Perverse effects of carbon markets on HFC-23 and SF_6 abatement projects in Russia

Supplementary documentation

Additional project information

The four registered JI projects include five production plants that produce HCFC-22, SF_6 and TFA. HCFC-22 is a GHG and an ozone-depleting substance regulated under the Montreal Protocol on Substances that Deplete the Ozone Layer. It is mainly used in refrigeration and air-conditioning appliances and as a feedstock in the production of polymers. HFC-23 is an unwanted by-product from HCFC-22 production; it has a GWP of 12,400 over a 100 year time horizon.[1] SF_6 is mainly used as insulator gas in the electrical industry. In the rectification of SF_6, a small fraction of SF_6 is lost through the off-gas. Larger quantities may be lost in the process of filling cylinders but these emissions are not subject to the JI projects.[2] SF_6 has a GWP of 23,500 over a 100 year time horizon.[1] TFA is the precursor to several products in the chemical industry. A range of fluorinated gases are unwanted by-products from TFA production.

Project RU1000201 (unique number assigned by the international transaction log operated by the United Nations Framework Convention on Climate Change) covers two plants at the industrial facility KCKK Polymer which produce HCFC-22 and SF_6. The project includes abatement of the HFC-23 waste gas stream from HCFC-22 production and the SF_6 waste gas stream from SF_6 rectification. Another industrial facility in Russia, HaloPolymer Perm, produces also both HCFC-22 and SF_6. HFC-23 and SF_6 emissions are addressed separately in two projects (RU1000202 and RU1000309). The projects RU1000201 and RU1000309 install a new HFC-23 and SF_6 destruction unit, while project RU1000202 consists of a modernization and capacity enhancement of three existing destruction units. All three projects aim at destroying all HFC-23 and SF_6. Another smaller HCFC-22 production plant in Russia, operated by JSC Khimprom Volgograd, was proposed as JI project but never registered. These three registered and the proposed project cover all production facilities in Russia: three HCFC-22 production facilities with a total capacity of about 44,000 tonnes per year and two SF_6 production facilities with a total capacity of about 1,800 tonnes per year.[3] Project FR1000029 at Rhodia Salindres in France abates a waste stream from the production of TFA consisting of HFCs, PFCs, as well as GHGs regulated under the Montreal Protocol on Substances that Deplete the Ozone Layer.

The projects RU1000201 and RU1000202 were developed at the same time by Camco International. They initially applied the CDM baseline and monitoring methodology AM0001 for HFC-23 destruction (version 5.2), with some adjustments. The methodology aims to avoid perverse incentives through two provisions:

1. The amount of HCFC-22 eligible for crediting is capped to the maximum annual HCFC-22 production observed in the period 2002 to 2004. This provision aims to avoid perverse incentives to increase HCFC-22 production beyond levels that would be produced in the absence of the CDM.
2. The maximum HFC-23 that can be used for crediting is capped to the minimum of the annual waste generation rates observed in the period 2002 to 2004. This provision aims to avoid perverse incentives to artificially increase the HFC-23 waste generation rate beyond levels that would occur in the absence of the CDM.

The original PDDs of the projects RU1000201 and RU1000202 both limited the amount of HCFC-22 that is eligible for crediting and established a cap on the maximum HFC-23 waste generation eligible for crediting, in line with the methodology. No CDM methodology was developed for abatement of SF_6 emissions from SF_6 rectification, but project RU1000201 nevertheless capped the amount of saleable SF_6 production and the rate of SF_6 losses in relation to the saleable production of SF_6, similar to the provisions in the CDM methodology for HFC-23 abatement.

In 2011, both projects adopted a revision to the monitoring plan, using a JI specific approach instead of applying a CDM methodology. The new approach was applied retroactively as of 1 January 2010 to both projects. The revision removes both the cap on the amount of HCFC-22 production that is eligible for crediting and the cap on the waste generation rate; all waste gas generated becomes eligible for crediting. The revised monitoring plans also declare key data and information provided in the original PDDs as inaccurate, including regulations applicable in Russia as well as historical data on HCFC-22 production, HFC-23 generation, and HFC-23 abatement.

Both original PDDs state that HFC-23 was already abated in part prior to the implementation of the JI projects in existing incinerators, together with other waste gases originating from the same industrial facility. Historical abatement levels are partially quantified. The original PDDs indicated that the level of abatement depended on the capacity of the existing destruction units and the extent to which these had to destroy toxic waste gases. According to the original PDDs, the objective of both projects is to enhance HFC-23 abatement beyond historical levels. In contrast, the documentation of the revised monitoring plans of both projects declares that HFC-23 was not abated prior to the start of the JI project. With regard to SF_6 abatement in project RU1000201, both the original PDD and the revised monitoring plan consistently state that it was not captured and abated prior to the implementation of the JI project. Both original PDDs also considered applicable regulations with regard to a "specified level of maximum permissible emissions" in calculating the level of baseline emissions. The documentation on the revised monitoring plan of both PDDs concludes that no regulations are applicable and removes the relevant provisions from the calculation of baseline emissions. The information on the level of waste gas formation in the original PDDs is indicated as black continuous line in Figure 1, the information according to the revised monitoring plan as grey continuous line. Both the information in the original PDDs and the information in the revised monitoring plan was confirmed as correct by two different AIEs, Det Norske Veritas (DNV) at PDD determination and Bureau Veritas Certification (BVT) at verification. The project RU1000309 does not provide information whether SF_6 was abated prior to the implementation of the project and states that its destruction is not required by regulations.

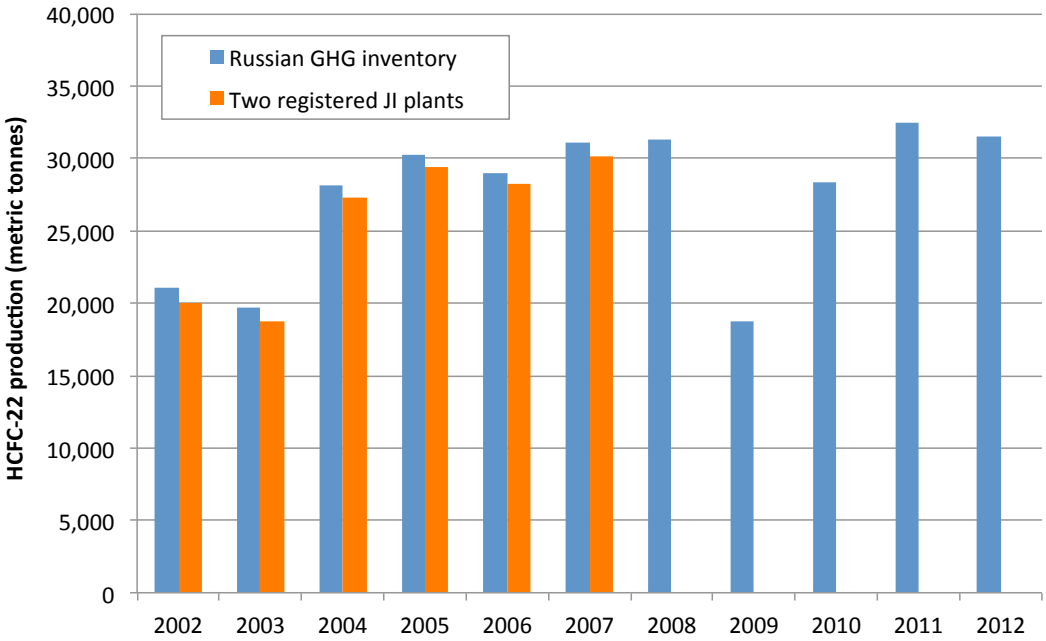
In some countries, small quantities of HFC-23 are sold. According to information in the original PDD of project RU1000201, a small fraction of the HFC-23 was sold in the period 2002 to 2007. In the calculation of emission reductions, the actual sales of HFC-23 are monitored and subtracted from the baseline emissions. However, the economic value of one tonne of HFC-23 incinerated and credited under JI could be higher than the market price for HFC-23, depending on the price of ERUs and HFC-23. This could create perverse incentives for the project participants to incinerate rather than sell HFC-23. In the project RU1000201, the available monitoring reports, covering the period from 1 January 2010 to 10 November 2012, document that no sales of HFC-23 occurred. The project RU1000202 did not report any historical sales of HFC-23.

Implications of the increase of waste gas generation

An increase of the waste gas generation can have different implications with regard to the amount of potential over-crediting:

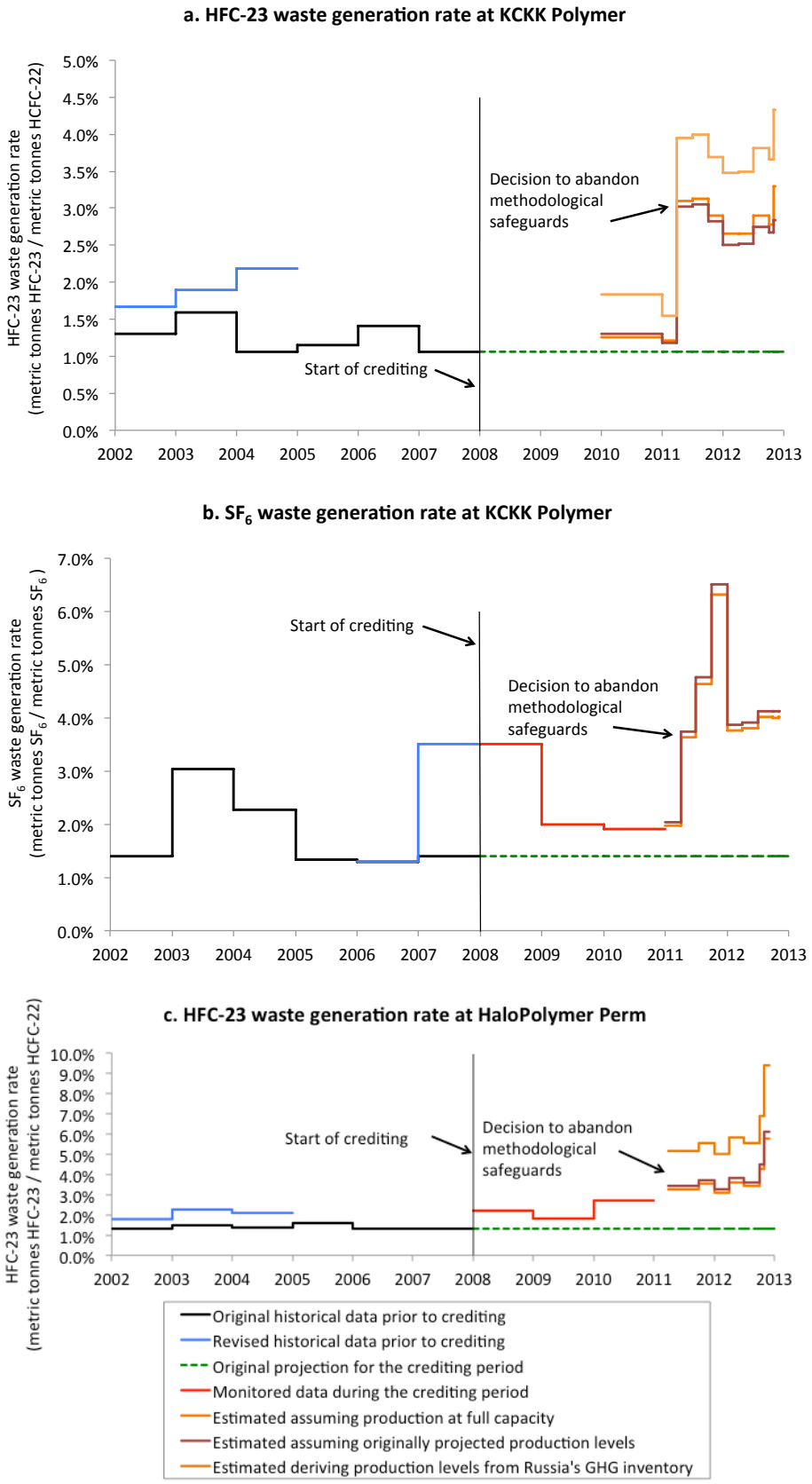
- **Increased waste generation *rates*:** If the increase of waste gas generation occurs due to an increase in the waste generation *rate*, then the amount of over-crediting correlates with the increase in waste gas generation.
- **Production shifts:** If the increase of waste gas generation occurs due to an increase in production of the main product — HCFC-22, SF_6 or TFA — and if the product is used (and not vented to the atmosphere), then the emissions impact depends on where and how the product would otherwise be produced, i.e. at which waste generation rates the other plants would operate, whether the waste gas is abated, and whether any abatement occurs under JI or the CDM. Production shifts due to incentives from JI could lead to over-crediting and potential economic distortion of competition.
- **Increase in production and venting of the product:** In the worst case, the main product could be produced without demand, for the purpose of generating and incinerating the waste gas under a crediting mechanism, and be vented to the atmosphere. In this case, the GHG emissions increase would be larger than the amount of credits issued, due to the GWP of the main products HCFC-22 and SF_6. In addition, efforts to protect the ozone layer would be undermined in the case of HCFC-22.

Monitoring data that would allow determining the way in which the waste gas generation was increased is not available. In the case of the three plants illustrated in Figure 1, the new approach towards calculating emission reductions, introduced in 2011 and retroactively applied as of 1 January 2010, does not monitor anymore HCFC-22 and SF_6 production. To assess whether the production or the waste generation rate increased in these plants, we estimate the plausible range of the waste generation rate using three scenarios: first, we assume that the plants would operate at their maximum HCFC-22 and SF_6 production capacity. Information on the production capacities is provided in monitoring reports; the capacity did not change in the period 2010 to 2012 in any of the three plants. This approach provides the lower end of the possible range of the waste generation rate. Second, we use the annual HCFC-22 and SF_6 production level projected in the original PDDs. And third, we correlate data from the projects with data from GHG inventory reports submitted by the Russian government to the UNFCCC.[4] In Russia, three HCFC-22 plants with a total capacity of about 44,000 tonnes are reported to be operational.[3] The two registered JI plants together have a capacity of 40,200 tonnes and thus make up for most of the production capacity in Russia. For the period 2002 to 2007, for which HCFC-22 production data is available from both the Russian GHG inventory and the two registered JI projects, the HCFC-22 production in the GHG inventory is reasonably consistent with the amount of HCFC-22 production reported by both plants in their revised monitoring plans under JI (see Supplementary figure 1). Supplementary figure 1 shows that the total HCFC-22 production in Russia did not substantially increase in 2011 and 2012 compared to previous years and was significantly lower than the total production capacity of 44,000 tonnes. Under this third approach, we assume that the two registered JI plants would continue to produce about 97% of the Russian production, as in the period 2002 to 2007. We allocate the total production to the two plants proportionally to their plant capacity, which is largely consistent with their historical production shares.



Supplementary figure 1 | HCFC-22 production in Russia. The Russian GHG inventory includes data from three HCFC-22 production plants whereas the two registered JI projects include two HCFC-22 production plants.

Supplementary figure 2 shows how the HFC-23 and SF_6 waste generation *rate* developed over time, based on the three approaches to estimate HCFC-22 and SF_6 production. The relative increase in the waste generation *rate* in Supplementary Figure 2 is similar to the increase in absolute waste gas generation in Figure 1. Moreover, total HCFC-22 production in Russia did not increase substantially in 2011 and 2012 compared to previous years, except for the decline in 2009 which may be attributable to the economic recession in that year. This confirms that the increase in waste generation can largely be attributed to an increase in the waste generation *rate*. In 2012, the HFC-23 waste generation rate at HaloPolymer Perm not only exceeds the IPCC range of 1.5% to 4% but also any known values from other operating plants, including historical and monitored data from the 19 CDM plants located in developing countries.[5,6]



Supplementary figure 2 | HFC-23 and SF_6 waste generation rates at the KCKK Polymer plant (panels a and b) and HFC-23 waste generation rate at the HaloPolymer Perm plant (panel c). For three different scenarios for HCFC-22 and SF_6 production, the waste generation rate increases beyond historically observed levels, after the plant operators decided to abandon methodological safeguards to prevent perverse incentives.

In the case of SF_6 abatement at HaloPolymer Perm, as illustrated in Figure 2, data on SF_6 production is not available for the period prior to 2008; therefore, the waste generation rate cannot be determined for that period. We approximate the waste generation rate roughly, by combining GHG inventory data for the period 1990 to 2007 with production data for the period 2008 to 2010. If the GHG inventory emissions were caused by the two plants proportionally to their production capacity, if the emissions were only caused from waste gas generation during production and not from handling SF_6 at the production site, and if the plant in Figure 2 would have produced over the period 1990 to 2007 the same amount of SF_6 as in the period 2008 to 2010, the waste generation rate would vary from 0.4% to 5.8% over the period 1990 to 2007, with an average of 3.8%. This range is significantly lower than the rate of 16.9% reported by the plant in the period 2008 to 2010, which indicates that the increase in waste gas generation may be mostly attributable to an increase in the waste generation rate.

Finally, we observe peaks in waste generation during some periods: HFC-23 and SF_6 waste generation was significantly ramped up in October and November 2012 at HaloPolymer Perm and SF_6 waste generation at KCKK Polymer peaked in the fourth quarter of 2011. A possible explanation could be that the further increase could enable the delivery of more credits as per the 1st of December delivery date commonly used for futures and other contracts in the carbon market.

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