate Mitigation Action (NAMA) strategies. The concept of NAMAs was introduced at COP13 in the Bali Action Plan as: "nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner." In particular, Mexico and Thailand are developing HFC-specific activities in their NAMA strategies.

Mexico is in the preliminary stages of coordinating and implementing a Domestic Refrigerator NAMA that will control HFC emissions by recovering and destroying refrigerants during the decommissioning of old refrigerators. Within a five-year timeframe, the NAMA aims to phaseout HFC-based technology and replace 100 percent of Mexico's domestic market with HFC-alternative, energy efficient technology (i.e., 2.4 million units). This NAMA has the potential to mitigate approximately two million $MTCO_2$ eq.—63 percent of which could be attributed to replacing HFC-134a (DNV Kema 2013).

The Thailand Greenhouse Gas Management Organization, with support from GIZ PROKLIMA, has successfully completed a baseline study on the inventory of HFCs in Thailand (Geiss 2012; Prapaspongsa 2012). The completion of the study marks the first time that such a comprehensive database was established for the Thai refrigeration and air conditioning sector. Currently, the Thai-German initiative is working to develop a NAMA focusing on the refrigeration, air conditioning, and foam blowing sectors (German International Cooperation).

Corporate Responsibility Efforts

Several corporations are integrating HFC initiatives into their sustainability strategies. Companies are not only recognizing the potential climate impact of HFCs but are anticipating future HFC regulation and increasing customer concern, and thus are responding proactively. Many different types of corporate initiatives have emerged, including the introduction of new low-GWP alternatives, non-HFC pilot programs, equipment replacements, voluntary reduction targets, and research. Several advancements in new climate-friendly technologies have been made through corporate initiatives. Such technologies include those that reduce HFC charge sizes and/or leak rates, as well as those that fully replace HFCs with lower GWP substances—while preserving or improving life-cycle energy efficiencies.

In particular, the beverage industry, including corporations such as the Coca-Cola Company, PepsiCo, Heineken, and Red Bull, provides an example of private enterprise driving the transition to non-HFC refrigerant alternatives. The Coca Cola Company is a multinational corporation that offers over

3,500 products in almost every country in the world[18] (The Coca-Cola Company 2013; Hebblethwaite 2012). In 2009, Coca-Cola announced that 100 percent of their new vending machines and coolers would be HFC-free by 2015. In 2011, the Coca-Cola Company adopted CO_2 as the non-HFC refrigerant of choice. The company signed a CO_2 compressor supply contract with Sanden Japan to purchase 1.1 million compressors (The Coca Cola Company 2013). This type of contract not only commits Coca-Cola to CO_2 technology but also provides a signal to equipment producers that there is a shifting preference within the refrigeration market, thus potentially increasing the availability of these alternative technologies. Increased production of CO_2 compressors can also result in lowering the cost of the equipment, thereby providing an additional incentive for conversion. As of April 2012, 600,000 units with HFC alternatives have been installed world-wide (Mate 2012).

Potential Market Impact

The Coca-Cola Company accounts for over 10.5 million dispensers, vending machines, and coolers in the marketplace worldwide. Coca-Cola estimates that over 52.5 million $MTCO_2$ eq. of emissions could be saved as a result of HFC phaseout efforts (The Coca Cola Company 2013).

PepsiCo, the main competitor to the Coca-Cola Company, is transitioning towards CO_2 and hydrocarbon refrigerants in their equipment. PepsiCo cites that the migration of other industry members towards green refrigerants as one of the reasons why the company is shifting towards non-fluorinated alternatives (Jafa 2012). Thus far, PepsiCo has had pilot projects for climate-friendly technologies in Turkey, Russia, United States, Canada, and several other emerging markets (Jafa 2012). As of April 2012, Pepsi had installed nearly 150,000 climate-friendly coolers and vending machines in 24 different countries (Mate 2012; Jafa 2012).

Heineken and Red Bull are two other beverage companies that have made significant changes to their equipment fleet. Heineken, in attempts to reduce its carbon footprint, began installing hydrocarbon refrigerant bottle coolers on a global scale. In 2010, Heineken sourced approximately 130,000 hydrocarbon coolers with higher energy efficiency features (Mate 2012). These efforts are expected to save the company 30 percent in energy expenditure (Mate 2012). Red Bull has begun to replace their HFC coolers with hydrocarbon ECO-Coolers. ECO-Coolers consume up to 45 percent less energy than previous generations of cooling equipment (Red Bull 2013). As of 2012, 313,000 ECO-Coolers were installed worldwide, the equivalent of 35 percent of Red Bull's entire cooling fleet (Red Bull 2013; Mate 2012). In both these cases, companies experienced both environmental and bottom-line financial benefits, making for a stronger case for non-fluorinated alternatives.

The leading companies in the beverage industry have set ambitious goals to transition to non-HFC technologies within the next few years, setting a new environmental standard within the industry and influencing competitors to transition technologies as well. Multinational companies have wide market penetration and thus can also introduce new technologies in different global regions. Non-HFC vending machines and coolers can be introduced to developing countries before the country's government may implement policies on the issue.

Lessons Learned: Transitioning to Non-HFC Technologies

Emad Jafa, Director of Global Research and Development at PepsiCo, highlighted some key lessons learned from transitioning to new refrigerant technologies (2012):

- Building non-HFC infrastructure in one country and expanding to other countries in the region may be more efficient.
- Introducing non-HFC technologies in Europe first is easiest due to the existing knowledge and available technology.
- Establishing alliances between suppliers is important for knowledge sharing about new technologies.
- Working with business units and bottlers to neutralize cost and optimize systems during the design process helps build a business case for HFC alternatives.

Industry Initiatives

In addition to private sector initiatives taken on by individual companies, industry programs exist that bring together corporations from around the world. The primary purpose of these initiatives is the mobilization of businesses through knowledge sharing and support. Two examples of these industry initiatives are *Refrigerants, Naturally!* and the Consumer Goods Forum (CGF). *Refrigerants, Naturally!* is a global initiative of corporations that are working towards replacing fluorinated gases such as HFCs, in commercial and industrial point-of-sale cooling applications[19] with non-fluorinated alternatives. Current members include Coca-Cola, Unilever, PepsiCo, and Red Bull, with support from UNEP and Greenpeace. Member companies have been replacing their equipment with high-efficiency units utilizing non-fluorinated alternatives such as CO_2 and hydrocarbons (e.g., Unilever's hydrocarbon ice cream freezers). Each member company commits to sharing progress, technology, and technical information about alternative refrigeration with other partners, and works with NGOs and multilateral organizations to promote safe alternatives and provide a platform in communicating with the refrigeration technology supply chain, other users, governments, and civil society (Refrigerants, Naturally! 2013).

The Consumer Goods Forum (CGF) is a newer and much larger initiative. Created in 2009, the CGF now consists of more than 400 retailers, manufacturers, service providers, and other stakeholders with combined sales of €2.5 trillion (CGF 2012). The CGF has committed to "mobilize resources within our respective businesses to begin phasing out HFC refrigerants as of 2015 and replace them with non-HFC, non-florinated refrigerants where these are legally allowed and available for new purchases of point-of-sale units and large refrigeration installations" (CGF 2012).

The Global Reach of Unilever

Unilever has placed over one million hydrocarbons coolers in Europe, Latin America, and Asia to date. Unilever also uses ammonia in the majority of their production facilities and cold stores worldwide (Refrigerants Naturally! 2013).

These industry initiatives demonstrate similar themes as both the partnership programs and the individual corporate initiatives: knowledge sharing amongst stakeholders; non-HFC technology promotion; and the possibility of introducing new technologies globally. These forums encourage the sharing of lessons learned amongst peers, which can expedite the transition to non-HFCs by helping companies identify the most viable and efficient approaches to take. *Refrigerants, Naturally!* and the CGF also have large, multinational memberships; unlike policies for single countries, these forums can result in the proliferation of non-HFC technologies in multiple countries at once.

[19] Point-of-sale cooling may include the entire retail infrastructure (e.g., HVAC), but excludes manufacturing and distribution (Refrigerants, Naturally! 2013).

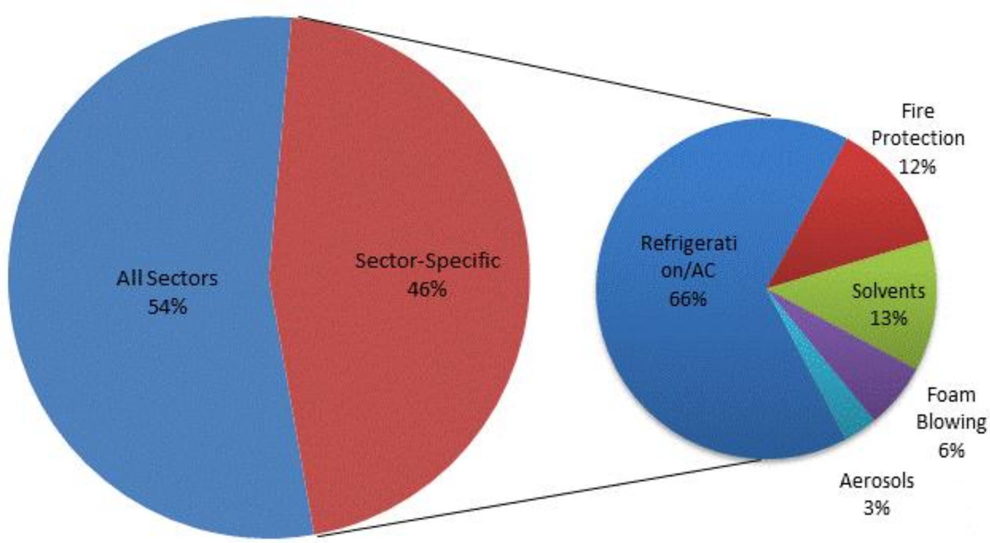
5 Conclusion

A number of common themes and key takeaways were identified in the review of HFC policies and other initiatives; as summarized in this section. Most notably, **significant action to address HFCs is taking place in every region of the world.** This action includes the establishment of national policies, corporate initiatives of national and multinational corporations, and conversion of HCFC-reliant firms in a manner designed to bypass the use of high-GWP HFCs.

With regard to policy action, general conclusions and observations include:

- **Countries are shaping their policies to address their specific circumstances and, as a result, there is no one size fits all policy or policy mechanism.** On the other hand, the diversity of interventions presented in this analysis allows countries to consider a range of options for implementation for a specific policy. The instruments identified within existing HFC policies included in this report vary in their objectives and scope. In some instances, policies are directed toward a certain industry sector or a specific application. Of the 48 existing HFC policies, slightly more than half cover all HFC consuming sectors while the remainder target specific industries, as illustrated in **Figure 5-1**.

Figure 5-1. HFC Policy Coverage by HFC-Consuming Sectors (Percent)[a]



[a]The smaller pie chart represents the coverage of HFC-consuming sectors by the sector-specific policies; a single sector-specific policy may cover multiple HFC-consuming sectors while still not covering all sectors.

The U.S. passenger light-duty vehicles fuel economy and GHG emissions, for example, can be met through HFC compliance credits earned by applying technologies that reduce the system HFC refrigerant losses (i.e. system leakage), improving the system efficiency, or adopting a system that uses an alternative to HFCs that have a lower GWP. Other policies may be directed more broadly. The preferred type of action may depend on various national and/or regional factors and the challenges faced in the various sectors. That said, the review of policies so far identified suggests that countries have found it useful to impose regulations in a gradual or phased manner or with exceptions (e.g., exempting a certain end-use application from the restriction). Such a phased approach may provide transition time to help to overcome potential barriers of implementation. In addition, policy instruments that work well in some countries or regions may not work well in other countries or regions. Countries must consider what instruments would align well with their existing policies, programs, and stakeholders. Other considerations that may limit the transferability of one country's experience to another country include differences in political systems, availability of resources, geographical factors, technological infrastructure, and economic variables.

- **HFC policy design typically covers other F-gases and may expand on existing ODS regulatory frameworks.** Countries have found that they can leverage the lessons learned from implementing ODS legislation. Several countries have consequently expanded key features of their ODS policy to serve as a good framework for developing HFC policy. Additionally, several HFC policies are actually policies related to all F-gases (e.g., PFCs, SF_6). For example, in 2003, Australia extended their Ozone Protection Act of 1989 to cover HFCs and other GHGs.

- **Multiple policy instruments can be used in concert to achieve emission reduction objectives.** A survey conducted in the EU suggests that there is no simple solution in the form of a single policy option that can address the complexities of the different sectors and applications. Rather, an appropriate mix of policies may be the best way forward (European Commission 2012b). Measures such as bans, taxes, or trading programs are most commonly used in regulating consumption and emissions; however, when used together, or supplemented with other policy instruments such as recordkeeping and reporting or certification or training program requirements, governments are better positioned to track progress and to ensure that the right practices to support the overall policy's objectives are in place. In addition, some countries implement policies with multiple mechanisms that work in parallel to cover a larger portion of the overall HFC market. Denmark's F-gas regulations include taxes, regulatory bans, and participation in the EU ETS.

- **Before and during policy implementation, several program analyses provide estimates of the reduction potential to be achieved through the effective implementation of HFC policies.** The proposed HFC tax in Sweden, for example, is expected to decrease HFC emissions by approximately 100,000 MT CO_2 eq. by 2020 (Swedish Ministry of Finance 2009).

- **Evaluating the extent to which HFC emissions are avoided or consumption is reduced as a result of the implementation of specific policies can be difficult to ascertain.** Achievements may be masked if aggregated with other results of the policy (e.g., other F-gas reductions or increases) or the results of other policies affecting the same gases. In some cases, the emissions reductions are simply not quantified. In other cases, the policies designed by some countries have not included a method to measure results (e.g., monitoring data) in terms of avoided emissions or consumption; in other cases, the related requirement may be too nascent for such achievements to be quantified. Projected reductions are more common as a result of benefit-cost analysis prior to policy implementation.

- **Industry compliance and government enforcement is a common challenge associated with existing HFC policies.** Compliance is particularly challenging for policies that require potentially costly action without providing funding or other incentives. For example, the European Union requires, but does not offer, economic incentives for the recovery and destruction of HFCs. Accordingly, as long as HFCs cost less than the cost of recovery and destruction, compliance will require additional industry expenditures which some companies may find difficult to absorb or to pass on to consumers. This may prove an additional burden for entities, particularly smaller companies, to achieve compliance (Schwarz et al. 2011). Creating incentives for industry that support behavior change is shown to be highly effective as illustrated in Denmark, Australia, and Norway. Compliance also can be challenging for smaller companies or industries given limited resources or general lack of awareness. Furthermore, a lack of government enforcement can also be a challenge for ensuring compliance with HFC policies. In the European

> The EU F-gas regulation has labeling, reporting/recordkeeping, leak inspection, recovery, and certification requirements to ensure that HFCs and HFC and emissions are regulated throughout the entire lifetime of equipment.

Union, Member States are responsible for establishing their own penalties, but only 23 Member States had established penalties in place as of July 2011 (Schwarz et a. 2011). Government enforcement and other administrative oversight may be inadequate because of resource constraints.

Although numerous governments are taking action against rising HFC consumption and emissions through the implementation of these policies and regulations, there is still a significant amount of work that could be done in order to achieve a complete phaseout of HFCs. In fact, governments and industry are acknowledging that existing policies are not sufficient. According to an EC study, 84 percent of stakeholder respondents found that the current status quo of implementing the existing EU regulation on F-gases was not sufficient. Representatives of the refrigeration and air AC sectors, gas manufacturers and equipment manufacturers expressed the need for further legislative action, while those in the fire protection, aerosols, mobile air AC and transport refrigeration sectors, and contractor associations believed that better implementation would suffice (European Commission 2012b).

Several common themes and observations also emerged from this review of non-policy initiatives, as summarized below:

> Companies with initiatives have an interest in quantifying their reductions so that achievements can be demonstrated to the public and to shareholders.

- **Quantitative results are available from voluntary HFC initiatives.** Partnerships such as the U.S. GreenChill and RAD programs have successfully documented key performance metrics (i.e., number of participating entities, HFC reductions, and market penetration) over time; this allows the program to assess the impact of its initiatives and justify the investment of resources into program activities. Given that stakeholders voluntarily elect to join Partnerships and are engaged in the program, information for partnership programs may be easier to obtain than for regulatory mechanisms. These achievements communicate corporate responsibility and company action in anticipation of future regulatory requirements. Additionally, governments wish to present accomplishments to underscore the value of these programs and the need for their continued funding.

- **Non-policy initiatives such as implementation of projects designed to obviate the need for HFCs are widespread and are having an impactful change in developing countries.** Many corporations have adopted company policies or initiatives to transition to climate-friendly appliances and technologies. A multinational company's decision to adopt non-HFC technologies within its operations will result in the implementation of these technologies in many countries, both developed and developing. Hence, corporate decisions can accelerate the introduction and potential adoption of lower-GWP compounds and foam blowing agents in regions where national HFC policies may not exist yet. MLF demonstration projects and MLF projects which receive incentive funding for selecting low GWP options, are helping to demonstrate the viability of low GWP options in most developing countries. As these projects become more widespread, they can also spur government policies to require all users to convert in order to help level the playing field. **Corporate-based initiatives can create a competitive edge fuel further action.** When a multinational corporation such as Coca Cola introduces a pledge to transition their vending machines to environmentally friendly HFC alternatives, a ripple effect is felt not only within their own industry (as was demonstrated with subsequent action taken by their largest competitor PepsiCo) but also in other markets that realize the benefits of leading by example. Company actions serve as market signals and mobilize further action. Industry groups such as CGF and *Refrigerants, Naturally!* are evidence of the rapid progression of corporate initiatives; their formation are in response to a need to provide a forum for technological information exchanges to support this ongoing movement.

- **Voluntary, corporate responsibility initiatives are usually focused on certain objectives and are limited in their reach beyond sectors of concern.** While reductions to HFC consumption and emissions are resulting from voluntary programs and advancements of lower GWP options being made through corporate responsibility, the reach of the success of these efforts is limited. For example, the Consumer Goods Forum focuses on new purchases of point-of-sale units but does not address installed base of existing equipment. Additionally, while there has been a large momentum in the beverage refrigeration industry as illustrated through efforts made by Coca-Cola Company, PepsiCo, Heineken, and Red Bull, voluntary efforts in other sectors—air conditioning and relatively smaller HFC consuming industries (e.g., solvent cleaning, aerosols) are lacking.

Reducing HFC consumption and preventing further emissions requires many different mechanisms to achieve optimal results. Industry is not only responding to policy developments but also taking proactive steps in anticipation of further controls. In turn, the innovation from chemical manufacturers and equipment manufacturers is being leveraged such as through MLF-funded projects. The growing attention toward this issue from both governments and industry stakeholders is setting the international stage for further strengthening of regulation and increasing support for a global phasedown of HFCs

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6 HFC Global Phasedown Discussion

Is the proliferation of the various policies linked to a lack of a global phasedown?

Countries are implementing HFC-related policies and non-policy initiatives for a variety of reasons (e.g., international and/or regional commitments; pressure from industry, civil society, and other stakeholders; social responsibility; etc.); however, the absence of an overarching legally binding framework to curtail HFC production and consumption (e.g., proposed amendments to the Montreal Protocol) potentially may be providing further impetus for the global proliferation of HFC policies, programs, and initiatives. The widespread action in recent years may also be a proactive response in anticipation of a legally-binding international agreement—such proposals have already been tabled every year since 2009 and have gained wide support from country governments and industry alike. Either way, stakeholders agree that there is a need for well-coordinated global action. To date, two separate proposals have been put forth to phasedown HFCs under the Montreal Protocol—one by the United States, Canada, and Mexico and one by the Federated States of Micronesia—with more than 100 countries that have signed declarations to phase down HFCs under the Montreal Protocol. Additionally, several MEAs have declared support for a phasedown, including the Arctic Council's *Kiruna Declaration* and Rio+20's *The Future We Want* declaration.

What are the benefits of an overarching framework such as a global phasedown under the Montreal Protocol?

Using the Montreal Protocol as the vehicle to globally phase down HFCs offers many established benefits, including its flexible design, cost-effectiveness, ability to achieve sustained reductions, established expertise, and expeditiousness when it comes to implementation.

- **Flexibility**. While the Protocol determines the level of required reductions, it does not specify the means that must be used to achieve them. Countries can choose from a menu of policy mechanisms to meet their treaty obligations. Further, as the phasedown commitments call for gradual reductions over time, the treaty considers changes in the market place, giving companies adequate time to both develop and adopt new alternatives. As demonstrated by the ODS phaseout, this design not only reduces the cost of compliance but also makes the transition appear nearly seamless to consumers.
- **Cost-effectiveness**. The Montreal Protocol already has established a proven funding mechanism—The Multilateral Fund for the Implementation of the Montreal Protocol (MLF)—that can assist developing countries phasedown HFCs at an "incremental cost." The Fund's development of the incremental cost concept (i.e., covering the cost difference between adopting alternatives and the status quo) was ground breaking and soon became a part of other environmental treaties such as the Global Environment Facility (GEF). The concept ensures that the costs covered by the Fund are truly additional and incentivizes the early adoption of new technologies. Further, because the Montreal Protocol only pays for incremental costs to install the technology at the point of consumption or production instead of the costs for mitigating emissions, it has proven to be an economical model. A global phase down approach is estimated to provide climate mitigation at a fraction of the cost of other mitigation measures (e.g., the CDM) and is a far more cost-effective approach than regulating HFCs at the point of emission. By controlling the production and consumption of HFCs, countries and industries will be able to eliminate the problem at its source. This approach has already been implemented successfully two times before, once with the transition away from CFCs and again with the ongoing phaseout of HCFCs. Global participation in the Montreal Protocol has also contributed to its cost-effectiveness; for instance, since multinational companies face similar regulatory restrictions in industrialized markets, they can achieve economies of scale by removing controlled substances from entire product lines.
- **Ability to Achieve Sustained Reductions.** The Montreal Protocol is widely regarded as one of the world's most successful multilateral environmental agreements to-date and is a proven framework for achieving sustained reductions over time. The achievements made in avoided ODS emissions are translating into measurable and sustained reductions in the concentration

of ODS in the stratosphere. To date, the Montreal Protocol has enabled reductions of more than 97 percent of all global consumption and production of controlled ODS. Further, the Montreal Protocol has resulted in one of the largest reductions to GHG emissions, significantly greater than in all parties to the UNFCCC and its Kyoto Protocol had reached their reduction targets for the first commitment period. According to Velders et al. (2007), avoided emissions from the Montreal Protocol in 2010 were estimated at 13,300 to 16,700 Tg CO_2 Eq., equivalent to an emission reduction of 91-93 percent compared to a world without the Montreal Protocol. Based on this history of success and methodologies employed for sustained aggregate reductions, an HFC phasedown under the Montreal Protocol would achieve similar results. The U.S. Government estimates that an HFC phasedown, as proposed through the 2013 North American Amendment to the Montreal Protocol, could achieve sustained HFC environmental benefits of about 90,100 million MT CO_2eq. through 2050 (EPA 2013d). The Federated States of Micronesia's proposed amendment could prevent the consumption of up to 100,000 million MT CO_2eq. through 2050.

- **Established Institutions with Relevant Expertise.** The Montreal Protocol has established panels of experts with decades of experience in all relevant sectors that rely on HFCs, including the Technology and Economic Assessment Panel (TEAP), Scientific Assessment Panel (SAP), and Environmental Effects Assessment Panel (EEAP). These panels are made up of professionals from governments, industry, academia, and civil society within both industrialized and developing countries. At the request of Parties, the TEAP assesses and evaluates various technical issues related to the availability and feasibility of ODS alternatives, including low-GWP options. To complete its work, the TEAP operates under numerous Technical Options Committees (TOCs) and Task Forces, providing several reports to the Parties each year. These independent scientific, environmental, technological, and economic feasibility assessments are a key strength of the Montreal Protocol, enabling Parties to reach informed, consensus-based decisions. Recreating these institutions from scratch would be an inefficient use of global resources, especially when such unparalleled technical expertise has already been established and organized into committees in all of the HFC sectors, which include refrigeration, air conditioning, foams, aerosols, fire extinguishing, and solvents.
- **Expeditiousness in Implementation.** Yet another key benefit to using the Montreal Protocol as a vehicle for action is that implementing an HFC consumption phasedown schedule requires a ratified amendment, a process used successfully by Parties in the past (e.g., the 2009 HCFC accelerated phaseout). Further, because alternative technologies are readily available, efficiencies can be gained by leapfrogging HFCs concurrently with the HCFC phaseout under the Montreal Protocol.

Can we ensure sustained aggregate reductions in the absence of an Amendment?

Several of the actions discussed in this report are not legally binding and lack the economies of scale and efficacy needed to ensure sustained reductions of HFC consumption. Local or regional policy action and other patchwork legislation is further limited due to the global nature of the HFC market—i.e., production often takes place in one country where consumption and associated emissions often occur in another (Schwarz et al. 2011). International frameworks have overcome these challenges to achieve objectives at a grander scale—the most illustrative and relevant example is the Montreal Protocol. As demonstrated by the ODS phaseout, countries would be able to leverage their existing HFC policies to meet phasedown obligations; yet, maintain the flexibility of their policies to tailor to their own domestic needs.

Can we ensure full-sector coverage in the absence of an Amendment?

Global action to address HFCs is currently taking place in all key HFC sectors (i.e., refrigeration and air-conditioning, foams, aerosols, fire protection, and solvents); however, fewer policies collectively cover all sectors. While most of the action is targeting the refrigeration and air-conditioning and foams sectors, fewer policies and non-policy initiatives are addressing other HFC consuming sectors. A global phasedown schedule of HFC consumption would guarantee appropriate coverage across all sectors

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