









TWO BILLION TONNE CLIMATE BOMB:

How to Defuse the HFC-23 Problem

eia
environmental investigation agency

ABOUT EIA

EIA is an independent campaigning organisation committed to bringing about change that protects the natural world from environmental crime and abuse. As part of our work, we have undertaken groundbreaking investigations into the illegal trade in ozone depleting substances (ODS) and have been closely involved in the international ozone and climate negotiations for well over a decade.

ACKNOWLEDGEMENTS

Report design by:
www.designsolutions.me.uk

June 2013

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EXECUTIVE SUMMARY

HFC-23 (trifluoromethane) is one of the most potent greenhouse gases being emitted into the atmosphere today.

HFC-23 (trifluoromethane) is one of the most potent greenhouse gases being emitted into the atmosphere today. HFC-23 is produced as a by-product during the manufacture of a commonly used refrigerant, HCFC-22, and is 14,800 times more damaging to the climate than carbon dioxide (CO_2). Incineration technology has been deployed in many HCFC-22 plants to destroy this powerful by-product, and yet measurements indicate that emissions of HFC-23 are at least 127 million tonnes CO_2-equivalent (CO_2e) per year and concentrations of HFC-23 in the atmosphere are steadily increasing.

Under the Clean Development Mechanism (CDM) of the United Nations Framework Convention on Climate Change (UNFCCC), incinerators for HFC-23 destruction were installed at 19 HCFC-22 refrigerant facilities in China, India, South Korea, Argentina and Mexico. These "CDM plants" received billions of dollars in windfall profits from the sale of HFC-23 carbon credits, much of which went to the Chinese Government through a 65% tax on carbon credit revenues. The Chinese government however has failed to use these profits, totaling more than one billion dollars, to control harmful emissions from their 17 "non-CDM" production lines. The rapidly rising concentrations of HFC-23 in the atmosphere provide strong indication that HCFC-22 facilities in other countries have also been venting HFC-23.

HCFC-22 producers in developed countries, including chemical giants Dupont, Honeywell and Arkema, share some of the responsibility for ongoing HFC-23 emissions despite reportedly deploying incineration technology. In 2011, US emissions of HFC-23 were 6.9 million tonnes CO_2e and are almost wholly attributed to just two facilities owned by Honeywell (Louisiana) and Dupont (Kentucky). Best available technologies and maintenance practices allow 99.99% of HFC-23 to be destroyed and there is no excuse for continued HFC-23 emissions from these companies.



Honeywell International
Baton Rouge Plant

After scandalous manipulation of HCFC-22 production and HFC-23 waste ratios in the CDM projects was uncovered in 2010, HFC-23 destruction credits have been prohibited from the world's largest carbon market, the European Emissions Trading Scheme (ETS), from 1 May 2013. Carbon markets in New Zealand, Australia, Canada and California have also announced that they will not allow the use of HFC-23 offsets. As a result, HFC-23 CERs are now virtually unmarketable. The cash cow has finally died.

The Environmental Investigation Agency (EIA) conducted an investigation to establish whether non-CDM HCFC-22 manufacturing facilities in China have been releasing HFC-23 into the atmosphere, despite the availability of cost-effective destruction technology that can prevent these emissions. This investigation indicates that 17 production lines in China have been venting millions tonnes of CO_2e a year, making them some of the largest point source emitters of greenhouse gases in the world.

EIA's investigations also demonstrate that these emissions could be just the tip of the iceberg. EIA has learned that, without continued windfall profits from the CDM, most of the plants in China covered by the CDM are poised to join the non-CDM plants in venting their HFC-23. Likewise, there are strong indications that unless they receive additional financing, Indian CDM plants may also vent their HFC-23. If this should occur, it would represent a virtual "climate bomb", causing global GHG emissions to skyrocket.

Some officials from both China and India have made public announcements about impending venting - EIA's ground proofing establishes that these threats are real. After reaping windfall profits for years, companies around the world are threatening to explode further 'climate bombs' unless payments continue. Many former CDM Chinese and Indian plants may begin venting HFC-23 in the coming months, if they have not started already. The same financial realities are affecting all former CDM facilities and Joint Implementation projects in Russia, and as a result plants in Mexico, Argentina, South Korea and Russia may also be preparing to vent HFC-23, as none of these countries mandate its destruction.

If all of these facilities join China's non-CDM facilities and vent their HFC-23, they will set off a climate bomb emitting more than two billion tonnes of CO_2 equivalent emissions by 2020. This is equivalent to the CO_2 emissions created by the entire global car fleet each year – from just a couple of dozen companies in just a handful of countries.

The Governments of China, India, Mexico, Argentina, South Korea and Russia must act now to defuse this climate bomb. Cost effective technology to destroy HFC-23 is readily available, and already installed in most of these facilities. Either the plants themselves should be mandated by regulation to internalize the cost of incineration, or Governments should offer incentives and assistance to ensure all HFC-23 is destroyed. If non-CDM plants in Article 5 countries need assistance with the cost of installing the best available incineration technologies, they should seek it from the Montreal Protocol.

Governments in developed countries, in particular the US and European countries, must lead by example and ensure that their facilities employ best available technologies and storage and maintenance practices which ensure destruction of all HFC-23 by-product. While commendable that these companies have largely agreed to voluntarily destroy their HFC-23 by-product, it is time that developed countries enforce these agreements and bring HFC-23 emissions to zero.



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WHAT IS HFC-23?

HFC-23 (trifluoromethane) is a by-product in the manufacture of a refrigerant known as HCFC-22 (hydrochlorofluorocarbon-22), and it is one of the most powerful known greenhouse gases, 14,800[1] times more climate damaging than carbon dioxide (CO_2).[2]

While a few niche applications exist for use of HFC-23, it is primarily a waste product that, if vented into the atmosphere, has a significant impact on atmospheric greenhouse gas concentrations. Given the extraordinary potency of HFC-23 and the fact that it can be destroyed inexpensively with thermal oxidation or plasma pyrolysis, HFC-23 became the focus for the first emission reduction projects under the United Nations Framework Convention on Climate Change (UNFCCC) funded by the UN Clean Development Mechanism (CDM).

HCFC-22 is primarily produced for use in refrigeration, air conditioning, foams and aerosols, and as a feedstock in the manufacture of fluoropolymers (including Teflon), plastics and hydrofluorocarbons (HFCs). HCFC-22 is an ozone-depleting chemical, and its production for emissive uses such as refrigerants and propellants is scheduled to be phased-out by 2020 in developed countries and 2030 in developing countries under the Montreal Protocol. However, feedstock uses of HCFC-22 are not controlled under the Montreal Protocol as the chemical is mostly consumed in these reactions. This means that the annual production of hundreds of thousands of tonnes of HCFC-22 for feedstock will likely continue for the foreseeable future, with corresponding production of waste HFC-23.

CDM Credits for HFC-23 destruction

The CDM was set up in 2001 to allow emission reduction or removal projects in developing countries to generate carbon credits, each equivalent to one tonne of carbon dioxide (CO_2). These certified emission reduction credits (CERs) are traded and sold and used by industrialized countries to a meet part of

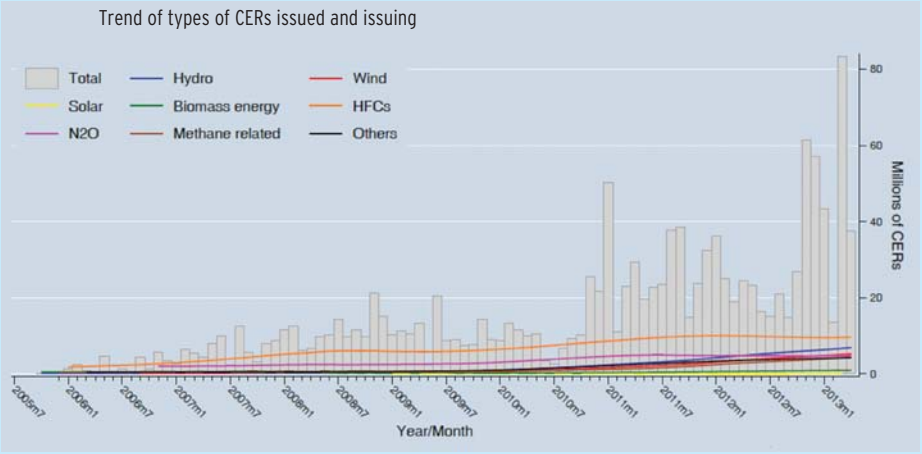
TABLE 1: LIST OF PROJECTS THAT HAVE RECEIVED CDM CREDITS FOR DESTRUCTION OF HFC-23

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database

CDM Crediting Start Date (D/M/Y)	Project	Country	CDM #	Total CERs Issued (kCERs)
01/01/2003	Ulsan	South Korea	2	15,842
07/01/2004	SRF	India	134	29,688
13/2/2006	Gujarat Fluorochemicals	India	1	52,781
14/6/2006	Quimobasicos	Mexico	499	12,344
08/01/2006	Zhejiang Juhua	China	294	36,406
10/01/2006	Changshu 3F Zhonhao	China	472	62,620
11/01/2006	Zhejiang Dongyang	China	672	22,408
12/01/2006	Jiangsu Meilan (Alibaba)	China	473	50,464
01/01/2007	Limin Chemical	China	673	28,705
01/01/2007	Shandong Dongyue	China	356	59,239
16/2/2007	ChemPlast Semnar	India	484	3,106
04/06/2007	Zhejiang Juhua #2	China	1000	27,765
05/01/2007	Navin Fluorine	India	897	15,374
05/01/2007	Zhonghao Chenguang	China	741	11,557
14/9/2007	China Fluoro	China	1678	21,082
15/10/2007	FrioIndustrias	Argentina	725	6,134
05/01/2008	Changshu Haike	China	1578	12,928
14/11/2008	HFL	India	2705	1,204
20/4/2009	Yingpeng	China	1848	28,767
Total CERs issued				**498,413**

FIGURE 1: HFC-23 PROJECTS HAVE DOMINATED THE CDM (UNFCCC AND UNEP RISOE) DATA AS OF 31 APRIL 2013[6]

Source: UNFCCC & UNEP Risoe



Notes: Trends are locally weighted regressions at a band width of 0.50

"Refrigerant manufacturers were transformed overnight by the CDM into ventures that generated large volumes of CERs, with a sideline in the manufacture of industrial gases."

their emission reduction targets under the Kyoto Protocol.[3]

Two HFC-23 destruction projects, one in South Korea and one in India, were the first projects of any type registered under the CDM. There are currently nineteen HFC-23 destruction projects registered: eleven in China, five in India, one in Mexico, one in Argentina and one in South Korea (see Table 1).[4] Although there are nearly 9,000 projects now registered with the CDM, these 19 plants alone account for almost half a billion credits, representing more than 39% of all offset credits ever issued by the CDM (see Figure 1).[5]

73% of these HFC-23 credits have been issued to 11 plants in China and 20% to five plants in India. The remaining 7% of the credits have been issued to HCFC-22 production facilities in Mexico, Argentina and South Korea.

CDM Subsidizes HCFC Chemical Producers

The CDM awards one CER for each tonne of CO_2 equivalent destroyed. However, although HFC-23 can be destroyed for just €0.17 per tonne of CO_2-equivalent (US$0.20/t$CO_2$e), when the HFC-23 CERs were sold, primarily on the European Union Emissions Trading Scheme (EU ETS), they commanded as much as €12-€15, or 70-90 times more than it cost to destroy the gas.[7]

The Methodology Panel of the CDM recognized early on that profits from CERs could encourage projects to artificially increase HCFC-22 production. In order to address this, a number of revisions to the methodology took place in 2005, which: capped the amount of HCFC-22 production that could be credited, based on the maximum annual production between 2000 and 2004; capped the HFC-23/HCFC-22 waste ratio to the minimum of historical rates or 3%, whichever was lower (or 1.5% if no data was available); and limited projects to plants with more than three years operating history between 2000 and 2004, in order to prevent facilities being set up just to take advantage of the HFC-23 credits.[8]

However these changes in the CDM methodology failed to address the massive profits being made by the already registered CDM HCFC-22 plants.

In 2007, an article by Stanford Law Professor Michael Wara in Nature magazine exposed the fact that HFC-23 CERs projected to be issued up to 2012 would be worth approximately €4.7 billion at the current carbon market prices, which at the time were about €10 (US$13) per tonne CO_2e, while the cost of the actual destruction was estimated to be just €100 million. According to Wara, HFC-23 emitters could earn almost twice as much from CDM credits as they could from selling the HCFC-22 refrigerant.[9] In a subsequent 2008 Working Paper, Michael Wara and David Victor noted: "*Thus, refrigerant manufacturers were transformed overnight by the CDM into ventures that generated large volumes of CERs, with a sideline in the manufacture of industrial gases.*"[10]

The Technical and Economic Assessment Panel (TEAP) of the Montreal Protocol came to the same conclusion and warned that that such market distortion could undermine global efforts to phase out HCFCs and move the refrigerant industry toward more environmentally friendly technologies (see Figure 2).[11] Since HCFC-22 is itself a potent greenhouse gas (with a Global Warming Potential, GWP, of 1,810), the CDM was effectively subsidizing the massive expansion of the production of one "super" greenhouse gas in order to destroy another.

PROFITING FROM THE CDM

Although carbon prices have steadily fallen since mid-2011, from mid-2009 to mid-2011 the average CER price was around €12 (US$20), approximately 70 times the actual cost of destroying HFC-23.[13] As a result, the HCFC-22 chemical companies and the Chinese government, through a 65% tax on HFC-23 CERs, have made massive profits from the HFC-23 destruction projects.[14]

An extreme case is Gujarat Fluorochemicals Limited (GFL), India's largest HCFC producer, that reported revenues from CERs of about US$175 million (about €134 million) in the financial year 2012, compared to revenues from refrigerant sales of only US$14.4 million (approximately €11 million).[15] Therefore, in 2012, a staggering 93.4% of GFL revenues from the fluorochemical business were as a result of selling HFC-23 carbon credits, with just 6.6% of the revenues from the sale of the refrigerants themselves (see Table 2).

An analysis of annual reports from four of the five Indian companies reveals that the obscene profits were not limited to GFL. The four Indian fluorochemical companies have earned a cumulative revenue from HFC-23 destruction of almost one billion US dollars since 2007 (see Table 3).

China is by far the largest HCFC-22 producer, with 92% of developing country production, and has therefore gained the largest profits from HFC-23 credits.[16] China has an estimated 23 facilities, 11 of which are covered at least in part by the CDM. The CDM facilities produce approximately 206,000 metric tonnes of HCFC-22 per year and 65.7 million HFC-23 CERs each year from destroying HFC-23 by-product. Of the almost half-a-billion HFC-23 credits issued to date, 73% (362 million) have been issued to Chinese HFC-23 projects, earning the chemical companies, project developers and the Chinese Government well over a billion dollars.[17]

The Chinese Government imposed a tax on CER revenues at a rate of 65%, with the proceeds forming a special fund called the Sustainable Development Facility, which is intended to fund investment in energy efficiency and renewable energy projects.[18] As of December 2012, the Chinese Government tax on CDM credits had earned an estimated 12.15 billion RMB ($1.98 billion), with the vast bulk coming from HFC-23 projects, which are taxed at a higher rate than other CDM projects.[19] Since HFC-23 destruction costs an estimated €0.17 per tonne CO_2e (currently US$0.22), this income could potentially fund the destruction of more than 5 billion tonnes CO_2e of HFC-23,

FIGURE 2: VALUE OF CER CREDITS PER KG OF HCFC-22 PRODUCED AS THE CARBON PRICE INCREASES

Source: TEAP Report, 2007[12]

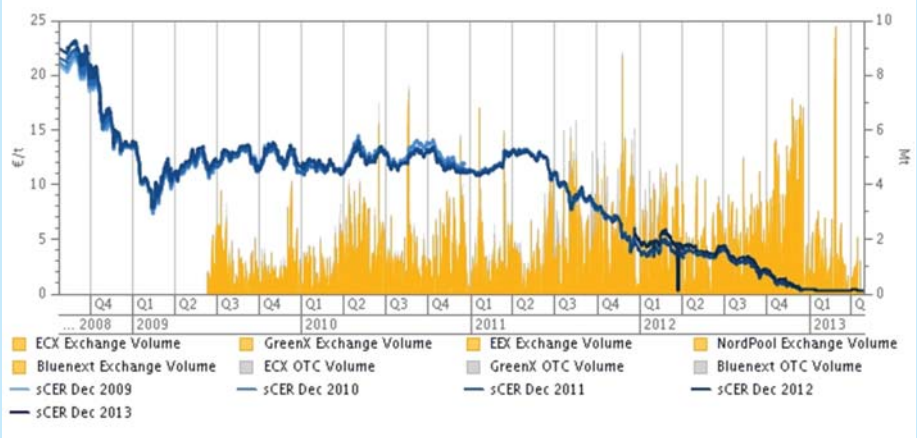


TABLE 2: GFL REVENUE FROM HFC-23 CERS AND REFRIGERANT SALES [1] [2]

	Yr ending 31/3/2012	Yr ending 31/3/2011	Yr ending 31/3/2010	Yr ending 31/3/2009	Yr ending 31/3/2008	Yr ending 31/3/2007
Revenue from refrigerant sales (INR lacs)	7,237	22,146	18,838	18,943	17,222	17,348
CDM Revenue (INR lacs)	87,614	20,243	47,296	62,931	45,394	39,006
CDM Revenue (US$)	$ 175,228,200	$ 40,486,400	$ 94,591,800	$ 125,862,400	$ 90,787,600	$ 78,011,800
Revenues from CERs as a % of total fluorochemical revenues	92%	48%	72%	77%	72%	69%

(1) 1 lac=100 000 rupees; calculations using 1 INR approx = 0.02 USD
(2) All data derived from financial reports available at http://www.gfl.co.in/Financial_%20Results.htm

TABLE 3: CUMULATIVE REVENUE FROM CERS RECEIVED BY INDIAN HCFC-22 PLANTS [1] [2] [3] [4]

(INR Lacs)	Yr ending 31/3/2012	Yr ending 31/3/2011	Yr ending 31/3/2010	Yr ending 31/3/2009	Yr ending 31/3/2008	Yr ending 31/3/2007	Cumulative revenue from CERS (Lacs)	Cumulative revenue from CERS (US$)
SRF	43,973	7,281	25,956	34,837	26,771	NA	138,818	277,636,380
GFL	87,614	20,243	47,296	62,931	45,394	39,006	302,484	604,968,280
NAVIN	25,190	No CER income booked due to study conducted by CDM board	Data unavailable	Installed this year	0	0	25,190	50,380,000
CHEMPLAST	NA	4,939	4,553	4,621	5,023	0	19,136	38,272,660
Total Revenue							**485,629**	**971,257,320**

(1) 1 lac=100 000 rupees; calculations using 1 INR approx = 0.02 USD
(2) All data derived from financial reports available at http://www.gfl.co.in/Financial_%20Results.htm, http://www.nfil.in/financialresults.html, http://www.moneycontrol.com/bse_annualreports/5240130311.pdf, http://www.moneycontrol.com/bse_annualreports/5240130312.pdf, http://www.moneycontrol.com/bse_annualreports/5240130310.pdf, http://www.moneycontrol.com/bse_annualreports/5063550311.pdf
(3) The fifth plant, Hindustan Fluorocarbons Limited (HFL), did not report its revenues from CERs in the annual reports available online. The closing CERs stock reported by HFL for the year ending 3/31/2011 was about 3.4 million USD.
(4) ChemPlast has two CDM projects, so an unknown (presumably small) portion of this sum is derived from a waste recovery project

almost 80 years of current CDM project production in China.

Despite the 65% tax levied by the Chinese Government, substantial revenue has also flowed to Chinese chemical plants. For example, 3F, the majority shareholder in the largest HFC-23 CDM project, Changshu 3F Zhongaho Chemicals Company Ltd, which runs a joint venture with US chemical giant Dupont, reported a 2007 net profit from the CDM project of RMB 79.735 million (€8 million or US$11.7 million) and in 2008 RMB 119.99 million (€12 million or US$19.1 million), based on a contract price of €6 per CER. This is after the 65% government tax on revenues.[20] Mexico's only HCFC-22 production facility, Quimobásicos, S.A. de C.V. is located in Monterrey, Mexico,[21] and is joint owned by Cydsa (51%) and US chemical giant Honeywell (49%).[22] The Quimobásicos facility has two production lines, one covered by the CDM, which produced 8,393 tonnes of HCFC-22 from 2011 to 2012, 7,570 tonnes of which was eligible production under the CDM approved project.[23] In December 2006, after installing the destruction technology, Quimobásicos sold the first 1.5 months of HFC-23 CERs for $10.8 million.[24]

These CERs have been a major source of revenue for the company. Even accounting

for a 21 month suspension of CER sales due to new regulations, Quimobásicos earned $136.2 million from the sale of CERs in less than 6 years.[25] Given a capital cost of $2 million for their destruction technology, industry average annual operating costs of $200,000, and destruction costs of $0.25 per tonne CO_2e, the Quimobásicos capital outlay has been well under 7% of its earnings.[26] In its detailed audited financial statements for 2011, co-owner Cydsa reveals that "refrigerated gases and CERs" brought in net revenues of $123.8 million, of which 21% ($26 million) came from CERs. Resumed CER sales were also largely responsible for a conglomerate-wide 109% increase in export sales from 2010 to 2011.[27] In 2008, the sale of CERs alone generated 8.5% of Cydsa's entire income.[28]

Despite these exorbitant profits, Quimobásicos maintains that, absent a CDM project on its second plant, it has "no economic incentive… to incur the capital costs and operating costs of an HFC destruction unit," - costs that are a fraction of what it has already earned from the CDM.[29] Even as it reported CER sales of US$26 million, Quimobásicos petitioned the Executive Board of the Clean Development Mechanism that November not to lower the current maximum waste generation rate for fear of making abatement economically unattractive.[30]

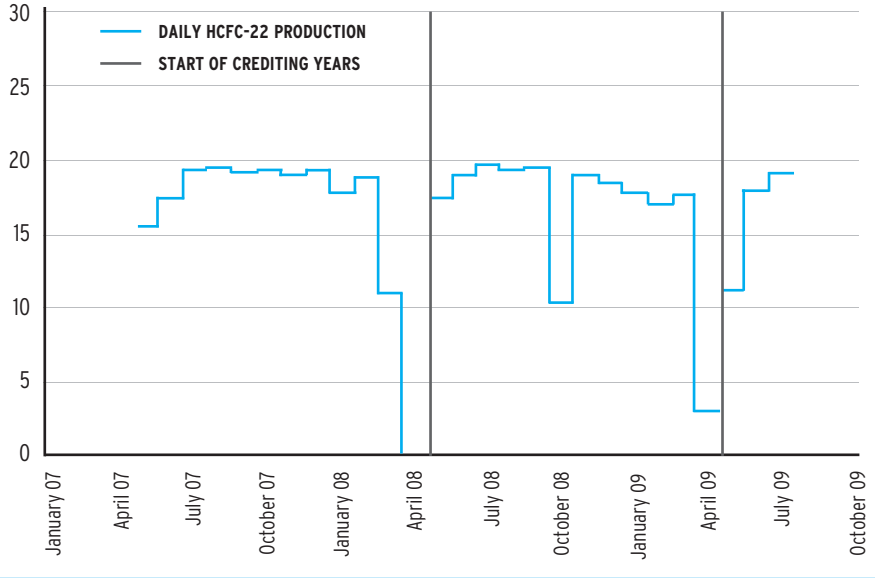
HFC-23 SCANDAL EMERGES

With HFC-23 projects dominating the mandatory carbon markets, and chemical producers receiving billions of dollars of profits, independent observers began to look more closely at the HFC-23 project methodology and the activity reports of the HCFC-22 producers.

In March 2010, a request to revise the HFC-23 methodology was submitted to the CDM Methodology Panel.[31] It provided strong evidence that HCFC-22 manufacturers were manipulating their operations to increase the amount of HFC-23 generated for destruction and subsequent crediting with CERs. Using the plants' own monitoring reports, it was documented that for many plants the amount of HCFC-22 and HFC-23 generated corresponded to the exact amounts that were eligible for carbon crediting. In several plants, the HCFC-22 production corresponded each year to the amount that was eligible for crediting, while lower or more variable amounts were produced before the companies entered the CDM. Two plants produced lower rates of HFC-23 by-product waste during periods where no carbon credits could be claimed, and then increased their ratio of HFC-23/HCFC-22 production once carbon credits could again be obtained. One plant even stopped HCFC-22 production when it was not allowed to generate further credits, and

FIGURE 3: DAILY HCFC-22 PRODUCTION DURING THE CREDITING PERIOD FOR ZHONGHAO CHENGUAGE RESEARCH INSTITUTE OF CHEMICAL INDUSTRY IN CHINA (TONNES PER DAY). THE GRAPH REVEALS THAT A RELATIVELY STABLE PRODUCTION WAS MAINTAINED UNTIL THE HCFC-22 AMOUNT ELIGIBLE WAS REACHED, AT WHICH POINT PRODUCTION CEASED. PRODUCTION IMMEDIATELY BEGAN AT THE START OF THE NEW CREDITING PERIOD ON 1ST MAY.[32]

Source: Methodology 0001 Revision Request, F-CDM-Rev. ver.01, 8 March 2010



then resumed operation when it became eligible for CERs. The analysis demonstrated that CDM HCFC-22 plants were being intentionally operated in a manner to maximize the production of HFC-23, creating fraudulent credits.

In a subsequent investigation, the CDM Methodology Panel identified "a series of circumstances under which the current methodology and its treatment of parameters [HCFC-22/]HFC-23 waste ratio w, HCFC-22 production and lifetime may overestimate baseline emissions compared to the situation without the CDM."[33] The confidential report obtained by EIA documented that while waste ratios ranged from 1.8% to 3.4%, seven of the CDM projects maintained their waste ratio at or slightly in excess of the allowable crediting ratio. In addition, seven projects stopped production when the annual production cap on HCFC-22 was reached and HFC-23 was no longer eligible for crediting. In the case of 9 projects, the amount of HCFC-22 produced in a year very frequently matched the exact amount eligible for crediting.

The Methodology Panel Report noted that the waste ratio could be controlled and decreased over time through maintenance that modernizes the process equipment, and that the CER revenues created a strong disincentive for HCFC-22 plants to do this. It also noted that significant overcapacity of HCFC-22 production existed in China in 2008, and that the CDM credits created the probability that rather than reducing production in CDM plants (which tend to be older and less efficient), companies reduced production in newer plants that produced less HFC-23, but could not obtain credits. Moreover it was clear that the credits could lead to the operational lifetime of the older plants being extended, rather than replacing them with newer more efficient plants that would not be eligible for credits.

As a result of the analysis and the investigation that followed, the CDM Executive Board temporarily suspended issuance of HFC-23 credits in August 2010. In November 2010 the methodology was put on hold, pending recommendations from the Methodology Panel, however at the same time the CER suspension was lifted and the flow of fraudulent credits resumed. In May 2011, the Methodology Panel issued recommendations for establishing a more conservative limit (for the HCFC-22/HFC-23 waste ratio[34]) but it was not until November 2011 at the 65th meeting of the CDM Executive Board that it was agreed to cut the waste ratio from three to one percent. Point Carbon analysts predicted the change would cut the amount of credits from over a billion to 750 million tonnes by 2020.[35] However, in the short term, the new methodology had no impact since it applies only to projects when they are renewed, not to existing projects.



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ABOVE:
China Dongyue Chemicals ("Dongyue"), China.

The controversial projects were dealt a further blow by the CDM Policy Dialogue, an independent high-level panel established to take stock of the CDM in 2012. The authors recommended that the Executive Board should "*Stop registering new projects involving gases with comparatively low marginal costs of abatement (e.g. projects that reduce HFC-23 and projects that reduce N_2O from adipic acid plants).*"[36]

European Union and Other Countries Take Unilateral Action to Ban HFC-23 Offsets

Realizing that even strong action by the CDM Executive Board to revise the HFC-23 methodology would fail to remedy its inherent flaws, and concerned by the enormous number of cheap credits of questionable or illegitimate value that were flooding the European carbon market, in January 2011, the European Union banned the use of HFC-23 and all other industrial gas offset credits from the EU Emissions Trading Scheme (EU ETS). The ban took effect on 1st January 2013, with a four-month phase-out period for credits from existing projects.[37]

The EU Regulation on HFC-23 and other industrial gas credits declares: "International credits from industrial gas projects do not contribute to technology transfer or to the necessary long-term transformation of energy systems in developing countries. Abating these industrial gases through JI or the CDM does not contribute to reducing global emissions in the most efficient manner, because the high

"If there's no trading of credits, they'll stop incinerating the gases. That's what almost all the big Chinese producers of HFCs have told me."

Xie Fei, Revenue Management Director at China Clean Development Mechanism Fund

returns by project developers are not used for emission reductions."[38]

Led by the Danish Government, at least 19 EU Member States have voluntarily extended the HFC-23 offset ban to their national targets for non-traded sectors (e.g. agriculture and transport).[39] Effective December 18, 2012, CERs from HFC-23 destruction projects were also banned from use in the New Zealand Emissions Trading Scheme and Australia has also indicated that will not accept HFC-23 credits in its future carbon trading scheme.[40]

These actions have been criticized by the countries and facilities that stand to lose the substantial CDM revenue. Chen Huan, Deputy Director of the China CDM Fund called the EU ETS decision 'irresponsible', and warned that without any incentive to destroy HFC-23, project-owners would start releasing the HFC-23 into the atmosphere again.[41] Likewise, according to Xie Fei, Revenue Management Director at China Clean Development Mechanism Fund, chemical companies threatened to start venting HFC-23 in response to the EU ETS decision to ban HFC-23 credits. In November 2011, in an interview at the Carbon Forum Asia in Singapore, Fei said: "*If there's no trading of credits, they'll stop incinerating the gases. That's what almost all the big Chinese producers of HFCs have told me. They say they can't bear the cost. They'll lose competitiveness.*"[42]

Recent investigations by EIA, detailed in the next section, have confirmed that these are not idle threats.

BELOW:
Zhejiang Pengyou, China.



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EIA HFC-23 INVESTIGATIONS

In early 2013, EIA investigated five Chinese HCFC-22 facilities and four Indian HCFC-22 facilities to determine whether non-CDM plants were venting their HFC-23 and to understand the future intentions of the CDM plants in light of the collapse of the market for HFC-23 credits.

EIA investigators obtained clear statements from both Chinese and Indian CDM plants that they would soon begin venting HFC-23, absent government regulation or additional financial incentives to incinerate the by-product. Two of the three non-CDM plants visited admitted that they were already venting HFC-23. Virtually all the HCFC-22 facilities agreed that there was almost no market for HFC-23.

CHINA INVESTIGATION

In early 2013, the EIA team visited five facilities across China, and conducted undercover interviews with facility managers, vice-presidents and other senior plant employees. The investigation confirmed that HCFC-22 plants currently not covered by the CDM are venting virtually all of their HFC-23 by-product, and that CDM plants intend to begin venting soon, unless the Chinese government requires them to continue incineration or they are granted additional funding.

Non-CDM Facilities

Zhejiang province, near Shanghai, is home to the majority of China's HCFC-22 production facilities. Currently, five CDM plants are registered in the province, and there are at least four additional non-CDM HCFC-22 plants that have been identified by EIA (see Tables 4 and 5). The EIA team visited three of the non-CDM facilities in this area, two of which openly discussed their current venting.

EIA investigators visited **Zhejiang Pengyou** ("Pengyou" or "Pengyou Tomo Chemicals"), an HCFC-22 facility located in Jinhua city in central Zhejiang province. This facility produces 12,000 metric tonnes of HCFC-22 and 348 metric tonnes of HFC-23 per year, amounting to an approximate waste ratio of 2.9%. Pengyou is a subsidiary of Yingpeng group, one of China's 500 largest chemical companies, which also owns a CDM facility in nearby Yongkang which produces about 24,000 tonnes of HCFC-22.[43] The Yingpeng group is a

large enterprise with fourteen subsidiaries, including seven others in Zhejiang.[44] Yingpeng supplies HCFC-22 for a variety of international customers including Carrier, DuPont, Daikin, Panasonic, Samsung, LG, and Gree.[45] During conversations with the EIA team, the plant manager of Pengyou stated that although they attempt to sell the HFC-23, at least 50% of it is vented directly, with the rest subsequently vented, because they often can't find a buyer. Therefore, as much as 5.1 million tonnes CO_2e HFC-23 could be vented from the Pengyou facility every year.[46]

Jinhua Yonghe is a large privately owned HCFC-22 factory on the outskirts of Jinhua. The company produces 25,000 tonnes of HCFC-22 per year, and has a fluorine chemical sales income of 10.14 billion RMB per year (US$1.65 billion /€1.28 billion).[47] During a visit to the factory, the plant CEO told EIA investigators that the Chinese government has required it to reduce production to 18,000 tonnes by the end of 2013 (to meet the HCFC production freeze at 2009-2010 production levels under the HCFC phase-out), and thus will be reducing its HFC-23 production from

TABLE 4: LIST OF NON-CDM PLANTS IN CHINA PRODUCING HFC-23

Parent Company	Company Name	HCFC-22 Production (metric tonnes/year)	HFC-23 Production (metric tonnes/year)[14]	CO_2 equivalent (tCO_2e)[15]
Dongyue Group Ltd[1]		**150,000**[1]		
	Shandong Dongyue non-CDM	92,264.84[16]	2,675.68	39,600,064
Jiangsu Melan Group[1]		**100,000**[1]		
	Jingsu Meilan non CDM[4]	40,000[4]	1,160	17,168,000
Zhejiang Wuhua Fluor-Chemistry Co., LTD (Zhejiang Juhua)[2]		**100,000**[1]		
	Zhejiang Lanxi Juhua	15,000[5]	435	6,438,000
Yingpeng Group[1]		**37,000**[1]		
	Zhejiang Pengyou	12,000[6]	348	5,150,400
Zhejiang Sanmei Chemical Industry Co., Ltd[1]		**30,000**[1]		
	Zhejiang Sanmei	15,000[4]	435	6,438,000
	Jiangxi Sanmei	30,000[7]	870	12,876,000
Sichuan Honghe Fine Chemical CO., LTD[1]		**30,000**[1]		
	Sichuan Zingong China[4]	10,000[4]	290	4,292,000
	Sichuan Honghe (Haohua Hongs)	12,000[8]	348	5,150,400
Linhai Limin Chemicals Co., Ltd[1]		**26,000**[1]		
	Limin Chemical non-CDM	8,500[9]	246.5	3,648,200
Zhejiang Yonghe New Type Refrigerant Co., Ltd[1]		**25,000**[1]		
	Jinhua Yunghe	25,000, now reduced to 18,000[10]	725	10,730,000
Changshu 3F Zhonghao/Shanghai 3F (Joint venture with dupont)				
	Changshu 3F non-CDM	12,000[11]	348	5,150,400
Haohua Chemical Group Ltd[3]				
	Zhonghao Chenguang non-CDM	12,000[12]	348	5,150,400
jiangsu Rijin		10,000[4]	290	4,292,000
Shandong Xianteng		30,000[4]	870	12,876,000
Shandong Jinan 3F		* production amount unknown[13]		
Hunan Zuzhou		5,000[4]	145	2,146,000
Wuhua Chianjiang		5,000[4]	145	2,146,000
Total			**9,679.18**	**143,251,864**

(1) Main HCFC-22 producers in China, 2011. Source: CCM International, China Fluoride Materials Monthly Report
(2) Zhejing Quhau is part of Zhejiang Juhua http://zjqhfhgs.en.alibaba.com/company_profile.html and http://www.jhgf.cn/pages/aboutus.htm
(3) http://www.chinahaohua.com.cn/haohuaen/index.htm
(4) Leaked UNFCCC data
(5) http://www.lanfuchem.com/template/aboute.html
(6) Total production at Yingpeng is 37,000 tonnes, therefore it is estimated that this facility produces 12,000 tonnes http://www.yingpengchemical.com/cgi/search-cn.cgi?f=product_cn+introduction_cn+news_cn1+contact_cn&t=main_cn
(7) http://www.sanmeichem.com/company/id/22.html
(8) http://www.hhhh.chemchina.com/hhhh/gywm/gsjj/B020101web_1.htm
(9) http://cdm.unfccc.int/filestorage/P/Q/F/PQF8UYZE45XQOUQ8YXY5Q935L9ZOJ4/%26%2312487.pdf?t=Vzh8bW9qaXlnfDD-qcBKivR4oG4gL0OZNY2z
(10) Data was acquired during EIA's Investigation
(11) http://cdm.unfccc.int/filestorage/9/M/7/9M7MLW12TKXFW9GRJRYR3MAHONE181.1/CDM%26%2320107.pdf?t=SUJ8bW9qamZyfDA6pAOy9N55Iy6EATccywww
(12) http://cdm.unfccc.int/filestorage/4/8/6/486EI0927S94QCCVOCCZ877VOPE7ZG/Rev.%20PDD?t=WFp8bW9qam56fDBgwjj6W4sOwDnBqJzzUfTA
(13) The website lists this facility as a producing HCFC-22 but does not provide production amounts http://www.jnflon.com/company/Company_Browse.aspx
(14) HFC-23 data was found by taking the HCFC-22 production data and multiplying by the average waste ratio of Chinese HCFC-22 CDM facilities, 2.9%.
(15) CO_2 equivalent was determined by multiplying the metric tonnes of HFC-23 by 14800, the global warming potential of HFC-23
(16) HFCFC-22 production data is based the total amount provided by CCM International (1) data subtracting the production data of the two CDM plants owned by Dongyue provided in their PDD documents

approximately 725 tonnes of HFC-23 to approximately 540 tonnes.[48]

The CEO informed EIA that Yonghe is unable to sell much, if any, of their HFC-23 byproduct, and they are therefore venting it. While some of the HFC-23 is captured and stored in the hope of finding a market, the stored HFC-23 is eventually vented. He also informed EIA investigators, "*only recently did people start collecting it [HFC-23]. Before, it was always vented out.*"[49] At the Jinhua Yonghe factory, the HFC-23 must be processed in order to be vented. "*In production, out product [HFC-23 is] liquidized when temperature is below -45°C, when -70°C, it is vented directly. You can't see it, no odor, no color, no harm for people but only to the atmosphere… [the] greenhouse effect.*" EIA was told that the Chinese Government is aware that facilities are venting, but "*the Government does not want to pay*", and it costs the plants a lot of money to burn the HFC-23, "*thus some plants are very straight forward, if you do not give me money, I will stop burning right away and vent, simple as that.*" EIA estimates that Jinhua Yonghe has been venting over 11 million tonnes CO_2e HFC-23 per year.[50]

One HCFC-22 facility, **Zheijiang Sanmei**, told EIA that they sell the majority of their HFC-23 to the submarine industry. However EIA is uncertain of the validity of this claim, given that all other facilities informed EIA that there was no market for HFC-23.

The EIA team learned from other HCFC-22 facilities that although all of the non-CDM plants would like to find buyers for their HFC-23 byproduct, they are generally unsuccessful and are "forced to vent." Many companies told EIA that HFC-23 storage tanks were very expensive, because the gas must be

TABLE 5: HCFC PRODUCERS IN CHINA RECEIVING CDM CREDITS FOR DESTRUCTION OF HFC-23

Parent Company	Company Name	HCFC-22 Production (metric tonnes/year)	HCFC-22 2010 actual production data[15]	HFC-23 Production (metric tonnes/year)[16]	CO_2 equivalent (tCO_2e)[17]
Dongyue Group Ltd[1]		**150,000**[1]			
	Shandong Dongyue CDM	39,735.16[4]	**40,365**	977	14,457,128
	Zhejiang Dongyang	18,000[5]	**18,000**	583	8,631,360
Jiangsu Melan Group		**100,000**[1]			
	Jingsu Meilan (Alibaba) CDM	30,000[6]	**32,200**	979	14,487,424
Zhejiang Wuhua Fluor-Chemistry Co., LTD (Zhejiang Juhua)[2]		**100,000**[1]			
	Zhejiang Juhua	16,000[7]	**17,407**	550	8,140,906
	Zhejiang Juhua #2	13,708.90[8]	**14,956**	471	6,972,487
Yingpeng Group		**37,000**[1]			
	Yinpeng	25,000[9]	**24,108**	733	10,846,671
Arkema (Changshu) Fluorine Chemical Co., LTD		**35,000**[1]			
	Changshu Haike	35,000[10]	**25,344**	436	6,451,569
Linhai Limin Chemicals Co., Ltd		**26,000**[1]			
	Limin Chemical CDM	17,000[11]	**16,822**	532	7,867,313
China Fluoro Technology Co., Ltd		**12,000**[1]			
	China Fluoro	12,000[12]	**13,181**	399	5,910,888
Changshu 3F Zhonghao/Shanghai 3F					
	Changshu 3F Zhonghao CDM	40,000[13]	**44,418**	1284	18,998,467
Haohua Chemical Group Ltd[3]					
	Zhonghao Chenguang CDM	6,000[14]	**29,493**	894	13,225,841
Total			**276,294**	**7837.1658**	**115,990,054**

(1) Main HCFC-22 producers in China, 2011. Source: CCM International, China Fluoride Materials Monthly Report
(2) Zheijing Quhau is part of Zhejiang Juhua http://zjqhfhgs.en.alibaba.com/company_profile.html and http://www.jhgf.cn/pages/aboutus.htm
(3) http://www.chinahaohua.com.cn/haohuaen/index.htm
(4) http://cdm.unfccc.int/filestorage/7/T/Z/7TZGJPKFU27EIL1UGEF1U3KHH16LJS/DongyueHFC23PDD.pdf?t=cVp8bW9IbnIzfDDTSRHeQ_1pPPIizpIVXoxn
(5) http://cdm.unfccc.int/filestorage/A/H/E/AHETYR48IX96KNZYGENW0OBYKKAV86/%26%2312487.pdf?t=ZXZ8bW9IcGJ0fDACaLuYaaPVCPR-80oBpoL_
(6) http://cdm.unfccc.int/UserManagement/FileStorage/76WZ09W3DPKK8M165HGPV2KS884CS3
(7) http://cdm.unfccc.int/filestorage/E/5/Z/E5ZHNT07RRDV0RH4ESDSKDNIJS12S0/JUHUA_HFC23_PDD_ENG051123%20without%20first%20page%20and%20track%20changes.pdf?t=aXI8bW9qZndIfDAWYY7dxfomU7MRdMY3n1n0
(8) http://cdm.unfccc.int/filestorage/E/5/Z/E5ZHNT07RRDV0RH4ESDSKDNIJS12S0/JUHUA_HFC23_PDD_ENG051123%20without%20first%20page%20and%20track%20changes.pdf?t=aXI8bW9qZndIfDAWYY7dxfomU7MRdMY3n1n0
(9) http://cdm.unfccc.int/filestorage/F/5/0/F50UYQ6A971HCGETO3NSPJZ2VK4LWB/CDM_PDD_YINGPENG_v1.5_Apr%2020%202009_clean%20text._1947?t=V2I8bW9qZ2J1fDDk9qdzCPX_wlk243S54wnL
(10) http://www.arkema.com.cn/en/china/greater_china_plants_changshu_fluorochemical.php, and http://cdm.unfccc.int/filestorage/A/I/5/AI5XXU7ER3EOJCTY9O9NE9WD71HGMU/PDD%20%28clean%20version%29.pdf?t=U1p8bW9qaHo4fDBgOp6XketIG6SbJxeBclXH
(11) http://cdm.unfccc.int/filestorage/P/Q/F/PQF8UYZE45XQOUQ8YXY5Q935L9ZOJ4/%26%2312487.pdf?t=Vzh8bW9qaXInfDD-qcBKivR4oG4gL00ZNY2z
(12) Data was acquired during EIA's Investigation
(13) http://cdm.unfccc.int/filestorage/9/M/7/9M7MLW12TKXFW9GRJRYR3MAH0NE181.1/CDM%26%2320107.pdf?t=SUJ8bW9qamZyfDA6pA0y9N55Iy6EATccywvw
(14) http://cdm.unfccc.int/filestorage/4/8/6/486EI0927S94QCCVOCCZ877VOPE7ZG/Rev.%20PDD?t=WFp8bW9qam56fDBgwjj6W4s0wDnBqJzzUfTA
(15) 2010 production values from UNEP Riso Center 1 April 2013
(16) HFC-23 amounts were calculated using waste ratios provided in the most recent CDM monitoring report for each plant and the 2010 production data
(17) CO_2 equivalent was determined by multiplying the metric tonnes of HFC-23 by 14800, the global warming potential of HFC-23

stored at a high pressure and low temperature, therefore few plants have significant storage capacity. One CDM plant manager told EIA directly that it is common for non-CDM plants to vent directly into the atmosphere.

In addition to the three facilities visited by EIA investigators, EIA identified four other plants producing HCFC-22 that are not covered by CDM contracts and three CDM plants that have production lines not enrolled in the CDM because they were created after the cut-off for CDM eligibility.[51] These plants are estimated to produce more than 330,000 tonnes of HCFC-22 and more than 9,000 tonnes of HFC-23 each year. Given the lack of market, the vast majority of this is likely to be vented, adding another 143 million tonnes CO_2e straight to the atmosphere every year. This is likely to be an underestimate, given the lack of concrete data on the number of HCFC-22 plants in China.[52]

CDM Facilities

EIA investigators visited two of the 11 CDM facilities in China, both of which stated they would be "forced" to vent because of the closing of all mandatory carbon markets to HFC-23 credits.

EIA undercover investigators visited the **China Fluoro Chemical plant** ("**China Fluoro**") in Jinan, Shandong province, China, and spoke with the CDM project manager. China Fluoro is a privately owned business, and a subsidiary of 3F Chemical Industry ("3F"). The plant was created in 2004 to facilitate a joint venture with Dupont. 3F has offices around the world, including a United States headquarters in North Carolina and European offices in Germany and Italy.[53] The China Fluoro plant produces 12,000 tonnes of HCFC-22 a year, 70% of which is for the company's own use as feedstock for production of fluorinated polymers.[54] The plant is in its 6th year of generating CDM credits, and has received the profits from over 21 million CERs.[55]

During EIA's visits in early 2013, the project manager informed investigators that he would be forced to vent HFC-23 soon. Specifically, he indicated that the plant will store HFC-23 in two 90-tonne tanks for the next 3-9 months until they are full, but without another buyer for their CERs they will be forced to vent. "*There is something I wanted to be clear of … we are in the 6th year of the CDM project; we are one of the 11 projects. We have in the past six years reduced at least 20 million CER's of carbon equivalent. We have done our contribution to slowing down the greenhouse effect. We are a responsible enterprise. Like you saw earlier, the CER's I am generating, there is no market for that, no one is paying me. My contracts were over by Dec 31, 2012, but I am still running the operation in accordance to CDM rules. But it won't last forever; I see it being 3-6 months. If in 3-6 months, there is still no new policies coming out, and there is no clear attitude from the government by then, we may stop the burning but collect the HFC-23.*"
"*I have two big storage tanks, and this makes me the only one amongst the eleven CDM project owners [to have this storage capacity]. They were built in 2006 and capable of storing up to 6 months' production. So 6 months, plus [the 3 months production since Dec 2012), this is total 9 months. After 9 months still we don't see a clear picture, we will think of other possibilities.*"



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ABOVE:
Jinhua Yonghe. China.

The project manager claimed that it costs 2-3 million RMB every month (about $5 million USD/€3.8 million per year) to keep incinerating the HFC-23, and the plant has been financing this destruction itself since the EU ETS closed, as it has no market for its CERs now. During EIA's second visit later in spring 2013, the CDM project manager indicated that venting was imminent, saying that he felt they could not keep incinerating any more. When pressed about whether the facility was going to vent, he responded, "*Yes, what else can we do? It's been almost 5 months.*"

China Dongyue Chemicals ("**Dongyue**") is located in Zibo city in Shandong province, and is one of China's largest privately-owned chemical plant. It sells



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TOP:
Hindustan Fluorocarbons Limited (HFL), India.

ABOVE:
Gujarat Fluorocarbons Ltd (GFL).

numerous fluorochemical products with a 5.6% share of the global market Dongyue produces 40,365 metric tonnes of HCFC-22 each year which is eligible for carbon crediting, relating to approximately 976 metric tonnes (14.4 million tonnes CO_2e) of HFC-23 by-product. When asked about venting the HFC-23, the plant manager did not deny the possibility, and implied that it may be the only thing to do "*since it costs money to burn*." He further stated, "*If we do not see [incentives] coming in for a long time [discussed in months not years], like all of us have been discussing it, we will then be forced to stop [the incineration]*."

INDIA CDM PLANTS

EIA has also been able to evaluate the future of HFC-23 destruction in four of the five Indian CDM plants. Three of the four companies have indicated that they too will be forced to vent if a new revenue stream for HFC-23 destruction cannot be found.

Gujarat Fluorocarbons Ltd (GFL) was the first HCFC-22 facility to receive CDM approval and is the second largest credit receiver in India. To date it has been issued with 52.8 million CERs. The HCFC-22 Director at GFL, stated: "*my sense is that we will probably stop [the incineration] internally, because there is cost in incinerating, and unless there is revenue to at least compensate that cost, it wouldn't make sense to keep on incinerating. There are no regulations to keep us to incinerating, for sure, so we do not need to do, to keep on in our plants. The reason we did was because of the economic incentives offered to the operation, but if the incentives are taken away, there is no commercial justification to continue to incinerate*."

When explicitly asked "*so you will vent?*" the Director answered "*I guess, if you will not intervene with Rupees*", confirming that if GFL does not continue to receive financing for HFC-23 destruction, GFL will vent the HFC-23 that it produces.

The Plant Manager of **Hindustan Fluorocarbons Limited (HFL)**, a CDM plant outside of Hyderabad in Andhra Pradesh also stated that the HFL plant is poised to vent. The plant manager stated that although they have collected and stored the HFC-23 during the first months of 2013, that this storage cannot continue indefinitely and that "*people are saying that, yes, we will have to vent*."

The Senior Vice President at **SRF**, the largest Indian CDM plant with an estimated production capacity of 15,000 tonnes of HCFC-22, made a similar statement: "*There is a pollution regulation, but specifically for (HCFC) 22, it's not there. In theory we could vent*". In contrast, the Chief Executive of **Chemplast Semnar** said that with the end of CDM crediting, he was willing to close down their plant, as "*once 22 is phased out, we will be out of the refrigerant business*."

HFC-23 Emissions Continue Despite Multi-Billion Dollar CDM Investment

Scientific studies back up EIA's on the ground findings, demonstrating significant ongoing HFC-23 emissions despite the billions invested through the CDM.

Montzka *et al*. (2010) demonstrated increasing concentrations of HFC-23 in the atmosphere through firn-air and ambient air measurements of HFC-23 from three excursions to Antarctica between 2001 and 2009. They derived mean global emissions for the period 2006-2008 to be approximately 200 million tonnes CO_2-e per year, almost 50% higher than the 130 million tonnes CO_2e per year derived for the 1990s.[56] A second study (Miller *et al*., 2010) measured fractions of HFC-23 from ambient air sampled at the Advanced Global Atmospheric Gases Experiment (AGAGE) network of five remote sites (2007-2009) and in archive samples (1978-2009) from Tasmania, Australia.[57] Their study showed a plateau of HFC-23 emissions during 1997-2003, followed by a rapid increase (approx 50%) to a peak of 222 million tonnes CO_2-eq in 2006. According to Miller *et al*., following this peak, emissions of HFC-23 declined to just over 127 million tonnes CO_2e as destruction of HFC-23 started to take place under the CDM projects. The scientists attributed 90% of the emissions to non-CDM plants based in China.

Assuming an HFC waste ratio of 2.9% (the average of the CDM projects), HFC-23 emissions of 127 million tonnes CO_2e represent just under 300,000 tonnes of HCFC-22 being produced each year without incineration of the HFC-23 by-product. This figure matches estimates of non-CDM HCFC-22 production capacity by the CDM Methodology Panel, which reported capacity of 300,500 tonnes and production of approximately 220,000 in nine plants, 8 in China and one in Venezuela.[58]

EIA has identified twelve plants falling outside the CDM, in addition to six non-CDM production lines within six CDM plants: one at the Quimobásicos plant in Mexico, one at the Zhejiang Linhai Limin chemical plant in China, one at the Sichuan Zhonghao plant in China, one at the Zhonghao Chenguang plant in China, one at the Jingsu Meilan, and one at the Changshu 3F Zhonghao plant in China. Based on atmospheric data and the reported production capacity of these plants, which totals more than 330,000 tonnes of HCFC-22, it is highly likely that all of the non-CDM plants[59] and additional lines have been venting all of the HFC-23 that they produce.[60] In its recent investigations, EIA was able to document venting of HFC-23 from two out of the three non-CDM facilities visited, and there is wide acceptance within the industry that there is no market for HFC-23, therefore similar venting is highly likely from the other non-CDM plants.

DEVELOPED COUNTRY CHEMICAL PLANTS MUST ELIMINATE ALL HFC-23 EMISSIONS

HFC-23 emission data from developed countries (primarily US and European countries) as decreased from 6-8 Gg/yr in the late 1990s to 2.8 Gg/yr in 2007.[61] This decline is attributed to a combination of declining HCFC-22 production in developed countries, optimization of the process to lower the HFC-23/HCFC-22 waste ratio and an increased rate of HFC-23 destruction by voluntary incineration. While emissions are lower than those from developing countries, given the effectiveness of optimization and HFC-23 destruction methods, EIA questions how multi-billion dollar chemical companies in the US and Europe can continue to allow HFC-23 emissions from their facilities. Chinese and Indian plants have storage tanks that collect up to nine months of HFC-23 production if the incinerator is not functioning, and there is no reason for HCFC-22 producers from developed countries not to have similar storage capabilities.

> "People are saying that, yes, we will have to vent.. "
>
> The Plant Manager of Hindustan Fluorocarbons Limited (HFL)

HFC-23 Emissions in the United States

Under the Mandatory Reporting of Greenhouse Gases rule by U.S. EPA,[62] facilities that produce HCFC-22 must report HFC-23 emissions. The U.S. EPA reported HFC-23 emissions of 6.9 million tonnes CO_2e in 2011 and 6.4 million tonnes CO_2e in 2010.[63] More than 99% of the entire emissions (see Table 6) are from just two facilities: the Honeywell International plant in Baton Rouge, Louisiana (31.9%), and the Dupont manufacturing plant in Louisville, Kentucky (67.9%).

While emissions have declined significantly from an estimated 36.4 million tonnes CO_2e in 1990, they still represent significant point source emissions. Of particular concern is the fact that 2011 emissions were higher than 2010, which the U.S. EPA attributes to a 9 percent increase in HCFC-22 production.[64]

Honeywell is also responsible for significant HFC-23 emissions from the Quimobásicos plant in Mexico, through its 49% share of the company. Quimobásicos has a total HCFC-22 production capacity of 18,400 to 20,440 metric tonnes per year.[65] In 2011 Quimobásicos manufactured around 8,837 tonnes of HCFC-22 from its CDM line, generating and destroying 227 tons of HFC-23 waste.[65] Production from its second plant (which does not collect CDM revenue) has been significantly lower, producing around 3,000 tonnes of HCFC-22 in 2011.[67] Emissions data shows that Quimobásicos vented almost 1.2 million tonnes CO_2e of waste HFC-23 (78 tonnes) in 2011, even as it collected over two million CERs from its CDM line worth an estimated €20 million on the EU ETS.[68]

In 2008, Quimobásicos submitted a CDM project design document seeking to install HFC-23 abatement on the second line, which was ultimately unsuccessful. In it, the company stated that "The plasma technology of the proposed project activity has a nominal destruction efficiency of 99.9999%."[69]

There is absolutely no justification for companies like Honeywell and Dupont to allow continued emissions of HFC-23, whether from wholly owned US facilities or from joint ventures in developing countries. These companies should immediately install the best available technology to ensure complete destruction of HFC-23.

HFC-23 emissions in the EU – Higher Than They Should Be?

HFC-23 emissions in Europe reportedly have decreased from 3,000 tonnes in 1997 to approximately 100 tonnes (1.48 million tonnes CO_2e) in 2011, with the closure of around half the EU's HCFC plants and the installation of thermal oxidation abatement systems. By 2010, only five chemical plants with HFC-23 emissions were operating, one each in France, Germany, the Netherlands, Spain and Italy.[70]

However, in 2011 the Swiss Federal Laboratories for Materials Science and Technology (EMPA[71]) published a paper demonstrating that Western European emissions of HFC-23 were as much as 140 per cent higher than the figures contained in national emissions reports.[72] The Swiss study showed that Solvay's Solexis plant near Milan[73] was venting 10-20 times more HFC-23 than reported by the Italian government. Significantly higher emissions were also

TABLE 6: HFC-23 EMISSIONS FROM US HCFC-22 PRODUCERS IN 2010 AND 2011

Source: The U.S. EPA Greenhouse Gas Emissions Inventory

Company	Facility	HFC-23 emissions (tonnes CO_2e) 2010	HFC-23 emissions (tonnes CO_2e) 2011	% of Total Emissions
Daikin	Daikin America Inc.	5,324	4,809	0.07
Dupont	Louisville and Washington Works	3,265,154	4,710,767	67.94
Honeywell	Baton Rouge and Geismar Complex	3,081,319	2,218,425	31.99
Total US HFC-23 emissions		**6,351,797**	**6,934,001**	

reported from The Netherlands, where DuPont operates a plant in Dordrecht,[74] and to a lesser extent from the Ineos[75] plant in the UK. Emission levels from the Arkema plant[76] in France were also twice as high as reported values.

These emissions were observed despite the fact that HFC-23 abatement systems have been installed by European chemical companies voluntarily since the mid-1990s.[77] According to the Frankfurt-based environmental consultancy Öko-Recherche,[78] current best practice technology comprising capture and thermal oxidation of the vent gases can achieve a destruction efficiency of up to >99%. Nonetheless, "the impact of "down-time" of thermal oxidation units, which is estimated at 5%-10% of the operating time of the HCFC-22 plant, needs to be taken into account since HFC-23 is released to the atmosphere during this time period. HFC-23 emissions from HCFC-22 plant with an incineration system amount to 0.1 to 0.2% of the HCFC production."[79] However, Öko-Recherche ignores the fact that these emissions can be captured, stored and the incinerated once the incinerator has been fixed and is once again operational. It also ignores other evidence that technologies allow a destruction efficiency of almost 100%.[80]

Given the EMPA report's findings, it is clear that European lawmakers must establish a clear regulatory requirement to capture and destroy the entirety of all fugitive HFC-23 emissions at all fluorinated gas plants located in the EU. As part of the ongoing revised EU F-Gas Regulation, consideration is being given to a proposal by the European Commission that "*producers shall ensure that any trifluoromethane (HFC-23) produced as a by-product in significant quantities is destroyed as part of the manufacturing process*." In order to destroy all HFC-23, these plants will need to capture the HFC-23 produced when incinerators are not functioning and incinerate the collected gas once the incinerators are once again operational.

Russian Joint Implementation HFC-23 projects

The Joint Implementation Mechanism (JI) is a parallel mechanism to the CDM that allows projects in developed countries reducing net GHG emissions in another developed country to receive credits, which are called Emission Reduction Units (ERUs). There are two registered JI HFC-23 projects[81] in Russia and another Russian project awaiting registration. When the two projects were registered (one of which also involves SF6 abatement), they were expected to each generate around 4 million ERUs per year (equivalent to the destruction of 4 million CO_2e tonnes of HFC-23). To date, however, the two projects have already been issued with almost 40 million credits, considerably more than expected according to the project design documents.[82]

The EU ETS industrial gas credit ban applies to JI projects as well as to CDM projects. As a result, in 2012, the EU ETS saw a huge surge in the number of JI credits surrendered in advance of the ban. The Russian Government appears to have taken no steps to mandate destruction of HFC-23 at the three plants that were the subject of the three JI projects, neither has it required HFC-23 destruction at any other fluorinated gas plant. There is no reason to believe that without national or international regulatory action that these Russian plants will not join the Chinese and Indian plants and start venting HFC-23 now that these credits have been banned from the EU ETS.



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TOP:
France, Arkema.

ABOVE:
Netherlands, DuPont Dordrecht.



CONCLUSIONS

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While many CDM plants are due to cease production under the Montreal Protocol's accelerated phase-out of HCFCs, production of HFC-23 will continue because production of HCFC-22 as a feedstock for materials such as Teflon is not controlled by the Montreal Protocol. HCFC-22 production for feedstock is expected to soar over the coming decades, reaching one million tonnes by 2035. Most of this growth is expected in China and India, which are on course to triple HCFC-22 feedstock production between 2010 and 2035.[83] There is therefore, a growing urgency to find a sustainable solution to eliminating HFC-23 emissions, which could increase dramatically if all plants start to vent and could triple with estimated increases in feedstock production.

Current HFC-23 emissions, estimated to be 127 million tonnes CO_2e, are already too high. With technologies able to destroy 99.9999% of the HFC-23[84] there is no legitimate reason for these emissions to occur. US and European chemical companies, that have made huge profits from the production of fluorinated chemicals, bear much of the responsibility for these emissions. These companies should be at the forefront of ensuring that the best available destruction, storage and maintenance technologies and practices available are employed to destroy HFC-23, particularly given their business ties to chemical plants in developing countries that have benefited financially from the CDM.

HFC-23 emissions are occurring on a massive scale in China and apparently have been since the non-CDM plants were constructed. These plants are some of the largest point source of greenhouse gas emissions in the world. However EIA's investigations demonstrate that this could be just the tip of the iceberg, with clear indications from Chinese and Indian companies that absent further CDM profits or regulatory action, they will start venting HFC-23 from their facilities, despite having received billions of dollars through the CDM to date.

Without immediate action to ensure continued incineration and address those currently venting from the Governments and companies involved, these few companies are sitting on a climate bomb of more than 2 billion tonnes of CO_2 equivalent by 2020.

Despite receiving massive windfall profits from destruction credits, CDM plants in China and India are clearly threatening to vent if these profits do not continue.[85] In late 2010 the Deputy Director of China's CDM Board issued a public statement threatening that China's CDM HCFC-22 production facilities would vent HFC-23 if not paid to destroy it.[86] Likewise, in October 2012, a senior member of the Prime Minister's Council on Climate Change in India was quoted stating that the Indian Government would not compel Indian industries to continue incinerating HFC-23 if they were not being paid by the CDM, citing the absence of any such domestic legislation prohibiting such action.[87] These statements have not been confirmed as government positions by India or China, but neither have they been disavowed.

Considering the billions of dollars of profits accruing to **all** HCFC chemical companies, through the production of gases that destroy our ozone layer and through the manipulation of the CDM that was meant to transfer clean development technologies to developing countries, the continued venting of HFC-23 is a huge environmental scandal that must be immediately addressed.

A Way forward

In recent years, proposals have been submitted to the Montreal Protocol to pay the incremental costs of the non-CDM HFC-23 destruction. These have been repeatedly rejected by the primary producers of HFC-23. In a 2012 New York Times article, the past chair of the CDM Executive Board Martin Hession was quoted explaining how "politically hard" it was to get India or China to agree to anything that meant losing this financial incentive to incinerate HFC-23.[88]

The issue of China's HFC-23 emissions is particularly pressing, with around half of their HCFC-22 facilities already emitting and the rest considering venting in the absence of further CDM profits. However, there was a significant breakthrough at the last meeting of the Montreal Protocol's Multilateral Fund, with a decision to fund the phase-out of China's HCFC production to the tune of US$385 million. As part of the funding agreement, China agreed to "*... coordinate with stakeholders and make best efforts to manage HCFC production and associated by-product production in HCFC plants in accordance with best practices to minimize associated climate impacts.*"[89] With best practice confirmed as practically 100% destruction of HFC-23, this indicates that China may be willing to defuse the HFC-23 bomb and address HFC-23 emissions from all HCFC-22 plants. Moreover, China's "12th Five-year Plan on Greenhouse Emission Control (guofa [2011] No. 41)," has called for pilot programs that aim to promote a low-carbon economy, and specifically commits to, *inter alia*:

1. **reduce GHG emissions from the refrigerant production industries through improvement of production technologies; and**

2. **actively promote the research, development and application of emission reduction technologies on HFCs, PFCs and SF6.**

Taking immediate action to stop emissions of HFC-23 from non-CDM HCFC-22 facilities and to ensure that CDM HCFC-22 facilities continue to properly operate and maintain their HFC-23 incinerators would substantially advance the goals of China's own 5-year plan for addressing greenhouse gas emissions. The June 2013 announcement that China would work with the U.S. and other countries to phase-down the production and consumption of HFCs also signals that China is willing to seriously address HFC-23 emissions, and not a moment too soon.

The logical solution is for all Governments to mandate that all HCFC-22 plants destroy HFC-23. Companies that have CDM projects have profited considerably from carbon credits, and should build the cost of continued incineration into their normal costs of doing business. In the case of non-CDM plants (to our knowledge only based in China), EIA recommends that China utilize some of the approximately US$700 million that it has collected from taxing HFC-23 destruction credits to immediately equip its non-CDM plants with incinerators. The plant operators should then proceed to operate and maintain the incinerators as a cost of continued production of HCFC-22.

If existing destruction technologies currently deployed can be improved to achieve 100% ncineration, consideration should also be given to using the incremental cost funding approach of the Montreal Protocol to install HFC-23 equipment based on the best available technology.

EIA urges all Governments with HCFC-22 production to implement the following without delay:

- **Immediately enact legislation to require that all HCFC-22 plants must address HFC-23 emissions through incineration or other best-practice technology;**

- **Explore incentives (e.g. in the case of China through the CER tax) to help fund those HCFC-22 facilities that have not received huge profits from the CDM to date to ensure they are able to install the necessary equipment;**

- **Require all HCFC-22 plants to install best available technologies with near 100% abatement, and sufficient storage capacity to ensure that that all HFC-23 produced as a by-product of HCFC-22 production is stored during any authorized incineration shutdown (i.e., mechanical breakdowns) so that no venting occurs;**

- **Reject the use of HFC-23 carbon credits in mandatory or voluntary carbon markets.**

REFERENCES

1. Early assessments determined that HFC-23 was only 11,700 times as powerful as CO_2 and this value was used by the CDM, subsequently research established that HFC-23 is actually 14,800 times as climate damaging.
2. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html
3. The United Nation's CDM Program website is available at: http://cdm.unfccc.int/
4. UNEP Risoe CDM/JI Pipeline Analysis and Database, April 1st 2013.
5. UNEP Risoe CDM/JI Pipeline Analysis and Database, April 1st 2013.
6. https://cdm.unfccc.int/Statistics/Public/files/201304/cerstypenum.pdf
7. IPCC & TEAP, IPCC/TEAP Special Report on Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons (2005)
8. http://cdm.unfccc.int/Reference/Notes/meth/meth_note02.pdf
9. Michael Wara (2007) "Is the Global Carbon Market Working?", in Nature, Vol 445, 8 February 2007 http://www.nature.com/nature/journal/v445/n7128/full/445595a.html
10. Wara & Victor (2008), "A Realistic Policy on International Carbon Offsets", PESD Working Paper #74 http://iis-db.stanford.edu/pubs/22157/wp74_final_final.pdf
11. http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/TEAP-TaskForce-HCFC-Aug2007.pdf, page 6.
12. http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/TEAP-TaskForce-HCFC-Aug2007.pdf, page 57.
13. http://www.pointcarbon.com/news/marketdata/cdmandji/forward/scer/
14. China CDM Fund 2011 Annual Report, p.12 http://www.cdmfund.org/userfiles/20120620%E8%8B%B1%E6%96%87%E6%B8%85%E6%B4%81%E5%9F%BA%E9%87%91.pdf
15. http://www.gfl.co.in/Annual%20Reports/GFL%20Annual%20Report%202011-12.pdf GFL's annual report states "A part of the expected CER generation of the Company till December 2012 have been sold under firm fixed price contracts, a part under floating price contracts with floor prices, and a part have been kept unheeded for sale in the spot market on issuance. Spot prices have softened over the past twelve months, due to supply-demand imbalance, largely caused by the European economic situation."
16. MLF press release http://www.multilateralfund.org/InformationandMedia/default.aspx?PageView=Shared
17. UNEP Risoe CDM/JI Pipeline Analysis and Database, May 1st 2013 www.cdmpipeline.org
18. CDM 2012 Annual report available here: http://www.cdmfund.org/newsinfo.aspx?m=20120912144529467324&n=201305230903 26723992 In the The By end of 2012 the Chinese CDM fund had collected 12.15 billion RMB from CDM projects (US$1.98 billion)
19. CDM 2012 annual report, ibid
20. http://news.cnfol.com/091106/101,1591,6764305,00.shtml
21. Clean Development Mechanism Project Design Document Form (2004) available at http://cdm.unfccc.int/filestorage/C/R/F/CRFVZP3HKZRLQGI9TRPXWMK7OPFNRE.1/PDD_Quimobasicos_19Dec05bis.pdf?t=Wml8bW85eWdjfDD025tp_mYzMLa8dTE-cmz2
22. Quimobásicos HFC Recovery and Decomposition Project, Project Design Document, Clean Development Mechanism, May 23, 2006, p. 1. Retrieved at http://cdm.unfccc.int/UserManagement/FileStorage/CRFVZP3HKZRLQGI9TRPXWMK7OPFNRE.
23. http://cdm.unfccc.int/filestorage/u/2/871G04UVEFA9N5R6XCKBMSYL3JPIT0.pdf/MR_Quimobasicos%20HFC%2034th.pdf?t=MWZ8bW9haDhzfDBhodciUmd-5iC7lor4f83Y
24. Cydsa 2006 Annual Report, p. 5. Retrieved at http://www.cydsa.com/cydsa_ing/InfoFin_pdf/RAnual/pdf06/annualreport06.pdf. Quimobasicos Issuance Request for First Monitoring Period. Retrieved at http://cdm.unfccc.int/Projects/DB/DNV-CUK138260062.2I/iProcess/TUEV-SUED1157984301.7/view
25. Cydsa 2007 Annual Report, p. 25, shows $10.8 mil in December 2006 and $22.3 mil for 2007; Cydsa 2008 Annual Report, p.27, shows $52 mil for 2008; Cydsa 2009 Annual Report, p. 29, shows $8 mil before sales were suspended in May; Cydsa 2010 Annual Report shows no sales in 2010; Cydsa 2011 Annual Report, p. 54, shows $26 mil after sales resumed in February. All retrieved at http://www.cydsa.com/cydsa_ing/ranual11.html Cydsa Financial Report for the Third Quarter of 2012, p. 4, shows $17 mil in sales through the third quarter. Retrieved at http://www.cydsa.com/cydsa_ing/InfoFin_pdf/QReport/2012/3Trim12ingles.pdf
26. Takeover Offer for DoloMatrix International Limited: Independent Expert's Report, 26 May 2008, p. 75. Retrieved at http://newsstore.smh.com.au/apps/previewDocument.ac?docID=GCA008452Z74DMX&f=pdf
27. Cydsa, S.A.B. de C.V. and Subsidiaries: Consolidated Financial Statements for the Years Ended December 31, 2011 and 2010, and Independent Auditors' Report Dated March 12, 2012, Deloitte, p. 20, 27. Retrieved at http://www.cydsa.com/Infofin_pdf/ReportesAnio/CydsaySub2011IngEFDSAB.pdf
28. Cydsa, S.A.B. de C.V. and Subsidiaries: Consolidated Financial Statements for the Years Ended December 31, 2008 and 2007, and Independent Auditors' Report Dated March 6, 2009, Deloitte, p. 2, 19. Retrieved at http://www.cydsa.com/Infofin_pdf/ReportesAnio/Cydsa%20y%20Sub%202008%20IngEFDSAB.pdf
29. Quimobásicos HFC Recovery and Destruction Project (plant 2), Project Design Document, Clean Development Mechanism, December 15, 2008, p. 10. Retrieved at http://cdm.unfccc.int/UserManagement/FileStorage/20BX7TY9K6P83RHALVOMISDWUE0CJ4
30. Cydsa 2011 Annual Report, p. 56. Sergio Lozano Garcia to the Executive Board of the Clean Development Mechanism, November 14, 2011. Retrieved at http://cdm.unfccc.int/public_inputs/ 2011/eb65_01/ cfi/CDGFLGKDJBWZW93P5IRLCMIN90Y0VZ
31. Methodology 0001 Revision Request, F-CDM-Rev. ver.01, 8 March 2010 https://cdm.unfccc.int/methodologies/PAmethodologies/ revisions/58215
32. Source: Methodology 0001 Revision Request, F-CDM-Rev. ver.01, 8 March 2010
33. https://cdm.unfccc.int/methodologies/PAmethodologies/revisions/58215
34. Meth Panel 47 Report on HFC-23 Issues (AM0001). Version 2, Bonn, 16 November 2010. Confidential.
35. Draft revision to the approved baseline and monitoring methodology AM0001 "Incineration of fluoroform (HFC-23) waste streams". http://cdm.unfccc.int/Panels/meth/meeting/11/049/ mp49_an03.pdf
36. CDM Policy Dialogue final report available at: http://www.cdmpolicydialogue.org/report
37. Commission Regulation (EU) No 550/2011 of 7 June 2011 on determining, pursuant to Directive 2003/87/EC of the European Parliament and of the Council, certain restrictions applicable to the use of international credits from projects involving industrial gases, 6 June 2011, http://eur-ex.europa.eu/LexUriServ/LexUriServ.do ? uri=CELEX:32011R0550:EN:NOT
38. Commission Regulation (EU) No 550/2011, ibid
39. http://carbonmarketwatch.org/hfc-23-update-un-bodies-stall-eu-moves-ahead-newsletter-15/
40. http://www.climatechange.govt.nz/emissions-trading-scheme/building/regulatory-updates/
41. China slams EU's HFC 23 offset ban, Point Carbon, 2 December 2010
42. "China May Emit Worst Greenhouse Gases as Europe Bars Credits", Natalie Obiko Pearson and Matthew Carr, November 3 2011, Bloomberg. http://www.bloomberg.com/news/2011-11-03/china-may-resume-pollution-without-offset-revenue-fund-says-1-.html43. http://cdm.unfccc.int/filestorage/F/5/0/F50UY06A971HCGET03NSPJZ2VK4LWB/CDM_PDD_YINGPENG_v1.5_Apr%2020%202009_clean%20text_.194?t=bWJ8bWh3dWo0fDC1npIUGiwcRchnd4dQBQUU; and 10,000 mt/yr is produced at the non-CDM facility. Personal communications with the Plant VP; see also Research China p. 4.
44. Research China, China Hydrofluoric Acid Industry Report, 2009-2012 available at http://www.researchinchina.com/FreeReport/PdfFile/6344547000562337 50.pdf
45. http://www.yingpengchemical.com/cgi/search-en.cgi?f=introduction_en+company_en_1_&t=introduction_en&title=about%20us
46. 290 tonnes of HFC-23 emitted per year, with a GWP of 14,800, equates to 2.9 million tC02e per year
47. http://www.yhfc.com/cn/about_profile.asp The text is only available in Chinese.
48. Based on conversations with Mr. Tong.
49. Personal conversations with Mr. Tong.
50. Annual emission of 750 tonnes of HFC-23, with GWP 14,800, equates to 11.1 million tC0.e
51. The non CDM plants are Jiangxi Sanmei, Shandong Jinan 3F, Sichuan Honghe, and Fuxin Hengtong Flourine Chemicals Co., Ltd., the last of which is potentially no longer producing HCFC-22.
52. There are likely more plants that EIA has not been able to indentify to date. China fluoro claims that there are 20 non-CDM plants, but would not provide additional information.
53. http://www.chinafluoro.com/en/
54. Information gained during the investigation
55. Information gained during the investigation and from UNEP Risoe CDM Pipeline
56. Montzka, Kuijpers, Battle, Aydin, Verhulst, Saltzman, Fahey, Recent increases in global HFC-23 emissions, Geophysical Research Letters, 37, L02808, doi: 10.1029/2009GL041195
57. Miller *et al.* (2010). HFC-23 (CHF3) emission trend response to HCFC-22 (CHClF2) production and recent HFC-23 emission abatement measures. Atmos. Chem. Phys., 10, 7875-7890 available at http://www.atmos-chem-phys.net/10/7875/2010/acp-10-7875-2010.pdf
58. P 21 Meth Panel 47 Report on HFC-23 Issues (AM0001), Version 2, Bonn, 16 November 2010.
59. Venezuela claims to destroy all HFC-23 that it produces, but this claim has not been verified.
60. Montzka *et al.*, (2010), ibid
61. Montzka, Kuijpers, Battle, Aydin, Verhulst, Saltzman, Fahey, Recent increases in global HFC-23 emissions, Geophysical Research Letters, 37, L02808, doi: 10.1029/2009GL041195
62. Note: This source category consists of: 1. Processes that produce HCFC-22 (Chlorodifluoromethane,or CHClF2) using chloroform and hydrogen fluoride; 2. HFC-23 destruction processes located HCFC-22 production facilities; and 3. HFC-23 destruction processes that destroy more than 2.14 metric tons of HFC-23 per year and that are not located at HCFC-22 production facilities.
63. Page 4-77, http://epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf
64. Page 4-77, http://epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf
65. "HCFC-22 Production Capacity," signed by Quimobásicos plant manager, Ing. Rodolfo Vidaurri Dufour reports that each plant has a capacity of 10,220 MPTY. Retrieved at http://cdm.unfccc.int/UserManagement/FileStorage/EL70HY16GVQFZ925R8ISNW0UCAP47X Reporte Anual 2011, CYDSA, p. 26 reports an overall capacity of 18,400 MPTY. Retrieved at http://www.cydsa.com/InfoFin_pdf/RAnual/pdf11/infoanual_2011.pdf.
66. "30th Monitoring Report," Quimobásicos HFC Recovery and Decomposition Project, June 25th, 2012, p. 58. Retrieved at http://cdm.unfccc.int/UserManagement/FileStorage/7Y5XPZ0DIFW43MSGJNIH9CUAQ02EBL
67. Reporte Anual 2011, p. 26 claims Quimobasicos HCFC-22 production ran at 64% capacity (from 18,400 MTPY) in 2011. This translates to about 11,776 tonnes: subtracting the 8,837 tonnes generated at the CDM plant, this leaves 2,939 tonnes produced at the second plant.
68. Versión Preliminar del Registro de Emisiones y Transferencia de Contaminantes (RETC), 2011, SEMARNAT. Retrieved at http://appl.semarnat.gob.mx/retc/retc11pre/
69. http://cdm.unfccc.int/filestorage/2/Q/B/2QBX7TY9K6P83RHALVOMISDWUE0CJ4/PDD%20Version%203.1?t=Z0I8bW9id2p4fDBOA4wFTO63Of2FqUczfKpR see page 7
70. Öko-Recherche *et al.*, (September 2011) Preparatory Study for a Review of Regulation (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, Final Report , p.174
71. http://www.empa.ch
72. Kellner *et al.*, Evidence for under- reported western European emissions of the potent greenhouse gas HFC-23, GEOPHYSICAL RESEARCH LETTERS, VOL. 38, L15808, doi:10.1029/2011GL047976, 2011, L15808 http://www.empa.ch/plugin/template/empa/*/110824
73. According to the company's website, Solvay Solexis is a leading provider of fluoromaterials http://www.solvayplastics.com/SITES/SOLVAYPLASTICS/EN/SPECIALTY_POLYMERS/SOLVAY_SOLEXIS/Pages/SolvaySolexis.aspx
74. Dordrecht is one of DuPont's largest production sites of in Europe. The site is home to nine manufacturing plants where the refrigerants Isceon® and Suva® and the fluoroproducts Teflon® and Viton® are made http://www2.dupont.com/Dordrecht_Plant_Site/en_NL/, last consulted on 24.05.2013
75. In 2010, INEOS Fluor was bought out by Mexichem, which now operates the UK production facilities in Runcorn, Cheshire (http://www.ineos.com/News/~/INEOS-Group-agree-sale-of-INEOS-Fluor-to-Mexichem-Fluor-SA/?items=10&businesses=4&year=&page=4). The Runcorn plant is the largest hydrofluoric acid production plant in the world. (http://www.mexichem.com/English/Fluor/marcas_fluor.html, last consulted on 24.05.2013). Hydrofluoric acid is used in the production of a wide range of HFCs
76. According to the company website, Arkema produces HCFC-22, HFC-23, HFC-141b at its plant in Pierre-Bénite http://www.arkema.fr/sites/france/fr/nos_sites/nos_usines/pierre_benite/pierre_benite_produits.page
77. Öko-Recherche *et al.*,op cit., p.235
78. http://www.oekorecherche.de/english.html
79. Oko-Rech *et al.* op cit,, p.173
80. http://cdm.unfccc.int/filestorage/2/Q/B/2QBX7TY9K6P83RHALVOMISDWUE0CJ4/PDD%20Version%203.1?t=Z0I8bW9id2p4fDBOA4wFTO63Of2FqUczfKpR
81. http://ji.unfccc.int/JIITLProject/DB/ONJYYFJ60YFZVWGTVNVW55JMSANCGV/details and http://ji.unfccc.int/JIITLProject/DB/IHERGMOKULXB0542II93XY4L3V10VH/details
82. See JI Pipeline at UNEP Risoe CDM/JI Pipeline Analysis and Database, June 1st 2013"
83. Miller, B. R. and Kuijpers, L. J. M.: Projecting future HFC-23 emissions, Atmos. Chem. Phys., 11, 13259-13267, doi:10.5194/acp-11-13259-2011, 2011
84. http://cdm.unfccc.int/filestorage/2/Q/B/2QBX7TY9K6P83RHALVOMISDWUE0CJ4/PDD%20Version%203.1?t=Z0I8bW9id2p4fDBOA4wFTO63Of2FqUczfKpR see page 7
85. http://www.nytimes.com/2012/08/09/world/asia/incentive-to-slow-climate-change-drives-output-of-harmful-gases.html?pagewanted=all; http://in.reuters.com/article/2012/10/31/india-hfc-emissions-idINDEE89U0C520121031
86. Chen Huan interview Dec. 2, 2010 with Kathy Chen/Point Carbon - China Slams EU's HFC 23 Offset Ban: and, We Must Watch Out For The Adverse Consequences Of The Draft Proposal - Review of Draft COMMISSION REGULATION of determining, pursuant to Directive 2003/87/EC of the European Parliament and of the Council, certain restrictions applicable to the use of international credits from projects involving industrial gases, Wang Anle
87. Reuters Point Carbon, India HFC-23 emissions may rise if CDM boon ends-former official, October 31, 2012, http://in.reuters.com/article/2012/10/31/india-hfc-emissions-idINDEE89U0C520121031
88. Elisabeth Rosenthal and Andrew Lehren, "Profits on Carbon Credits drive Output of a harmful Gas", New York Times, August 8 2012, http://www.nytimes.com/2012/08/09/world/asia/incentive-to-slow-climate-change-drives-output-of-harmful-gases.html?pagewanted=all
89. "Multilateral Fund approves landmark project for China with ozone and climate benefits - up to US $385 million of funding over the next 17 years", 22 April 2013, http://www.multilateralfund.org/InformationandMedia/default.aspx?PageView=Shared

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