**Extra Note on HFCs with very high-GWP in the current F-gas legislation**

Winfried Schwarz, 6 May 2013

**1**. On 7 November 2012 the European Commission launched a "Proposal for a Regulation of the European Parliament and of the Council on fluorinated greenhouse gases”. An essential of this proposal, which is largely based on the 2011 “preparatory study” by Öko-Recherche & Partners, is the HFC phase-down 2015-2030, which shall reduce the maximum HFC demand in EU-27 to 21% of its value in the reference period 2008-2011. The phase-down is based on the projected market penetration of technologies alternative to conventional HFC applications, which are considered both technically and financially feasible.

The demand for HFCs also includes those quantities which are presently first-filled into equipment outside the EU-27 and are imported into the EU-27. From 2018 (if the regulation enters into force 2015) such import of “pre-charged equipment” (except for hermetic systems) shall be prohibited, which implies that additional HFC bulk quantities must be available in the EU-27 – increasing the maximum HFC demand from 2018 onwards by (estimated) 10-15% for a certain period of time.

The following graph shows the projected "phase down of bulk HFCs, based on alternative technologies" in relation to the reduction steps as per Annex V of the 2012 COM proposal.



**2**. The HFC refrigerant blend R-404A (which is thermodynamically almost identical to R-507 which is used for the same purpose) exhibits an extremely high GWP of 3,922 (GWP of 507: 3,985). R-404A is not applied in stationary or mobile air conditioning but to large extent in refrigeration at the low temperature level. It is widely in use in industrial refrigeration systems and centralized commercial supermarket equipment, in addition to further non-hermetic application sectors like condensing units, refrigerated trucks, fishing vessels, reefer containers or that like. The demand for R-404A (which is treated here identical with R-507) presently contributes more than one third to the overall HFC demand in EU-27.

As a consequence, special measures with regard to R-404A have been discussed whether this blend could be replaced by refrigerants that are energetically at least equivalent but have lower GWP. Recent experience in UK shows that the HFC-blends R-407A and R-407F can well replace R-404A. The GWP of R-407A (marketed by all relevant F-gas producers) is 2,107; the GWP of R-407F (marketed by Honeywell alone) is 1,825. If we assume equal shares of the two refrigerants, the average GWP is 1,966, and thus only half the value of R-404A (R-507). From these circumstances it suggested itself to strongly support the use of R407A/F in systems for which HFCs are considered to be necessary instead of R-404A.

Art 11.3 of the COM proposal includes this idea saying that use of F-gases or mixtures with GWP of 2500 or more to "service or maintain refrigeration equipment with a charge size equivalent to 5 tonnes of CO2 or more, shall be prohibited from 1 January 2020". The only HFC refrigerant with GWP >2500 is R-404A(R-507) – except for R-23 which, however, is limited to extremely low temperatures of ~-78°C. Evidently, Art 11.3 addresses R-404A.

Ban on refilling R-404A into equipment that relies on R-404A, to compensate for refrigerant loss, would (1) lead to premature functional end of that equipment so that in existing equipment R-404A must be replaced by R-407A/F (Art 11.3. does not distinct between virgin and reclaimed R-404A), and (2) first fill of new equipment with R-404A would no longer make any sense; R407A/F would be the alternatives (unless technical solutions without HFCs would be chosen) for existing and new refrigeration equipment for low temperatures.

The intention of Art 11.3 of the COM proposal is further reduction of HFC demand in terms of GWP below the mark set by application of alternative technologies (shown in the above graph), which indeed would happen before 2030. However, the downside of this approach is necessarily that in the first years after 2020 the demand for the HFC blends R407A/F for the purpose of R-404A replacement in existing equipment temporarily but significantly raises the overall HFC demand over the level without that measure.

The following diagram show this effect for the (isolated) demand for R-404A alone (without Art 11.3) and alternatively for R-404A plus R-407A/F (as per Art 11.3). (WAM means "with additional measures"; it represents the original phase-down (no special treatment of R-404A).



From the graph it follows that under the assumption that within three years (2020-2022) all R-404A in existing equipment is replaced by R-407(A/F). This measure leads to sharp temporary increase in HFC demand from 45 to 70 MTCO2eq, which is in this time period not compensated by lower demand for first fill of new equipment (R-407A/F instead of R-404A). From 2024 onwards the overall HFC demand is significantly lower than without that "special treatment" of R-404A: all first fill and all re-fill of equipment which relies on R-404A in the "WAM scenario" is now first-filled and re-filled by R-407A/F with half the GWP of R-404A.

**3**. Looking at the overall HFC demand in the next diagram, it turns out that as a consequence of the Art 11.3 in the 2012 COM proposal the reduction steps (as per Annex V) could not be kept in certain years (2020-2022). *This diagram should be compared with the first diagram*.



**4.** On 27 February 2013 the Irish Presidency came forward with their Presidency text: "Proposal for a Regulation of the European Parliament and of the Council on fluorinated greenhouse gases – Presidency text". This proposal keeps the 1 January 2020 as start of a ban on re-fill with F-gases of GWP > 2500, which however is limited to charges > 40 t CO2 equivalent, and explicitly excludes temperature levels > -50°C (i.e. use of R-23, GWP 14.800) from such ban.

The most important change with respect to the special treatment of R-404A is that the ban on refill "shall not apply to reclaimed" R-404A (until 2025). This exclusion allows five years of continued use of R-404A in existing equipment (i.e. over the next 12 years from today).

This provision shows two important results with respect to the overall HFC demand in the first years of application of the new F-gas Regulation.

1. In terms of the regulation, "reclaimed" F-gases do not count as F-gas demand. Refill of, say 10 MTCO2eq, is not HFC demand of 10 MTCO2eq but of 0 MTCO2eq.

2. In the first five years no additional R-407A/F will increase the overall HFC demand, because existing equipment must not be retrofitted by extraction of R-404A and filling of R-407A/F.

*It should be mentioned that extraction/recovery of R-404A from existing equipment would not be an easy process (here we do not discuss the technical and energetic details) and would at any rate cause significant amounts of disposal emissions. In the COM proposal further use of R-404A outside the existing equipment would be impossible, so that all R-404A must be destroyed – causing another environmental problem.*

The ban on refill in the February 2013 proposal is limited to charges > 40 tCO2eq, which comes to ca. 10 kg R-404A refrigerant. This size-limit excludes condensing units and refrigerated trucks from that refill ban. The latter, however, are included in the ban on first fill in new equipment as per Annex III.13 and 14 which apply to all charge sizes of non-hermetic equipment from 2020 or 2025, respectively.

The altered approach to R-404A would lead to significant reduction in overall HFC demand in the 5 years after 2020, compared to the 2012 COM proposal.

5. The most recent EP compromise (May 2013) further strengthens the requirements to the high-GWP F-gas R-404A (GWP > 2500) by new timing. This will lead to an earlier and higher decrease in demand for R-404A and for HFCs in general, in comparison to the EP proposal from February 2013 and in particular to the COM proposal from November 2012.

The modification first of all applies to Art 11.3 (service refill) and Annex III (first fill):

Refill with F-gases with GWP > 2500 shall be banned three years earlier, from 1 January 2017 instead of from 1 January 2020. The ban refers to virgin R-404A only; the proposal sticks to continued use of reclaimed/recycled R-404A over 5 years from the start of the ban. It also sticks to charge limits (50 instead of 40 tCO2eq, which is not a major change) and to exclusion of operating temperatures of below -50°C (R-23).

First fill of F-gases with GWP > 2500 shall prohibited from 1 January 2015 instead of 1 January 2020 (stationary equipment) and 1 January 2025 (mobile refrigeration).

Our calculation of the effect of the above measures to the R-404 demand 2015-2030 and to the overall HFC demand 2015-2030 shows the following results.

**Demand for R-404A and for 404A+R407A/F in the May 2013 proposal, in the 2012 COM proposal, and in the original COM WAM scenario of the "preparatory study". Indications in MTCO2eq (million tonnes of CO2 equivalent)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2014 | 2015 | 2016 | 2017 | 2018 | 2020 | 2021 | 2024 | 2027 | 2030 |
| 1. Ban 404A First fill 2015 + 404A Refill 2017 (new 2013 proposal) | 56 | 39 | 38 | 16 | 15 | 13 | 12 | 8 | 5 | 3 |
| 2. Ban on Refill of any 404A 2020 (2012 Com Proposal) | 56 | 52 | 50 | 48 | 46 | 71 | 61 | 13 | 8 | 5 |
| 3. WAM Demand 404A (2011 COM WAM scenario) | 56 | 52 | 50 | 48 | 46 | 40 | 37 | 26 | 17 | 11 |
| Difference 1. – 3. | 0 | -12,4 | -12,0 | -32,1 | -30,6 | -27,0 | -24,6 | -18,1 | -11,7 | -7,9 |

From the above table is emerges that substantial reduction in HFC demand will achieved if the new proposal (May 2013) is applied instead of the COM proposal (Nov 2012). This can be seen in the bottom line on the difference between 1. and 3. The Ban of first fill as of 2015 will even decrease significantly the demand in the first reference year (2015) of the Phase-Down.

Graphically the difference between the new 2013 proposal and the 2012 Com proposal is shown by comparison of the COM proposal diagram (this diagram has also been shown above) with the diagram for the new proposal, with regard to R-404A and R-404A+407A/F, respectively.





The quantitative differences between R-404A in the COM proposal and R404A+R407A/F in the new proposal was applied to the new overall HFC demand, which is shown in the next diagram in relation to the requirements from the phase-down reduction steps as per Annex V.



This diagram should be compared with the diagram on page 3.

Conclusion: Under the requirements of the new proposal (May 2013) the phase-down steps can easily be met. In every year from 2015 onwards, the distance between the calculated HFC demand and the Phase-Down requirements is fairly high.

It must be noted that all these values are realistic only under the precondition that

(1) the projected replacement of conventional HFC applications by alternative, low-GWP technologies will take place as indicated in the 2011 preparatory study" and

(2) the requirements to bans on refill and first fill of HFCs with GWP > 2500, set by the new proposal, will be met in reality.

Frankfurt/Main, 6.5.2013

**Annex: (can be deleted, of course)**

Elements of the recent proposal:

|  |  |
| --- | --- |
| *10a. Stationary refrigeration equipment that contains fluorinated greenhouse gases with GWP of 2500 or more, except equipment intended for use at operating temperatures of below -50°C* | *1 January 2015* |

11.3 The use of fluorinated greenhouse gases, or of mixtures that contain fluorinated greenhouse gases, with a global warming potential of ***2500*** or more, to service or maintain refrigeration equipment with a charge size equivalent to *50* tonnes of CO2 or more, shall be prohibited from 1 January *2017.*

*This provision shall not apply to equipment intended for applications designed to cool products to temperatures below -50°C or equipment converted to use fluorinated greenhouse gases with a global warming potential above 2500 to meet commitments under the Ozone Depleting Substances Regulation (Regulation (EC) No 1005/2009)*.

*Until 1 January 2022, this provision shall not apply to reclaimed fluorinated greenhouse gases with* *a* *global warming potential of 2500 or more used for the maintenance or servicing of existing refrigeration equipment, provided that they have been labelled in accordance with Article 10(5).*

*Until 1 January 2022 this provision shall not apply to recycled fluorinated greenhouse gases with a global warming potential of 2500 or more used for the maintenance or servicing of existing refrigeration equipment provided they have been recovered from such equipment. Such recycled gases may only be used by the undertaking which carried out their recovery as part of maintenance or servicing or the undertaking for which the recovery was carried out as part of maintenance or servicing.*