ANNEX 2

POTENTIAL EMISSIONS (FORMERLY TIER 1 FOR CONSUMPTION OF HFCs, PFCs, AND SF_6)

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A2.1 BASIC METHOD TO CALCULATE POTENTIAL EMISSIONS

The following approach, formerly the Tier 1 approach for estimating 'potential' emissions related to the consumption of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), is no longer recommended as a method for estimating HFCs, PFCs, or SF_6 emissions. This is because it is likely to grossly overestimate emissions from sources in which stock is growing quickly and emissions are delayed for decades, such as air conditioning and refrigeration equipment, foams, and electrical equipment. However, when considered along with estimates of actual emissions, the potential emissions approach can assist in validation of completeness of sources covered and as a QC check by comparing total domestic consumption as calculated in this 'potential emissions approach' per compound with the sum of all activity data of the various uses. It may also assist in monitoring the growth of banked greenhouse gases and thereby provide an indication of potential future environmental burdens. Thus, the method is included here for reference purposes e.g., to facilitate consistent time series.

Since net consumption of a chemical is equal to production plus imports minus exports, the calculation formula for the basic method (former Tier 1) is as follows:

EQUATION A2.1

$$Potential\ SF_6\ emissions\ from\ all\ uses = Production + (Imports - Exports) - Destruction$$

Production refers to production of new chemical. Reprocessing of recovered fluid should not be included. Imports and exports include bulk chemicals and may or may not include the quantity of chemical contained in products, such as refrigerators, air-conditioners, packaging materials, insulating foams, fire extinguishers, etc.

Although destruction of HFCs, PFCs, and SF_6 is currently not widely practised, and may be technically difficult in some cases, it should be included as a potential option to reduce emissions. By-product emissions during HFC, PFC, and SF_6 production and fugitive emissions related to production and distribution have to be calculated separately.

There are two versions that formerly had been labelled Tier 1 (a and b) depending upon whether HFCs, PFCs, and SF_6 in products are taken into account. In the former Tier 1a, chemicals contained in products are *not* considered. In the former Tier 1b, chemicals contained in products are considered. The reason for two versions is that it is expected that there may be difficulties in many countries with the availability of data regarding imports and exports of HFCs, PFCs, and SF_6 in products, at least in the short term. The former Tier 1b methodology is preferred if relevant data are available. As an alternative, alternative activity data can be used to take into account consumption (potential emissions) associated with the trade of products containing HFCs, PFCs, and SF_6.

If countries choose to develop potential emission estimates, they are encouraged to track individual HFCs, PFCs, and SF_6 separately. However, such tracking (particularly for imports and exports) is complicated by the fact that many of the commercial types of HFC/PFC refrigerants, blowing agents, solvents, etc. are mixtures of two or more HFCs and/or PFCs. It is important to note that the composition of fluids for similar purposes may vary according to individual formulas developed by the different chemical companies.

Former Tier 1a

Quantities of HFCs, PFCs, and SF_6 contained in various products imported into or exported from a country may be difficult to estimate. In the former Tier 1a, only chemicals imported or exported in bulk are considered in the calculation of potential emissions, which is a similar approach presently used to report Ozone Depleting Substances (ODS) under the Montreal Protocol. The following definitions apply:

EQUATION A2.2

$$Imports = Imported\ HFC/PFC/SF_6\ in\ bulk$$

$$Exports = Exported\ HFC/PFC/SF_6\ in\ bulk$$

The application of the former Tier 1a may lead to underestimation or overestimation of potential emissions, depending on whether the majority of products containing HFCs, PFCs, and SF_6 is being imported or exported.

Data on production and exports of chemicals in bulk should be available from chemical companies. Information on imports of chemicals in bulk may be available from customs services. National environmental protection authorities may keep records of HFCs, PFCs, and SF_6 destroyed, if any.

Potential emission data for each individual chemical should be calculated according to the scheme in Table A2.1:

TABLE A2.1
CALCULATION SCHEME FOR POTENTIAL EMISSIONS ACCORDING TO THE FORMER TIER 1a

REPORTING YEAR:
TYPE OF CHEMICAL (e.g., HFC-134a):
Production of chemical
+ Import of chemical in bulk
– Export of chemical in bulk
– Destruction of chemical
= Sum (potential emission of chemical)

Emissions related to production and distribution of HFCs, PFCs, and SF_6 have to be taken into account as described in Section 3.10, Fluorochemical Production.

Former Tier 1b

The former Tier 1b is an extension of the former Tier 1a and includes HFCs, PFCs, and SF_6 contained in various products which are imported and exported. The following definitions then apply:

EQUATION A2.3

$$Imports = Imported\ chemical\ in\ bulk + quantity\ of\ chemical\ imported\ in\ HFC/PFC/SF_6\ containing\ products$$

$$Exports = Exported\ chemical\ in\ bulk + quantity\ of\ chemical\ exported\ in\ HFC/PFC/SF_6\ containing\ products$$

Data on production and exports of HFCs, PFCs, and SF_6 in bulk should be available from the chemical companies to their national governments. Information on imports of bulk chemicals should be available from customs services, as well as, in theory, imports and exports of products and equipment containing HFCs, PFCs, and SF_6. However, in practice, tariff codes do not normally distinguish between those products and equipment containing HFCs, PFCs, and SF_6 and those which do not. Accordingly, the use of the alternative activity estimates for HFCs, PFCs, and SF_6 contained may be helpful. National environmental protection authorities may keep records of HFCs, PFCs, and SF_6 destroyed.

To calculate the potential emissions according to the former Tier 1b, the calculation scheme in Table A2.1 has to be extended to include the import and export of chemicals in products. Section A2.2 demonstrates a possible set-up, based on refrigeration equipment, foam products, fire extinguisher equipment, solvent and aerosols, for calculation of emissions from exports/imports and the results should be added to the emissions calculated using Table A2.1. In Section A2.2, HFC-xxx is used as an example to demonstrate the procedure, which in practice will have to be performed for each individual HFC, PFC and for SF_6.

A2.2 ADDITIONAL CALCULATIONS FOR ESTIMATING POTENTIAL EMISSIONS ACCORDING TO THE FORMER TIER 1b

REFRIGERATION

EQUATION A2.4

$$G_{HFC-xxx} = G(Unit\ i) \bullet n(Unit\ i) \bullet F_{HFC-xxx}(Unit\ i) + \cdots + G(Unit\ m) \bullet n(Unit\ m) \bullet F_{HFC-xxx}(Unit\ m)$$

Where:

$G_{HFC-xxx}$ = total import (export) of HFC-xxx in pre-charged refrigeration units[1]

G(Unit *i*) = refrigerant charge in a refrigeration unit of type *i* ($i = i \rightarrow m$)

n(Unit *i*) = number of refrigeration units of type *i* imported (exported)

$F_{HFC-xxx}$(Unit *i*) = fraction of component HFC-xxx[2] in the refrigerant (mixture) of a unit of type *i*

FOAM PRODUCTS[3]

EQUATION A2.5

$$G_{HFC-xxx} = V(Foam\ i) \bullet J_{HFC-xxx}(Foam\ i) + \cdots + V(Foam\ m) \bullet J_{HFC-xxx}(Foam\ m)$$

Where:

$G_{HFC-xxx}$ = total import (export) of HFC-xxx in foams (flexible and rigid)

V(Foam *i*) = volume of foam of type *i* imported (exported) ($i = i \rightarrow m$)

$J_{HFC-xxx}$(Foam *i*) = remaining amount of blowing agent HFC-xxx per volume unit of foam of type *i*

FIRE EXTINGUISHERS (PRE-CHARGED)

EQUATION A2.6

$$G_{HFC-xxx} = G(Unit\ i) \bullet n(Unit\ i) \bullet F_{HFC-xxx}(Unit\ i) + \cdots + G(Unit\ m) \bullet n(Unit\ m) \bullet F_{HFC-xxx}(Unit\ m)$$

Where:

$G_{HFC-xxx}$ = total import (export) of HFC-xxx in pre-charged fire extinguishers

G(Unit *i*) = charge of fire extinguishing agent in a fire extinguishing unit of type *i* ($i = i \rightarrow m$)

n(Unit *i*) = number of fire extinguishing units of type *i* imported (exported)

$F_{HFC-xxx}$(Unit *i*) = fraction of component HFC-xxx[4] in the fire extinguishing agent of a unit of type *i*

[1] 'Refrigeration units' may be refrigerators, ice machines, AC window units, split-units, chillers etc.

[2] Many refrigeration units will contain HFC/PFC-mixtures. The fraction of each chemical (HFC-xxx) has to be considered.

[3] Include insulating and non-insulating foams in a variety of products, like refrigerators, insulation panels, prefabricated pipe section, PU formulated systems, etc.

[4] Many fire extinguishing units will contain HFC/PFC-mixtures. The fraction of each chemical (HFC-xxx) has to be considered.

SOLVENTS

EQUATION A2.7

$$G_{HFC-xxx} = G(Solvent\ i) \bullet F_{HFC-xxx}(Solvent\ i) + \cdots + G(Solvent\ m) \bullet F_{HFC-xxx}(Solvent\ m)$$

Where:

$G_{HFC\text{-}xxx}$ = total import (export) of HFC-xxx in solvents

G(Solvent *i*) = quantity of solvent of type *i* imported (exported) ($i = i \rightarrow m$)

$F_{HFC\text{-}xxx}$(Solvent *i*) = fraction of component HFC-xxx[5] in solvent of type *i*

AEROSOLS

EQUATION A2.8

$$G_{HFC-xxx} = G(Can\ i) \bullet n(Can\ i) + \cdots + G(Can\ m) \bullet n(Can\ m)$$

Where:

$G_{HFC\text{-}xxx}$ = total import (export) of HFC-xxx in aerosol cans

G(Can *i*) = charge of HFC-xxx propellant in an aerosol can of type *i* ($i = i \rightarrow m$)

n(Can *i*) = number of aerosol cans of type *i* imported (exported)

References

IPCC (1997). Revised 1996 IPCC Guidelines for National Greenhouse Inventories. Houghton J.T., Meira Filho L.G., Lim B., Tréanton K., Mamaty I., Bonduki Y., Griggs D.J. Callander B.A. (Eds). Intergovernmental Panel on Climate Change (IPCC), IPCC/OECD/IEA, Paris, France.

[5] Solvents will often not be pure HFCs or PFCs. The HFC/PFC fraction in the solvent composition (HFC-xxx) has to be considered.