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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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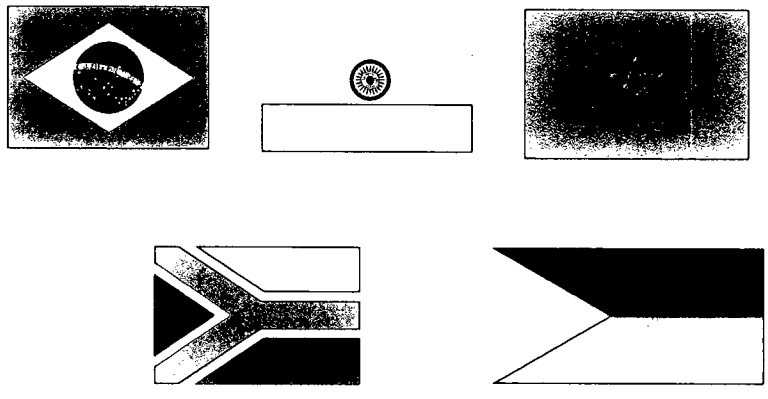
Addagy

Concept for Non-CO_2 GHG Emissions Reductions in the Manufacturing Sector: Focussing on Brazil, India, Morocco, South Africa and the Philippines

October 2004

FINAL REPORT



CONTENTS

1 Introduction

This report gives the results of a short study to investigate the potential for promoting innovative public-private partnerships for efficient clean development mechanism (CDM) operations specifically focussed on the "manufactured gases" Nitrous Oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur Hexafluoride (SF_6). The study was prepared as a background study for the preparation of the UNIDO component of a UN Inter-Agency project entitled "**Promoting Innovative Public-Private Partnerships for Efficient Clean Development Mechanism (CDM) Operations.** Information contained in this report has been gained from internet searches, telephone and face to face interviews with key stakeholders (contact details are listed in Annex 1) and in-house information held by Addagy Ltd on the subject of fluorinated gases. A copy of the questionnaire used to interview country representatives is presented in Annex 2.

The report presents a "snapshot" of the situation as of September 2004. The field is developing rapidly as countries and organisations position themselves to deal with the issues surrounding their Kyoto commitments. Even during the one month study period it is noticeable that organisations are continuing to develop their approach and rapid change can be expected for some time to come.

The study provides an overview of the alternative methods available for reducing emissions of manufactured gases and suggests potential options for emissions reduction projects for five selected Non-Annex 1 countries (Brazil, India, Morocco, the Phillipines and South Africa). An appraisal of the methodologies required to achieve these emission reductions and an analysis of potential interested stakeholders in instigating these projects is provided.

CDM is a subject awash with acronyms and technical jargon and to aid the reader a Glossary of Terms is presented in Annex 3.

1.1 The Kyoto Protocol and CDM/JI

In Kyoto, in December 1997, the Kyoto Protocol was drawn up. Implementation of the Protocol will reduce developed country emissions of the major greenhouse gases to 5.2% below 1990 levels by 2008 – 2012. Once the Kyoto protocol is "ratified" this becomes a legally binding commitment. For the Kyoto protocol to come into force, Annex 1 nations emitting 55% of total global emissions must individually ratify the protocol. To date 124

nations including all but five Annex 1 Countries have ratified. The Annex 1 nations who have ratified comprise a total inventory of 44.2% of emissions.[1]

The five Annex 1 countries that have not ratified yet are Australia, Liechtenstein, Monaco, Russia and the United States. But only ratification by Russia, which is responsible for 17.4% of the global 1990 CO_2 emissions, or the US, responsible for 36.1%, will make a difference as the three remaining countries together account for only 2.1%. After the United States withdrew from the Kyoto Protocol in early 2001, Russia now appears to hold the key for the Protocol's entry into force. It has announced that it will ratify soon and the future of the Kyoto Protocol relies on this happening or a change in policy by the US Government.

The Kyoto target covers a basket of six gases (Carbon Dioxide (CO_2), Methane (CH_4), N_2O, HFCs, PFCs and SF_6) weighted by their Greenhouse Warming Potential (GWP). Under the Protocol, the base year for CO_2, CH_4 and N_2O is 1990, whereas each signatory country has the choice to select a base year of either 1990 or 1995 for HFCs, PFCs and SF_6.

In order to increase the prospects of emissions being reduced for the least cost, the Kyoto Protocol allows for projects to be conducted in any country. These are done under the Clean Development Mechanism (CDM) and Joint Implementation (JI) which are defined as follows:

The Clean Development Mechanism (CDM) is a market mechanism defined in the Kyoto Protocol (Article 12) as a project between a developed country (Annex 1) and a developing county (non-Annex 1) that provides the developing country with the financing and technology for sustainable development and assists the developed country in achieving compliance with its emission reduction commitments. The major difference between CDM and JI (see below) is that it is possible to "bank" Certified Emission Reductions (CERs) prior to 2008 for use in the 2008 to 2012 Kyoto commitment period. Thus it is possible to start generating CERs today. A number of CDM projects have already started to generate CERs and this includes one project involving manufactured gases. This project is discussed in section 3.

Joint Implementation (JI) works in a similar way as CDM but is a partnership between two developed countries. No banking of emission credits is allowable for JI projects. For the purposes of this study we refer to CDM throughout as this is the mechanism appropriate to the five countries being investigated.

1.2 CDM Projects

There are a number of key steps in achieving a CDM project[2]. To be eligible to generate CERs, all CDM projects must be registered with the CDM Executive Board (EB). Full

[1] As of 1/9/04 – includes ratification, accession and acceptance

[2] A clear project cycle is laid out by the UNFCCC (see http://cdm.unfccc.int/pac/index.html)

project documentation must be presented to the board in the form of a project design document (PDD). This must include:

- An in depth description of the technologies to be used
- Detailed plans for monitoring and verification of claimed emissions reduction
- A rational for assessing the "business as usual" emissions, i.e the emissions that would have occurred if the project had not proceeded.
- A description of the "sustainability of the project" involving stakeholder consultation and an environmental impact assessment (EIA) where appropriate

The PDD is submitted to the EB who meet on a regular basis (the latest deadline for submissions is 28th October 2004) and the EB publish the PDD for public scrutiny (at the project developers cost). If the methodology is approved, the project developer can begin to implement the project. As of 24th August 2004, 12 methodologies have been approved, all of which deal with CO_2 emission reduction except for Approved Methodology AM 0001 which deals with reductions in emissions of a manufactured gas (HFC 23). The methodologies available for manufactured gases are discussed in detail in section 3. Clearly the preparation of a methodology can be time consuming and costly. There are a number of costs associated with initiating a project. The main costs are:

- Baseline and Methodology Preparation ($20k CERUPT or $40k PCF)[3]
- Validation (around $10k)
- Registration fee $5k
- Ongoing monitoring and verification costs >$10k p.a
- In addition the CDM executive board retains 2% of CERs as an adaptation levy.

The costs of developing and implementing a CDM methodology can be modest in comparison to some larger projects but could provide a significant barrier for smaller projects and hence some organizations exist specifically to support the development of smaller projects.

1.3 Funding CDM Projects

Experience to date has shown that successful CDM projects require partnerships containing the following mix:

- A technology leader
- Local agents/partners to oversee and manage the project
- Funding source
- A buyer for the credits generated

The main technology options available for manufactured gases are discussed in section 2 along with suggestions as to possible technology leaders, local agents and partners. In terms of funding, The World Bank has played a pioneering role in catalyzing the market for greenhouse gas emission reductions, through the Prototype Carbon Fund (PCF) and

[3] estimates sourced from TERI India

the Netherlands amongst others are taking a leading role in facilitating the purchase of CERs.

The Prototype Carbon Fund

The PCF was established by the World Bank in 1999. The PCF aims to pilot production of Emission Reductions within the framework of both JI and CDM. The PCF will invest contributions made by companies and governments in projects designed to produce greenhouse gas emission reductions. The PCF has three primary strategic objectives:

- **High-Quality Emission Reductions:** to show how project-based greenhouse gas Emission Reduction transactions can promote and contribute to sustainable development and lower the cost of compliance with the Kyoto Protocol;
- **Knowledge Dissemination:** to provide the Parties to the UNFCCC, the private sector, and other interested parties with an opportunity to "learn-by-doing" in the development of policies, rules, and business processes for the achievement of Emission Reductions under CDM and JI;
- **Public-Private Partnerships:** to demonstrate how the World Bank can work in partnership with the public and private sectors to mobilize new resources for its borrowing member countries while addressing global environmental problems through market-based mechanisms.

PCF operations began early in 2000. The PCF is funded to the level of US$180 million and is scheduled to terminate in 2012. One private company, Ecosecurities (see http://www.ecosecurities.com/) has registered with the PCF as a possible source of carbon finance. A list of CDM projects funded by the PCF and currently underway can be found at: http://carbonfinance.org/pcf/router.cfm?Page=Projects#1

The five countries to be researched in this study are all host countries for PCF carbon finance business[4] and PCF is extremely important to success at this stage in the development of CDM. In addition to the lead taken by the World Bank, a number of countries are developing their own support for CDM projects. This help is driven by two main objectives:

- To develop a market for CERs to ensure that a country can meet its KP target economically
- To develop trade links to enhance the economic performance of the host country

To date the most active country has been the Netherlands although other countries are also developing their approach. Some of these countries activities are discussed below:

The Netherlands – ERUPT/CERUPT

The Netherlands has taken a leading role in promoting CDM as a way to meet its national Kyoto targets. Responsibility for CDM in the Netherlands is with the Ministry of

[4] This means that the host government has signed a Memorandum of Understanding with the PCF

Housing, Spatial Planning and the Environment (VROM). The World Bank announced an agreement with the Netherlands in May 2002, establishing a facility to purchase CERs. The facility supports projects in developing countries in exchange for such credits under CDM. The facility's initial target was to purchase 16 million tonnes of carbon dioxide equivalent ($MtCO_2e$) in the first two years of the agreement. The agreement has now been extended, with a firm commitment to purchase an additional five $MtCO_2e$ by mid-2005. The agreement also allows for a further purchase of up to approximately 11 $MtCO_2e$.

In order to encourage CDM projects, VROM has established CERUPT (the Certified Emission Reduction Unit Procurement Tender). Through CERUPT the Netherlands hopes to stimulate CDM by providing funds for acquisition of CERs. In addition to CDM projects, JI projects are also covered under ERUPT (the Emission Reduction Unit Procurement Tender).

Through an organization called Carboncredits.nl, the Dutch company Senter[5] helps companies participate in ERUPT and CERUPT projects. Senter buys CERs on behalf of VROM from project developers. Prices are realised by a process of competitive bidding. At present Senter pays approximately EUR 3-5 per CER. Senter has already contracted around 25 projects in this manner, including 3 projects in India and one in Brazil. None of the projects as yet involves manufactured gases but these gases are not excluded. Senter organizes regular information and briefing sessions on participating in ERUPT and CERUPT. The last meeting took place in the Hague on 6th September. **Adriaan Korthuis** is Programme Manager of Carboncredits.nl. He is responsible for the ERUPT and CERUPT programmes.

Another interesting initiative by the Dutch is The Reduction Programme, non-CO_2 greenhouse gases (ROB). The ROB aims to reduce emissions of CH_4, N_2O, HFC's, PFC's and SF_6 by:

1. stimulating research into emission-factors and levels for the various emission sources
2. subsidising research into new reduction technologies
3. stimulating the implementation of reduction measures
4. stimulating cooperation between the government, sector groups and industry

The ROB is a multi-year interdepartmental programme with participation from the VROM, the Ministry of Agriculture, Nature Management and Fisheries, and the Ministry of Economic Affairs. The programme is managed by VROM and is implemented by Novem.(www.novem.org). ROB has focussed on the following manufactured emission sources:

- PFC emissions from aluminium production
- HFC emissions from the production of HCFCs
- Using HFCs and PFCs as an alternative for (H)CFCs

[5] see www.senter.nl

- N_2O emissions from catalytic converters in cars
- N_2O emissions from the production of nitric acid
- SF_6 emissions from the electricity sector
- SF_6 and PFC emissions from the semiconductor industry

Of these initiatives, some of the most promising work is being done on N_2O emissions from the production of nitric acid. Three Dutch companies, with a total of seven factories, produce nitric acid and emit approximately 8 Mtonnes of CO_2 equivalents (in the form of N_2O). Developments indicate that an 80% reduction in emissions is possible when using catalytic conversion. Several Dutch research institutes and companies are involved in the development of a suitable catalyst. Other N_2O reducing technologies are also in development. Furthermore, the Government and sector are currently discussing the implementation of these kind of measures. No approved CDM methodology currently exists for N_2O emissions from the production of nitric acid

CD4CDM (see www.klima.ph/cd4cdm/index.htm) is a project involving 12 countries worldwide funded by the Netherlands Ministry of Foreign Affairs. It is led internationally by the United Nations Environment Programme (UNEP) through the UNEP Risø Centre on Energy, Climate and Sustainable Development at Risø National Laboratory in Denmark. The aims of the project are stated as:

- Information Campaign and Awareness Raising.
- Strengthen the Capacity of Policy-makers.
- Support the Establishment of the Institutional Framework for the CDM.
- Strengthen the Capacity of Private and Public Sector Player such as Project Developers, Project Financiers, NGOs, Local Communities, National Research Institutions and Academia.
- Create a Pipeline of CDM Projects.

Of the countries in this study, CD4CDM is active in Morocco and the Philippines. Progress in the Philippines has been particularly strong and this is reviewed in section 2.2.

Austria

The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management takes responsibility for the Austrian JI/CDM Programme. It has been particularly active and aims to make a contribution to achieving the Austrian reduction commitment under the Kyoto Protocol through the application of CDM projects. Within the scope of its CDM Programme are:

- The purchase of CERs from CDM projects, which lead to avoidance or reduction of greenhouse gas emissions;
- Financing of general background and preparatory work, such as baseline studies etc., which are necessary with respect to CDM projects.

Based on the amendment of the Environmental Support Act the Programme started on August 21, 2003. Kommunalkredit Public Consulting (KPC) was appointed for the Programme Management (see http://www.ji-cdm-austria.at/en/kontakt.php).

A call for potential CDM projects was made on December 10, 2003. The call is open until September 30, 2004 and it is thus too early to comment on how this will progress. A second call for CDM projects will be made in October 2004 and there will be a workshop in Vienna on 21st and 22nd October which will provide further information. To attend call Martina Graf (Tel. +43 1 316 31 ext. 212).

UK

In the UK, initiatives on CDM are led by the Climate Change Project Office (CCPO). The CCPO is jointly funded by the Department of Trade and Industry (DTI) and the Department for Environment, Food and Rural Affairs (Defra). The CCPO are a Government advisory office set up to assist UK businesses who wish to pursue opportunities arising from the Kyoto Protocol such as CDM projects. They provide advice and support for projects which reduce greenhouse gas emissions and which could be eligible for CERs. They give information to companies who are new to Climate Change Projects and also provide help with specific project enquiries. The CCPO has four principal functions:

- to raise awareness of Climate Change Projects and the important role that they can play in a company's business strategy
- to offer specific advice in relation to individual project proposals
- to provide the means through which businesses can find out about related Government activities and any available support, and
- to contribute to UK Government policy-making and provide feedback to policy-makers on the experience of UK business.

The main difference between the UK programme and those described in the Netherlands and Austria is that the UK does not expect to need to purchase CERs to meet its KP target and hence the purchase of CERs is not an objective. Further CDM programmes are emerging in other countries such as Switzerland (see www.admin.ch/swissaij/) and Canada Office (see www.dfait-maeci.gc.ca/). It will be necessary to maintain a vigilant watch in this area as more country programmes are likely to emerge as countries determine their likely KP target shortfall. Activity will be further stimulated if the KP target of 55% is met.

Small Projects

As noted above, initiating small projects could be perceived to be a problem due to the initial costs of obtaining EB approval. Two specific projects exist to overcome this barrier:

The Pembina Institute established the **Canadian Clean Development Mechanism Small Projects Facility** (CDM SPF) with the support of the Canadian Department of Foreign Affairs and Trade (DFAIT) and the Canadian International Development Agency (CIDA in the Autumn of 2002. The objectives of the facility are four-fold:

- To promote small community-based renewable energy and other greenhouse gas reduction projects that qualify under the CDM simplified approval process;
- To increase CDM opportunities in regions with existing investment barriers;
- To support communities, non Governmental organisations, small medium enterprises, and other potential project hosts in preparing PDDs
- To link Canadian CDM investors with viable community-based projects from developing countries.

The facility is currently supporting eight small-scale renewable-energy projects in India. No current projects involve manufactured gases.

The Community Development Carbon Fund (CDCF)[6] acts to link small-scale projects in developing countries seeking carbon finance with companies, governments, foundations, and NGOs seeking to improve the livelihoods of local communities. They also help with the process of obtaining verified emission reductions. They have several projects already running, including one in India looking at alternative technologies for brick manufacture.

1.4 Potential for CDM Projects in the Manufactured Gases Sector

The manufactured gases comprise less than 10% of any countries greenhouse gas inventory. However, because manufactured gases are emitted as by products of manufacturing processes they can be relatively straight forward to isolate and reduce. These gases can therefore offer significant opportunities for emission reduction.
To qualify for funding through PCF, NCDF and other Government initiatives, the projects need to satisfy a range of criteria which overall are determined to identify what are known as "Good Projects". These are projects which contribute to sustainable development through implementation of CDM in the host country. These criteria vary and are open to interpretation but include a range of factors including, but not restricted to the following criteria. The project will:

- Deliver improvements in the overall local environment (often determined via an EIA and local stakeholder consultation)
- Deliver improvements to quality of life and or wealth creation to the region
- Deliver increased jobs
- Are viewed as "sustainable" i.e do not diminish scarce resources
- Provide CERs against a baseline which is satisfactory to all perspectives
- Has no negative impacts

[6] www.communitycarbonfund.org

- Result in replicable transferable technology
- Comply with all international rules and procedures governing and associated with the mechanisms established under the Kyoto Protocol
- Are consistent with all relevant national criteria.

The subject of manufactured gases can prove contentious in some quarters and any attempt to judge whether emissions reductions projects reach the criteria laid out above is necessarily subjective. The table below attempts to identify areas for a few possible projects where manufactured gases indisputably meet the criteria above.

Project	HFC 23 Incineration	N_2O Treatment	PFCs from Al	Waste HFC [illegible]	In life HFC [illegible]
Improve local environment					
Improve quality of life and or wealth creation	√	√	√	√	√
Increased jobs	√	√	√	√	√
Sustainable	1.	√	√	√	√
Baseline satisfactory to all perspectives	2.	2.	√	2.	2.
No negative impacts	√	√	√	3.	3.
Transferrable Technology	√	√	√	√	√
Methodology	Approved[7]	Proposed	Proposed	None	None

1. Seen by some to encourage continued production of HCFC 22
2. Controversy over what to use as baseline
3. Could encourage bad practice in definition of what is waste.

Thus it is likely that CDM projects can be developed in the manufactured gas sector, but not without some controversy.

1.5 The Carbon Trading Market

The market for carbon credits is still in its infancy and both supply and demand is very sporadic. It is difficult to get a true picture of the current situation as many trades are currently not revealed since the main drivers for private industry involvement are currently seen to be learning and public relations at this stage. According to EcoSecurities[8] around 70 transactions have been made to date, but this is expected to rise over the next few years. It is difficult to estimate the future value of carbon trades. According to Eco-Securities[8] the likely price range for future trades will be in the region of $US 5-11 per Tonne CO_2, and the total volume of trading is likely to reach around 1,000 M Tonne CO_2 by 2011. It thus appears likely that there is considerable scope for the development of a wide range of CDM projects.

[7] Although this methodology has been approved it is currently suspended (see page 22)
[8] contact Justin Guest +44 7855 352313

2. Options for Mitigation of Manufactured Gas emissions

Manufactured gases are taken in this study to include the following groups of chemicals:

a) **HFCs.** are compounds containing carbon, fluorine and hydrogen. HFCs had limited usage prior to the Montreal Protocol and the phase out of CFCs and HCFCs, but are now playing an important role as substitutes in a wide range of applications including aerosols, insulating foam, solvents and refrigeration. HFCs are also a by-product of HCFC 22 manufacture. HFCs have significant GWPs (Global Warming Potentials), albeit lower than the CFCs that they are being used to replace.

b) **PFCs.** are compounds containing just fluorine and carbon. PFCs have zero ODP but, because of their extremely long atmospheric lifetimes, they have particularly high GWPs. They are used in small quantities in certain industrial applications such as electronics and are being considered as replacements for CFCs and HCFCs in niche markets. PFCs are also a by-product of primary aluminium smelting.

c) **SF_6.** is a gas with a particularly high GWP. It is mainly used in the electricity supply industry, for magnesium smelting and in the semiconductor sector.

d) **N_2O.** is mainly emitted as a by product of combustion, through intensive agriculture and through the manufacture of nitric and adipic acid. In this study, only emissions due to manufacture of nitric and adipic acid are considered.

These gases are collectively referred to as "manufactured gases" in the rest of this study. These gases typically have much higher values of GWP (global warming potential) than does CO_2. GWP values for these fluids are shown in the table below:

Fluid Type	Typical Values of GWP*
HFCs	100 – 3000[9]
PFCs	5000 – 10000
SF_6	23900
N_2O	310

* GWP Relative to CO_2 = 1; 100 year time horizon

[9] HFC 23 has a GWP of 11,700 but is emitted only as a by-product. All the HFCs used as refrigerants have a GWP of 3000 or less.

Global warming emissions are presented throughout this report in "Mtonnes CO_2 equiv." (million tonnes CO_2 equivalent, based on the 100-year time horizon).

2.1 Sources of Emissions

There are three main routes for the gases listed above to be emitted to the atmosphere:

1. Emission of a gas as a by-product of manufacture of other products – this occurs in Aluminium (Al) smelting (PFCs), in the manufacture of Nitric and Adipic acid (N_2O) and in the manufacture of HCFC 22 (HFC 23)
2. Leakage of the gas from equipment during the normal lifetime of the equipment – this is usually the leakage of HFCs from Refrigeration and Air Conditioning (RAC) equipment or the leakage of SF_6 from switchgear
3. Emission of the gases at the end of the useful life of the equipment - this is usually the leakage of HFCs from RAC equipment or the leakage of SF_6 from switchgear.

A few other emissions sources exist but these are mostly minor and should be discounted at this stage[10]. Existing and potential new methodologies to deal with these sources of emissions are described in section 3. The main activities which result in emissions of manufactured gases as discussed above have all been addressed in Annex 1 countries and technologies or processes already exist which can reduce these emissions as shown in the table below:

Process	Emission Reduction Technology
HFC Usage in RAC equipment	Training and quality control – eg the STEK[11] approach in Holland
HFC 23 from HCFC 22 Manufacture	Incineration – eg the Ineos technology
Nitric Acid Manufacture	Catalytic reduction – eg the research being championed by ROB
SF_6 Usage in HV Switchgear	Collection for reuse or recycling – very occasionally destruction – eg Promosol
Adipic Acid Manufacture	Thermal decomposition – eg the technology used by Rhodia
Aluminium Smelting	Computer control of process – eg the technology used by Alcan

All of these emission reduction options are proven and are in use in Annex 1 countries already. It is these technologies and processes which can be transferred most easily. The

[10] see UK Emissions of HFCs, PFCs and SF6 – DETR 1999 for a fuller description.
[11] A full description of STEK can be found at www.stek.nl

only other option which might be proposed is in the use of SF_6 as a cover gas in primary Magnesium smelting. SF_6 is used as a cover gas in Magnesium smelting and some countries are looking at using or returning to SO_2 as an alternative. However this option is quite controversial due to the highly toxic nature of SO_2. Norsk Hydro are performing ongoing research in this area. This technology is not considered in this report.

2.2 Country Circumstances

In this section we consider which sources of emissions with transferable technologies as outlined above are present in each of the countries under investigation. It is thus important to determine the level of activity of each of these sources in each country under investigation. The following table summarizes the activity level in developing counties and these are then discussed in more detail for each country.

Process	Presence in Developing Countries?
HFC Usage in RAC equipment	Only just beginning. Mostly still CFCs and HCFCs – some HFCs mostly in car a/c
HFC 23 from HCFC 22 Manufacture	Rare – few manufacturing plants around the world
Nitric Acid Manufacture	Frequent – around 600 plants globally[12].
SF_6 Usage in HV Switchgear	Common in high voltage (HV) electricity transmission systems
Adipic Acid Manufacture	Rare – few manufacturing plants around the world
Aluminium Smelting	Fairly rare – smelting plants present if country is rich in bauxite

2.2.1 Brazil

Ratification and inventory

Brazil ratified the Kyoto protocol on the 23rd August 2002. It has yet to produce a national communication. However, a national inventory has been performed[13]. This inventory provides good detail on CO_2 and CH_4 emissions. It also provides details on N_2O emissions but not HFCs or PFCs. Emissions of N_2O were estimated to be 4,100 tonnes in 2001. A large proportion of these are likely to have come from the adipic acid plant which was run by Rhodia[14]. It has not been possible during this study to confirm whether this plant is still operated by Rhodia.

[12] according to US EPA.
[13] see http://ecen.com/eee37/engelsbenemis2.htm
[14] Rhodia is a global speciality chemicals company – see www.rhodia.com

Capacity Building

Brazil recently issued its CDM guidelines. According to Point Carbon[15], in their on-line magazine "CDM Monitor" – July 14th 2004, Brazil has taken the unusual step of approving CDM projects only on the basis that the KP enters into force. This effectively makes CERs purchased in Brazil riskier than those purchased elsewhere since there is still a risk that the KP will not enter into force. No other developing country has followed this route.

The Environmental Department of the German Chamber of Commerce (AHK) was created in 1996 with the major purpose to establish environmental technology transfer from Germany to Brazil. The AHK has good contacts in Brazil and regularly receives information requests related to CDM projects. AHK uses Ecoinvest as an advisory firm based in Brazil providing a broad range of financial services that meet the needs of environmentally conscious investors. Ecoinvest[16] focuses on identifying investments in cleaner technologies in Brazil, which will reduce emissions of greenhouse gases and become eligible for CERs CDM. Ecoinvest are currently developing two projects in Brazil, one on fuel switching at a cement plant and one on energy generation from sugar cane.

Summary Table

The table below summarises emissions in the country. As can be seen from the table, there are several options for projects in Brazil and in this case the area of Aluminium smelting looks particularly promising. Two global companies, BHP Billiton and Alcan operate in Brazil. BHP Billiton operate two Aluminium smelting plants in Brazil, at Valesul (92,000 tonnes capacity) and Alumar (370,000 tonnes capacity). Alcan[17] operate a smelting plant at Ouro Preto (135,000 tonnes). In addition, the Adipic and Nitric acid manufacturing plants probably offer good opportunities for emission reductions.

Activity	Present in Country?	Already being addressed?
HFC Usage in Refrigeration and Air Conditioning equipment	Yes	No
HCFC 22 Manufacture resulting in the emission of HFC 23 as a by product	No	No
Nitric Acid Manufacture	Yes	No
SF_6 Usage in HV Switchgear	Yes	No
Adipic Acid Manufacture	Yes	No
Aluminium Smelting	Yes	No

[15] see www.pointcarbon.com
[16] see http://www.ecoinv.com/english/
[17] A contact for Alcan is provided in Annex 1. No contact was made with Billiton during this study. For more information on Billion see www.bhpbilliton.com

A useful conference on the South American context is taking place in Brazil on 8-10 November. "The 2004 Carbon Credit Market in the Latin American Context". Topics to be discussed include: Challenges and Opportunities for Reliable Credit Generation - Regulatory & Financial Aspects and CDM Methodologies. The conference will present the positions of Latin America countries regarding their initiatives for supporting CDM projects. The venue is the Sheraton Rio Hotel & Towers, Rio de Janeiro, Brazil, The organizers are IBC Brazil and for further information and registrations contact: e-mail: carbono@ibcbrasil.com.br or phone: + 55 11 3017-6888

2.2.2 India

Ratification and inventory

India announced acceptance of the Kyoto Protocol on the 26th August 2002. India submitted its initial national communication on 1st November 2001. In the submission it is noted that emissions of N_2O come from Nitric acid manufacture with emissions estimated to be 9 Mtonnes CO_2 equiv. No adipic acid manufacturing is mentioned and it thus seems likely that there was no adipic manufacturing taking place. Emissions of HFCs, PFCs and SF_6 are not reported.

Capacity Building

A National Strategy Study (NSS) for CDM has been initiated to assess the issues and opportunities presented by potential international markets for greenhouse gases and to evaluate processes and methodologies to facilitate implementation of CDM in India. The study is being conducted by The Energy and Resources Institute (TERI) in New Delhi, with Swiss consultants providing additional inputs.

The NSS has not yet reported its findings. The CDM Monitor (May 12th 2004) reports that The National Strategy Study PIN pipeline includes 67 PINs of which 25 are in renewable energy, 16 in energy efficiency, 11 in the waste sector. Only 4 relate to thermal power generation[18]

India is the current leader in the overall number of CDM projects in the official pipeline (methodology and validation submissions). While biomass energy is currently the prevailing project type, the breadth and size range of the Indian portfolio is currently unrivalled. The DNA has approved 27 projects and another 9 are pending but are currently lacking clarification of issues.

India continues to be the leader of large-scale projects. The second HFC23 project is in preparation and a PFC reduction from a large aluminium smelter has been announced. These projects are discussed in detail in section 3 "methodologies".

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[18] see http://www.pointcarbon.com/category.php?categoryID=155&expand=155&sesstransport=0bd7fcaa7757b5a5dd7a45f9bffe5871%3A9b5d25d7885bdb1aa87209d3830f5a26

The UK has particularly strong historic links with India and in support of this on-going trade relationship the UK Foreign and Commonwealth Office (FCO) is supporting a project aimed at supporting the development of CDM projects in India with UK support. The project aims to focus down on identifying the best CDM opportunities in India, and to develop Project Idea Notes (PINs). Importantly the project will look to reduce emissions of all six Kyoto GHGs- CO_2, CH_4, SF_6, N_2O, PFCs and HFCs. The project has three main stages:

- An opening seminar in Delhi, 7th to 10th October to introduce potential participants to each other.
- A Participant Workshop *Delhi Week of 13th November* focussing on the initial CDM projects identified. (Including a "technology bazaar")
- A Final Seminar & PIN Delivery- *January/February 2005 aimed at* identifying carbon buyers in to assess whether preliminary agreements can be struck.

The project represents an excellent chance for UNIDO to meet the key players in India and it is recommended that a UNIDO representative should attend[19]. The conference organizer is **Jayesh Bhatia** Telephone + 0091-11-258 41 906.

There are several useful organizations already active in India, looking to help in the development of CDM projects. These include the Rabo Bank (Dutch), The Infrastructure Development Company (linked to the PCF), The Pembina Small Projects Facility (Canadian) and NEDO (Japanese).

There are[20] two biomass and four wind projects already endorsed under the CERUPT programme. These projects are estimated to deliver over 2.5 Mtonnes CO_2 savings at a total investment of around $90 M. The Indian Government believes that being a "first mover" in developing CDM projects can give its industry competitive advantage over competitor nations and it is thus keen to develop further projects.

Summary Table

As can be seen from the table below there are several options for projects in India. There are four HCFC 22 manufacturing plants in India. Of these, the plant in Gujerat is of particular interest. Gujarat Fluorochemicals Limited (GFL) has operated a HCFC 22 plant in Ranjitnagar, Gujarat since 1989. The plant uses Chloroform (CHCl3), Fluorspar (CaF2) and Sulphuric Acid as the main feedstock and produces HCFC 22 in a swing plant operation with by-product HFC 23, which is being vented to atmosphere (the swing plant makes CFC11 & CFC12 on campaign basis with HCFC22). GFL wishes to take up thermal oxidation of HFC 23, the by-product of HCFC 22, as a CDM project on a voluntary basis. Under this project activity, GFL shall additionally install, operate and maintain a HFC23 collection and thermal oxidation system to decompose HFC23 into its

[19] Full conference details are available at http://www.ecosecurities.com/cdmindia/cdm_Project_Documentation_Delhi.html

[20] according to Ms Gayathri Ramachandran of the Environment Protection Training and Research Institute - Hyderabad

products of combustion. A PDD is currently under consideration by the EB see section 3. In addition to Ineos and GFL, Rabo Bank and Sumitomo are also involved in the project.

Activity	Present in Country?	Already being addressed?
HFC Usage in Refrigeration and Air Conditioning equipment	Yes	No
HCFC 22 Manufacture resulting in the emission of HFC 23 as a by product	Yes	Yes
Nitric Acid Manufacture	Yes	No
SF_6 Usage in HV Switchgear	Yes	No
Adipic Acid Manufacture	No	No
Aluminium Smelting	Yes	No

2.2.3 Morocco

Ratification and Inventory

Morocco announced acceptance of the Kyoto Protocol on the 25th January 2002. Morocco submitted its initial national communication on 1st November 2001. in the submission it is noted that emissions of N_2O come virtually exclusively from agriculture with only a small proportion coming from energy emissions. It thus seems likely that there was no adipic or nitric acid manufacturing taking place. Emissions of HFCs, PFCs and SF_6 are not reported.

Capacity Building

The Ministry of Land-Use Management, Water and the Environment, takes responsibility for CDM in Morocco, the lead contact at the Ministry of Land is Mr Ali Aghoumi who is the national co-ordinator for CDM. Morocco is very well advanced in their approach to CDM. They established their Designated National Authority (DNA) in 2002 and this body started operating in 2003. A framework and structural procedure for assessing potential CDM projects has been established and the first three projects have been approved. Projects are judged against requirements that they must deliver real and sustainable emissions reductions, they must produce no negative effects and they must comply to the Sustainable Development criteria as follows. Projects must make a:

1. Contribution to the mitigation of global CC
2. Contribution to the sustainability of the local environment
3. Contribution to the creation of employment
4. Contribution to the durability of balance of payments
5. Positive contribution to the macro-economic plan
6. Positive impact on costs
7. Contribution to technology autonomy
8. Contribution to the sustainable use of natural resources

So far, a land fill gas project, a heat recovery project and a wind farm have been approved.

CD4CDM are hosting a conference in North Africa on 22-24 September 04[21]. This conference takes place at the end of the research period of this study and it will be useful to obtain the proceedings of this conference if they become available as it is a good opportunity to make contacts with Moroccan officials and ascertain further information on CDM in Morocco.

Summary Table

Activity	Present in Country?	Already being addressed?
HFC Usage in Refrigeration and Air Conditioning equipment	Yes	No
HCFC 22 Manufacture resulting in the emission of HFC 23 as a by product	No	No
Nitric Acid Manufacture	No	No
SF_6 Usage in HV Switchgear	Yes	No
Adipic Acid Manufacture	No	No
Aluminium Smelting	No	No

As can be seen from the above table, there are a few options for projects in Morocco.

2.2.4 The Philippines

Ratification and Inventory

The Philippines ratified the Kyoto protocol on the 20th November 2003. The Philippines submitted its initial national communication on 19th May 2000. This communication details in overall terms the level of emissions of greenhouse gases in 1994. In that year it is submitted that there were no industrial emissions of N_2O and no emissions of PFCs or SF_6. The total emissions of HFCs is noted to be around 1.5 Mtonnes CO_2 equiv.

Capacity Building

CD4CDM-Philippines is a three-year project that conducts public awareness activities, briefings and training courses on various aspects of the CDM Project Cycle in the Philippines. A number of regional national and international workshops are held and the next national workshop will be held in Metro Manila on 29th October, contact +(63) 2 426-5921 for details. The project is beginning to have some success and as of September

[21] Information on the conference is available from *amous.apex@gnet.tn*

1st 2004 one project had started, with another eight projects in the pipeline as shown in the table below[22]:

Type of Project	Earliest Start	Emission Reduction over 10 years kTonnes CO_2 equiv	Project Costs US$ M
Biomass	2006	17.5	3
Biomass	2006	354	50-60
Biomass	2007	1400	53-60
Energy from Waste	Oct 2004	540	
Energy from Waste	2004	30	0.4
Forestry	n/k	16500	35
Hydroelectric	2005	17.5	3.1
Windpower	Started – May 2004	707	48
Windpower	2006	783	55

No projects involving manufactured gases are currently under investigation.

Summary Table

Activity	Present in Country?	Already being addressed?
HFC Usage in Refrigeration and Air Conditioning equipment	Yes	No
HCFC 22 Manufacture resulting in the emission of HFC 23 as a by product	No	No
Nitric Acid Manufacture	No[23]	No
SF_6 Usage in HV Switchgear	Yes	No
Adipic Acid Manufacture	No	No
Aluminium Smelting	No	No

As can be seen from the above table, there are a few options for projects in the Philippines. The main opportunity is in the area of refrigerant recovery, recycling and destruction, but this is likely to be a lower priority than other projects discussed elsewhere since HFC usage levels are still likely to be quite low in the Philippines.

2.2.5 South Africa

Ratification and inventory

South Africa announced acceptance of the Kyoto Protocol on the 31st July 2002. South Africa submitted its initial national communication on the 11th December 2003. In this

[22] from http://www.klima.ph/cd4cdm/index.htm
[23] Philippines imports Nitric acid and it seems likely therefore that it is not a manufacturer.

communication it is noted that N_2O emissions are generated through the manufacture of Nitric acid and these emissions are estimated to have been 5.84 Mtonnes CO_2 equiv in 1990 rising to 7.27 Mtonnes CO_2 equiv in 1994. It can therefore be assumed that there was no adipic acid production in the country in these years. The report goes on to note that there are also emissions of HFCs, PFCs (principally from Al smelting) and SF_6 in the country and that these will be estimated "in the future". The World Bank National Strategy Study for South Africa[24] provides a wealth of background information on CDM and the national situation in the country. Unfortunately it gives no information on manufactured gases.

Capacity Building

Progress on capacity building is at an early stage. Contact was made with the Department of Environmental Affairs and Tourism who commented that although their department is not the implementor of the MP and KP in South Africa, they are co-ordinating these activities and set national framework policy around these. In fact it is the Department of Minerals and Energy who look after the CDM and act as the country's DNA. It was not possible to make contact with anyone from this department during the study and further work is needed here. Of all the countries researched in this study, South Africa is the least receptive towards CDM projects. A recent report by the Tyndall Centre for Climate Change Research talks of "profound skepticism prevailing amongst stakeholders in South Africa" towards CDM[25]. This skepticism is based on a fear of the impact of CDM on the countries coal dependent economy. There is therefore a need for a lot more effort to be made on capacity building to realize benefits from CDM in this country.

Summary Table

Activity	Present in Country?	Already being addressed?
HFC Usage in Refrigeration and Air Conditioning equipment	Yes	No
HCFC 22 Manufacture resulting in the emission of HFC 23 as a by product	No	No
Nitric Acid Manufacture	Yes	No
SF_6 Usage in HV Switchgear	Yes	No
Adipic Acid Manufacture	No	No
Aluminium Smelting	Yes	No

As can be seen from the above table, there are several options for projects in South Africa. BHP Billiton operate an Aluminium smelting plants at Hillside (676,000 tonnes

[24] see http://lnweb18.worldbank.org/ESSD/envext.nsf/46ByDocName/SouthAfricanNationalStrategyStudyontheCleanDevelopmentMechanism2002FullDocumentPDF15MB/$FILE/SouthAfricanNSSontheCDM2002fulldocument.pdf

[25] Available at http://www.tyndall.ac.uk/publications/working_papers/wp42.pdf

capacity). This is a very large and old smelting plant and is likely to offer a significant opportunity for a PFC emission reduction project. Pelchem[26], situated on the Necsa site, 30 km West of Pretoria and 55 km North-West of Johannesburg operate a large chemical plant manufacturing some HFCs, PFCs and SF_6.

2.2.6 Networking between Countries

SouthSouthNorth (SSN) operates a network in Brazil and South Africa as well as Indonesia and Bangladesh which provides technical and project management assistance to the developers of CDM projects. Assistance offered includes taking each project through the CDM activity cycle, from project identification through to registration and transaction. A number of the projects have reached the transaction phase, and SSN is in the process of receiving mandates from the Project Participants in order to market the projects. Interest, either in the form of a Joint Venture with the developers or in the purchase of carbon credits from the projects in the Investor Portal is currently being sought. The contact for this organization is Emily Tyler (Tel: +27 21 4251465, Email: emily@southsouthnorth.org)

[26] www.pelchem.com tel +27 12 305 4557

3. Existing and New Methodologies

As discussed in section 1, in order to be eligible to generate greenhouse gas emission reduction credits a proposed project must develop a methodology approved by the CDM technical committee. Proposed, approved and potential methodologies are discussed below:

3.1 Approved Methodologies

So far, one methodology has been approved in the area of manufactured gases. This is for the incineration of HFC 23 waste streams.[27] The methodology was developed by Ineos Fluor, Foosung Tech Corp and UPC Corporation and was based on the HCFC 22 manufacturing plant in Ulsan, Republic of Korea. The methodology involves the incineration of waste HFC 23 at temperatures in excess of 1,200°C. This elevated temperature makes the plant suitable for destruction of other waste chemicals including some CFCs, PFCs and HFCs. The plant is not suitable for destruction of SF_6 or halons. A detailed description of the process to be used to monitor the CERs generated is provided in the methodology. A similar PDD has been proposed for the GFL plant in Gujerat, India and this is currently out for consultation. The consultation takes 8 weeks and commenced on 1/9/04[28].

The described PDD is now implemented at the Korean plant and this plant commenced operation in May 2004. However as of week commencing 30th August -the CDM EB have suspended AM0001 relating to the Korean plant on the basis of concerns raised over possible leakage of emissions not being taken into account. The concern is that if more HCFC 22 is produced (than would have been the case without CDM) then there will be additional emissions of HCFC 22 which has a GWP of 1500). It is not clear what this means for the GFL project in India and the Korean project as these have been accepted for the registration process using an approved methodology. It is interesting to note that HCFC 22 is not a Kyoto Gas, and growth is already expected to occur according to the forecasts of the MP Technical and Economic Assessment Panel (TEAP). The AM0001 will now have to be revised either before or as part of the next project submission. According to Ineos this is not expected to be terminal to the project.

It should be noted that there was some opposition to this methodology and objections were raised *inter alia* by Du Pont who felt that the baseline used should have been a lower level of emissions. However the plant is now operational. The project was financed privately and the CERs are being purchased by the Dutch Government through Rabo Bank. Ineos noted that it took a lot of time and effort including the hiring of external consultants to develop the methodology, but that they are pleased with the overall methodology and they are keen to develop further projects.

[27] Approved Methodology AM0001
[28] see http://cdm.unfccc.int/methodologies/callinput_am0001.html

3.2 Proposed Methodologies

Three methodologies have been proposed for manufactured gases but are still awaiting approval:

N_2O from Adipic Acid Manufacture

Rhodia are proposing a methodology based on thermal decomposition of N_2O from adipic acid manufacture at a plant in Onsan, Republic of Korea. The technology proposed to be used to reduce emissions is the same as that used by Rhodia at its plant in Chalampe in France. This is proven technology. The proposed project will be privately funded.

According to Jean Lamberti, the Rhodia regulatory affairs manager, there are currently no plans to implement this technology at any other sites under CDM. Further information on technology aspects can be sought from M. Francoise Klijer at Chalampe (+33 389265658) if required.

More HFC Incineration Projects

Ineos are proposing a second HFC 23 methodology based on the HCFC 22 plant in Gujerat, as noted above. If this is successful there are three further plants in India which are suitable for this technology (operated by SRF, Navin and Chemplast). Of the other countries investigated in this study only one further plant exists and this is the large Pelchem plant in South Africa. Other countries with suitable plant for this technology include China, Mexico, Argentina and Venezuela (although Venezuela have not ratified the Kyoto Protocol).

It is unlikely that any totally new methodologies will be proposed in this area, although the plant would require redesign if the volume of "other gases" i.e not HFC 23 to be incinerated was increased. Baseline methodologies will also need to be considered.

PFCs from Aluminium Smelting

PFCs are emitted as a by product of Aluminium smelting due to a process known as the "anode effect" where Fluorine combines with the Carbon anode to emit CF_4 and C_2F_6. The Indian Aluminium Company (Indal) have proposed a methodology for reducing PFC emissions at their plant in Hirakud, in the state of Orissa, India. Whilst several companies in Annex 1 countries have successfully reduced PFC emissions from their Aluminium smelting operations, the technology being proposed by Indal has not yet been proven. Pilot trials have already commenced to attempt to prove the emission reduction potential and it is expected that the full project will be commissioned in December 2005.

Given that other technologies, (such as computer control of the process) exist for reducing PFC emissions and that there are a large number of smelters in non Annex 1 countries including Brazil and India, it is likely that further methodologies using proven technologies will be proposed. Discussions with Alcan have revealed that they are now

interested in progressing CDM projects in countries where they have operational sites. For the purpose of this study this includes Brazil and South Africa. The person taking the lead for Alcan on CDM is David Kennedy, based in Toronto (Tel + 1 9052066904).

3.3 Potential Methodologies

In addition to the methodologies proposed there are a few additional areas where new methodologies could be sensibly proposed. These areas include:

- End of life destruction of HFCs, PFCs and SF_6
- In life equipment emission reduction
- PFC emissions from electronics manufacture.

These are considered in turn below

End of Life Destruction

As noted earlier, the HFC 23 incineration plant could be adapted to incinerate other GHGs. Ineos believe that UNIDO could help in maximizing the benefits of these HFC 23 incineration plants by performing a study examining the possibility for the collection of end of life refrigerants for destruction in this plant. This would include CFCs and HCFCs as well as HFCs and therefore the crossover with the Montreal Protocol would need to be clarified. If this project looked feasible, Ineos believe UNIDO could further help with establishing the collection infrastructure and developing the control methodology. The main barrier to developing a methodology in this area is the difficulty in proving that only waste HFCs are being destroyed rather than HFCs which could be re-used. Local partners and the support of the Government would be required. In addition the support of the local electricity utility (for SF_6 recovery) would be useful.

In life equipment emission reduction

Refrigerant gas emissions can be significantly large during the normal working life of some refrigerant equipment. Whilst small hermetically sealed systems such as domestic fridges and small air conditioners rarely leak much, larger systems such as industrial refrigeration and supermarket systems are often, because of their design much more prone to leak. Car air conditioning can also be a major source of leakage. This provides an opportunity to reduce emissions.

From the interviews conducted it was generally agreed that this would be difficult to perform in non Annex 1 countries for quite some time. There are two major issues to resolve:

- The level of usage of HFCs in these countries is currently very low as most equipment still uses CFCs and HCFCs. This will change but it will be several years before equipment that is nearing the end of its life contains large volumes of HFCs in these countries. This means that projects established now would struggle

to generate significant volumes of CERs. This problem could be partly overcome by working with large organizations such as international supermarket chains or major car dealers.

- It is seen to be extremely difficult to develop a methodology where all parties are satisfied that the reductions claimed are genuine. A methodology could be based on the system run by STEK in the Netherlands. Under this system emissions of greenhouse gases from refrigeration plants have decreased from 35% to as low as 5% over a 12-year period. There are two main quoted reasons for this decrease: firstly, the effectiveness of the system of controls implemented, secondly (and above all), the readiness shown by companies throughout the industry to comply with the rules. The industry in the Netherlands has accepted its responsibility for reducing the use of refrigerants on a systematic basis. A lot of work would be needed to assess whether this could be achieved with equal success in a developing country. UNIDO could help in the support of this assessment.

One of the first key tasks to determine in assessing the feasibility of establishing cost effective projects in both in life emission reduction and end of life destruction of HFCs is to ascertain the current level of usage of HFCs in these countries. Since all of the countries in this study are in regions where air conditioning is required for large parts of the year, the penetration of HFCs will be largely dependent on population levels and relative affluence. This is summarized in the table below[29]:

	Population millions	GDP 1995 US $ Billion	GDP per capita US $ (,000)	Country Size Km^2
Brazil	176.26	812.11	4.6	8,456,510
Morocco	30.07	43.58	1.4	446,300
South Africa	44.76	182.28	4.1	1,219,912
India	1049.55	533.66	0.5	2,973,190
Philippines	78.58	93.61	1.2	298,170

From the table above it can be seen that in terms of population plus wealth the most promising country may be Brazil, although South Africa could be promising because of its relative affluence and Morocco could be interesting as all the units will be relatively near to each other. Although Brazil is a very large country, most of the population is concentrated around a few major centres and this should not prove a barrier to success.

PFC emissions from electronics manufacture

From the interviews conducted it was generally agreed that additionality would be a major problem in this sector. There is an existing global voluntary agreement which provides for a major reduction in emissions from this sector. The World Semiconductor Council negotiated a voluntary emission reduction of 10% in 2010, compared to 1995 levels. This would make establishing the baseline data problematic. At present no-one is proposing a CDM project in this sector.

[29] Data for 2002 taken from the International Energy Agency

4. EU Policies on non CO_2 Mitigation

Under the KP, the European Union (EU) committed itself to reducing its greenhouse gases emissions by 8% during the first commitment period from 2008 to 2012. This target is shared between the Member States under a legally binding burden-sharing agreement, which sets individual emissions targets for each Member State. On 31st May 2002, the EU and all its Member States ratified the Kyoto Protocol[30]. The EU has estimated that, provided cost-effective policies (including CDM) are given full priority, the compliance costs to the EU economy will be around 0.06% of GDP or €3.7 billion annually between 2008 and 2012.

The EU met its commitment to stabilise its greenhouse gas emissions at 1990 levels by 2000, by reducing its emissions by 3.3% between 1990 and 2000.. A considerable part of the initial progress was due to large cuts in CO_2 emissions in Germany (by 18.3%, about half of which is estimated to be the consequence of economic restructuring in former East Germany) and the UK (by 12%, part of which is due to the move from coal to gas) as well as Luxembourg (by 44.2%, much of which is a result of the restructuring of the steel industry). Ten of the 15 Member States are a long way off track towards meeting their obligations under the EU burden-sharing arrangement.

However, emissions went up by 0.3% between 1999 and 2000, and by 1% between 2000 and 2001. Emissions dropped by 0.5% between 2001 and 2002. This is the latest period for which estimates (compiled by the European Environment Agency) are available. The fall in 2002 took total EU15 emissions to 2.9% below their level in the base year used for calculations - 1990 in most cases.

Spain faces a greater challenge to meet its target than any other member state. Its emissions in 2002 were 39.4% above their base year level – well over double the 15% increase it is allowed between the base year and 2008-2012 under the EU agreement.

The Netherlands is a major proponent of CDM within the EU and considers it is on track to meet its target of cutting emissions by 6% by 2008-2012 by including its planned investments in foreign emissions-saving projects (JI and CDM). In 2002 its actual emissions were 0.6% above their base year level. Austria and Denmark have also earmarked considerable budgets for such projects but have not yet provided information on the emissions savings they anticipate.

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[30] The EU's 8% target refers to the 15 Member States as in 2002. The ten accession countries who joined the EU in May 2004 have all ratified the Kyoto Protocol and have their own Kyoto targets of between 6% and 8%.

It is interesting to note that the EU reduction was also due to measures that cut N_2O emissions from the chemical industry in France and the UK,

These figures show that significant further efforts are required by the EU and its individual Member States to meet their obligations under the Kyoto Protocol. The EU emissions trading system is expected to play an important role in bringing the less well performing EU Member States back on track.

European Climate Change Programme

The backbone of the Commission's effort to implement the Kyoto Protocol is underpinned by the work of the "European Climate Change Programme" (ECCP), which was launched in March 2000. The ECCP's goal was to identify and develop cost-effective measures that will help the EU meet its 8% Kyoto target, complementing the efforts of the Member States. Since the ECCP was launched, more than 200 stakeholders have been involved in eleven different working groups including one working group focusing specifically on fluorinated gases.

The findings of the Second ECCP Progress Report issued in April 2003 suggest that plenty of cost-effective measures exist to meet the EU's Kyoto target.[6] Forty-two potential emission reduction measures at a cost of less than EUR 20 per tonne of CO_2 equivalent have been identified with a total emission reduction potential of up to 700 million tonnes of CO_2 equivalent. The emission reduction needed to meet the EU's Kyoto target is estimated at around 340 million tonnes of CO_2 equivalent.

While the emissions trading scheme is the measure with most potential, the Council and the European Parliament have adopted several other initiatives, such as legislation to promote renewables in electricity production and bio-fuels in road transport, and legislation on the energy efficiency of buildings. Other measures have been proposed by the Commission, such as the Directive linking JI/CDM to the EU's emission trading system and a Directive to promote combined heat and power. Further proposals are in the pipeline, including possible legislation on regulating fluorinated gases.

Emissions Trading and CDM

Under the EU emissions trading scheme, the EU Member States will set limits on CO_2 emissions from energy-intensive companies (approximately 10,000 steel factories, power plants, oil refineries, paper mills, and glass and cement installations) by issuing allowances as to how much CO_2 these companies are allowed to emit. Reductions below the limits will be tradable.

Companies that achieve reductions can sell them to companies that have problems staying within their limits or for which emissions reduction measures are too expensive in comparison with what the allowances will cost. Any company may also increase its emissions above the level of allowance it is issued by acquiring more allowances from the market.

This scheme is intended to induce companies to make emission cuts where they are cheapest, thereby ensuring that reductions are made at the lowest possible cost to the economy and that innovation is fostered.

It is estimated that the companies currently participating in the scheme account for almost half of the EU's total CO_2 emissions. Other sectors important in terms of manufactured gas emissions, such as aluminium producers, the chemicals industry and the transport sector, might be brought in later.

The EU has also indicated its willingness to link the EU scheme to trading schemes in other countries that have ratified the Kyoto protocol. The Commission on 23 July 2003 adopted a proposal that links credits from JI and CDM projects with the emissions trading system. Under this proposal, European companies covered by the EU emissions trading system will be allowed to convert credits from JI and CDM projects for use towards meeting their commitments under the trading system. (Governments will be allowed to use credits from JI and CDM projects towards meeting their commitments under the Kyoto Protocol during the first Kyoto commitment period 2008-2012, provided that the Protocol enters into force.)

The Commission's proposal takes into account the obligation for Parties to the Kyoto Protocol to achieve a significant part of their Kyoto targets through emission reductions in the European Union, so that the use of the Kyoto flexible mechanisms is supplementary to domestic efforts. It therefore envisages the triggering of a review once JI and CDM project credits equivalent to 6% of the total quantity of allowances issued for the trading period 2008-2012 enter the emissions trading scheme. If and when triggered, this review will consider placing a limit on the credits that can be converted during the remainder of the trading period.

Commission Policy on F gases

The ECCP working group on fluorinated gases was given the mandate to take the lead on developing the commissions policy in this area. A large number of policy recommendations have been made in all the areas in which F gases are used[31]. The essence of the policy is that emissions of F gases must be minimized wherever possible but that the use of F gases remains necessary in a large number of areas.

[31] See http://www.climnet.org/EUenergy/fgaseccp.pdf for the final report

5. Manufactured Gases and the Montreal Protocol

Prior to 1990, there was very little use of HFCs. The only significant atmospheric emission of HFCs was in the form of HFC 23 released as a by-product in the manufacture of HCFC 22. Since 1990 there has been a significant growth in the market for HFCs because they have been identified as providing effective alternatives to CFC and HCFC fluids. Legislation on ozone depleting substances has placed increasing pressures on CFC and HCFC end users to start using alternative fluids and technologies. HFCs are important options for many end users. Refrigeration, foam blowing and aerosols are all potentially large markets. HFCs are highly attractive for these and other applications due to their physical and chemical characteristics, particularly their low toxicity and low flammability.

It is thus clear that any action taken to reduce emission of Kyoto Gases must be cogniscent of the fact that Montreal Protocol gas usage must not increase as a result. In terms of the generation of CERs through CDM projects where both Montreal and Kyoto gases are emitted, if the project results in the emission of MP gases, then their GWP impact must be deducted from the CERs generated. However, if the project results in a decrease in emission of MP gases then no extra CERs can be claimed.

There are two areas where overlap between MP and KP is important and these are considered below:

- HCFC 22 Production
- Destruction, recovery or replacement of CFC/HCFC with HFCs

HCFC 22 Production

HCFC 22 production, for non-feedstock use, is controlled by the MP, but also results in the emission of HFC 23 (a KP gas). HCFC 22 is used both as a refrigerant and as a feedstock (mainly for PTFE manufacture). There are currently no controls on production of HCFC 22 for feedstock use and production will continue beyond 2040 if there is a demand for PTFE. Currently PTFE production is increasing at about 3 to 4% annually globally[32] and is forecast to require over half the global capacity of HCFC 22 by 2010 to satisfy demand[33].

When considering the impact of CDM projects on HCFC 22 production it is important to take into account the relative timescales for CDM projects and potential additional phase down steps under the MP, in addition to the forecast demand for HCFC 22. The recent TEAP report on HCFC availability for developing countries forecast a potential shortfall

[32] see for example ECN, 10-16 May 2004 page 16.
[33] UNEP Report of the Technical and Economic Assessment Panel, May 2003, HCFC Task Force Report.

in production of HCFC 22 in 2010 and 2015. This is in part due to the phase-out schedule in the EU, which has a 65% reduction in 2008.

HCFC-22 Demand and Production[34]

HCFC-22	Demand and Production (ktonnes) (year)			
	2002	**2005**	**2010**	**2015**
Market Demand non-A5(1)	189	180	99	37
Market Demand A5(1)	104	132	212	305
Market Demand, total	293	312	311	342
Prod. Capacity: non-A5(1)	440	410	353	335
Prod.Capacity:A5(1)	166	181	205	230
Prod. Capacity: total	606	591	558	565
Feedstock Requirement	212	239	290	337
Available Market Capacity	394	352	268	228
Unused Capacity/Insufficient production capacity (negative)	101	40	-43	-114
Capacity Utilisation	83%	93%	100%	100%

HCFC 22 demand looks likely to remain substantial. If interim phase-down cuts were to be considered in the future for the Montreal Protocol then it appears unlikely that interim cuts would occur before 2024. In comparison, CDM projects can have a maximum of a 21 year life span (3 times 7 years). CDM projects in the next 2-3 years will be complete by 2028 at the very latest. Since there are only a small number of HCFC 22 plants. it seems likely that most if not all HFC 23 emission reduction projects will be complete by 2028, considerably in advance of final phase-out.

For India, the ODS Regulations and Control Rules, 2000 already limits expansions of capacity irrespective of CDM. However in India, production of HCFC 22 will increase as the plants are swing plants, which currently produce significant quantities of CFCs. These are produced according to the Indian 'Implementation of Quota System for CFC Production', which sets out quotas for individual producers. In 2003, 99.7% of the quota was used.

One of the key issues for the use of HCFCs is as 'transitional substances' in the replacement of CFCs. The GWP of CFCs is considerably higher than HCFC 22 (CFC 12 direct GWP 8100). The switch from CFCs to HCFCs has significantly reduced GHG emissions, and increases in HCFC 22 production should be considered in this context.

The installation of destruction technology for HFC 23, through CDM projects, will reduce GHG emissions for HCFC 22 production. It is expected that some of these projects will be implemented in the next few years leading to early GHG emission reduction. At the end of CDM projects it is important to ensure that the abatement

[34] UNEP Report of the Technical and Economic Assessment Panel, May 2003, HCFC Task Force Report, Table ES-2, page 6.

technology continues to be operated for the lifetime of the HCFC 22 plant. This will lead to significant ongoing emission reductions.

Destruction, recovery and replacement of CFC/HCFC with HFCs

The Multilateral Fund (MF) for the Implementation of the Montreal Protocol provides funds to help developing countries comply with their obligations under the Protocol to phase out the use of ozone-depleting substances (ODS) at an agreed schedule. Countries eligible for this assistance are those with an annual per capita consumption of ODS of less than 0.3 kg a year, as defined in Article 5 of the Protocol. They are referred to as Article 5 countries. In delivering financial and technical assistance, it works together with 'implementing agencies': the World Bank, UNEP, UNDP and UNIDO. It is these agencies who are currently developing programmes for the recovery, recycling or destruction of ODS refrigerants and this is where overlap with recovery, recycling or destruction of HFC refrigerants would occur.

From discussions with ineos and information from elsewhere, it appears that no studies on the effectiveness of Recovery/Recycle Projects have been carried out under the Multilateral Fund of the Montreal Protocol. It is believed that that the refrigerant management projects were a success for most governments, but the recovery/recycle equipment provided, was in many cases, not effectively used. There is no publicly available list of countries where recovery/recycle is working well or otherwise. Further information from the MF on this issue would be useful.

In designing a successful recovery/recycle programs it would be logical to start with large use sectors in developing countries. For instance, working with large garage chains or a large hotel or large supermarket group. With such a focus it would be easier to create value programs for the user and it is therefore here that any potential study should start. However, in developing countries there is currently little financial incentive for the repair company to seek to minimize refrigerant emissions and a major culture change programme could be required to encourage good behaviour. For instance, unless a "fee" is paid for recovered refrigerant then the gas is likely to be vented. Further work is required here. It may be possible to develop programmes in developing countries to recover refrigerant based on small financial incentives for refrigerant recovery at the end of life of equipment.

In summary, the overlap with the MP should provide opportunities for joint development of methodologies which can satisfy the aims of both the MP and KP.

6. Potential CDM Projects

The research outlined in the previous sections has identified a number of potential CDM projects. These can be summarized as follows:

Project	Brazil	India	Morocco	Philippines	S Africa
HCFC 22 Manufacture (HFC 23 reduction)	None	4 plants	None	None	None
Adipic Acid Manufacture (N_2O reduction)	1 plant	None	None	None	None
Aluminium Smelting	3 large plants	Yes	None	None	1 large plant
End of life HFC/SF_6 destruction	Yes	Yes	Yes	Yes	Yes
In life leakage minimization (HFC/SF_6)	Yes	Yes	Yes	Yes	Yes
Nitric Acid Manufacture (N_2O reduction)	Yes	Yes	No	No	Yes

Each of these types of projects offers its own risks and rewards and requires extremely varied amounts of support. Its fit with the national priorities is also varied since the relative impact on employment, the local economy and the local environment varies as does the need for additional support to stimulate activity. The key stakeholders in establishing the technologies differ but inevitably for all projects there is a need to ensure a willing buyer of the CERs, a good local approved verification body and the blessing of the local Government. This is broadly summarized in the table below:

Project	More Jobs	More trade	Improved local environment	Need for Support	Potential Partners
HCFC 22 Manufacture (HFC 23 reduction)[1]	No	Possibly	No	Low	Ineos Local manufacturer
Adipic Acid Manufacture (N_2O reduction)[2]	No	No	No	Medium	Rhodia Local manufacturer
Aluminium Smelting[3]	No	Yes	No	Medium	Alcan Local manufacturer
End of life HFC/SF_6 destruction[4]	Yes	Yes	No	High	Ineos, Promosol Local Govt, Local Utility
In life leakage minimization (HFC/SF_6)[5]	Yes	Yes	No	High	STEK , Local Govt Local Utility
Nitric Acid Manufacture (N_2O reduction)[6]	No	Yes	No	Med – High	ROB Local manufacturer

1. The major barrier for HFC 23 reduction projects is that they still need to overcome the methodology questions being raised at the EB. There are only a small number of potential projects worldwide and assuming the methodology

issues can be overcome it seems likely that most of these projects will be completed rapidly as the economics appear favourable. An opportunity exists here to work alongside Ineos or other developers of these projects to ensure that these sites can also be used for destruction of HFCs (and other chemicals such as Persistent Organic pollutants (POPs) and CFCs). Very few extra jobs are created and installation of the technology adds to the cost of running the plant but this is marginal and is more than offset by the value of the CERs generated.

2. Projects seeking to minimize N_2O emissions from adipic acid manufacture have yet to prove their economic viability as CDM projects. There are only a small number of potential projects worldwide and assuming the economics are favourable then most of these projects will be completed rapidly. Very few extra jobs are created and installation of the technology adds to the cost of running the plant but this is marginal and is more than offset by the value of the CERs generated.
3. Potential projects are still at an early stage but it looks likely that Alcan will be interested in developing some projects and Billiton (who share ownership of the Brazilian plant with Alcan) will also be interesting future developers.
4. HFC (and SF_6) destruction is a proven technology, however the infrastructure for collecting the HFC and ensuring that only waste HFC is destroyed does not exist. The creation of such an infrastructure would create jobs and trade but there is a need for much background work to scope out the size of the opportunity and the costs involved in setting up such a scheme.
5. The minimization of leakage of HFC (and SF_6) has been demonstrated to work by STEK in a developed country technology. However the infrastructure and the culture for establishing such a system in a developing country would need much background work to prove. Major issues to establish would be the size of the opportunity, the costs involved in setting up and policing such a scheme and the attitudes and enthusiasm of the local industry.
6. N_2O destruction is a proven technology in the laboratory but requires more work to demonstrate its economic viability in the field, especially at older plants. Further work is also needed to establish the locations of all the manufacturing units and their output as this is not well known at present.

6.1 Risks

The major risk for all CDM projects is that the 55% target for ratification is not met. If this does not happen then the Kyoto Protocol will not come into force. However the Russian government has recently signaled its acceptance of the Kyoto protocol. This means the treaty must go before the Duma (Russian lower house) before it is finally possible for Russia to ratify. Most observers now feel this is largely a formality. It is interesting to note however that major private companies and their financial backers have already proved willing to take that risk. Other risks are seen to include:

- The methodologies encompass National Legislation and this can mean that baselines must be re-calculated – reducing the CERs generated. It should be noted that countries may not do this as they would also suffer by consequence.
- Baselines can be recalculated according to new information (as is proposed for the HFC 23 methodology). This makes long term "banking" of projects difficult to achieve.
- The methodology process is very open and transparent and this leads to a lot of complaints from pressure groups (especially for projects on manufactured gases) and replying to all these issues can be time consuming and expensive
- Projects tend to be "half way round the world" and this always makes project management more difficult and more expensive
- Projects are often involving ageing plant and breakdown of this plant could jeopardize the project.

7. Conclusions and Next Steps

A review of the potential for promoting innovative public-private partnerships for CDM operations specifically focussed on the "manufactured gases" has been conducted. Opportunities for developing CDM in five specific host countries have been assessed. The following information has been determined.

- CDM projects are in their infancy and many organizations and Member States are still considering their enthusiasm for such projects.
- Early champions of CDM include the World Bank, the UN, the Netherlands, Austria, Denmark and Canada.
- The methodology that covers the process leading to the establishment of a CDM project is clear and well understood.
- Baseline and additionality methodology is somewhat more complicated, particularly for projects that involve fluorinated gasses.
- Pilot CDM projects are underway in many developing countries around the world.
- Their continued success is dependent on ratification of the KP by Russia or the USA
- CDM projects are progressing well in most of the countries researched
- CDM represents an opportunity for a developing country to receive substantial financial support, estimated at up to $10 billion, to improve its infrastructure and developing countries are therefore generally enthusiastic
- India, Morocco, Brazil and the Philippines are all particularly well advanced in their work in capacity building for CDM projects
- According to some sources, South Africa lags behind in its enthusiasm for CDM due to worries about impacts on its coal based economy
- The CDM projects underway and under consideration in these countries are focusing primarily on CO_2 emission reduction projects
- Only one project is currently looking at manufactured gases in these countries (HFC 23 project in Gujerat, India). This project is based on the methodology used for a similar project in Korea.
- Baseline and current emission inventories for manufactured gases do not exist in these countries except in the most rudimentary form
- This lack of information is clearly a barrier for further manufactured gas projects, particularly for projects looking at addressing in life or end of life use of HFCs and SF_6.
- A number of projects potentially suitable for developing CDM partnerships have been identified. These are:
    - HFC 23 projects in India
    - N_2O from adipic acid production in Brazil
    - PFCs from Al smelting in Brazil, India and South Africa
    - N_2O from nitric acid production in Brazil, India and South Africa

    - In life HFC and SF_6 emission reduction in all countries, (Brazil as a priority)
    - End of life HFC and SF_6 recycling and destruction in all countries
- Some of these projects are very likely to succeed with little intervention as long as methodological issues can be resolved and the economics remain favourable
- Much more work is required to establish methodologies to support in life and end of life HFC and SF_6 emission reduction from equipment containing these gases
- An in-depth study will be required to determine the feasibility of such a methodology.

From the above, it is clear that there are a number of options for developing CDM projects in the area of manufactured gases, A number of possible next steps towards doing this are suggested below

- Attend a CERUPT/ERUPT briefing in the Hague
- Attend a series of CDM conferences to develop good contacts. Conferences within the next few months are suggested in section 2 and are taking place in:
    - N. Africa
    - India
    - South America
    - Philippines
- Develop links with organizations purchasing CERs eg Senter,
- Develop links with Ineos, Rhodia and Alcan
- Work closely with host countries to develop reliable inventory data for the manufactured gases
- Fund a feasibility study on in life and end of life HFC and SF_6 emission reduction, possibly based on Brazil initially.

Annex 1 - Contacts

The table below provides a complete list of people contacted and attempted to contact during this research.

Organisation	Contact	Tel	Job Title
Alcan	**Jonathon Scott**	+44 1670 393508	Environment Manager (UK)
Alcan	**David Kennedy**	+1 905 2066904	Environment Manager (Global)
Brazil Country Rep	**Andre Correa do Lago**	+55-61 411 6640	Head of Division of Envt Policy and Sustainable Development. Dept of Environment
European Commission	**Tom Batchelor**	+32 2 296 8752	DG Environment -
European Commission	**Peter Horrocks**	+32 2 295 7384	DG Environment - Climate Change Unit
India – TERI	**Preety Bhandari**	+91 11 24682100 / 24682111	Policy Analyst
Ineos Fluor	**Andy Lindley**	**+44 1928 513145**	Regulatory Affairs Manager
Ineos Fluor	**Dr Louise Calviou**	**+44 1928 511312**	Business Development Manager
Moroccan Ministry of Land	Mr **Ali Agoumi**	+21237681759 +212 63721335	CDM National Co-ordinator
Philippines Country Rep	**Joy Goca**	+63-2 925 4794[35]	Inter-agency Committee on Climate Change Secretariat
Philippines Focal Point	**Dept of Foreign Affairs** –	+63 2 831 4783[36]	-
Rhodia	**Chris Mulliss**	**+44 117 9484242**	Regulatory Affairs Manager (UK)
Rhodia	**Jean Lamberti**	+33 1 55384064	Regulatory Affairs Manager (Global)
S Africa Country Rep	**Itumeleng Mabalane**	+27 12 3103904	Director, Air Quality Management. Dept of Environmental Affairs and Tourism
S Africa Country Rep	**Shiley Moroka**	+27 12 3103436	Not known
Senter	**Adriaan korthuis**	+31 70 373 52 04	Programme Manager – Carboncredits.nl
UK CCPO	**Jonathon Thomas**	+44 207 2151356	Manager
UK CCPO	**Jay Mariyappan**	**+44 207 2151356**	Principal Projects Officer

[35] sent 2 e-mails and tried twice

[36] Listed as national Focal point but when I called, no-one had any idea who I should speak to and referred me to the UN.

Annex 2 Country Questionnaire

CONFIDENTIAL QUESTIONNAIRE

BACKGROUND INFORMATION

1.1 Organisation Name _____

1.2 Address _____

_____

_____

1.3 Country _____

1.4 Telephone No: _____

1.5 Fax No: _____

1.6 Web site: _____

ORGANISATION ACTIVITIES

2.1 Please provide a short description of your organisations activities in the areas of CDM, JI and Greenhouse Gas inventories (for manufactured gases):

_____

_____

_____

_____

_____

_____

_____

Please provide contact details for any additional people who have responsibilities in this area in your country):

	Name	Area of Expertise	E-mail
(i)			

(ii)			
(iii)			

3 ACTIVITIES AND INVENTORIES

3.1 For each of the activities described which involve the use and or the emission of manufactured gases below please indicate the level of activity in your country:

Activity	Takes Place in Country? (Yes/No/Don't Know)
HFC Manufacture	
Nitric Acid Manufacture	
Adipic Acid Manufacture	
Aluminium Smelting	
HFC Usage in Refrigeration and Air Con	
SF_6 Usage in HV Switchgear	
Other	

3.2 For each of the activities where you have answered yes, please give the following information

Activity	Inventory Conducted (If so give emissions data (in Mtonne CO_2 equiv))	Main Players
HFC Manufacture		
Nitric Acid Manufacture		
Adipic Acid Manufacture		
Aluminium Smelting		
HFC Usage in Refrigeration and Air Con		
SF_6 Usage in HV Switchgear		
Other		

3.3 How is the collection of data on manufactured gases currently performed and is it likely to improve over the next two years?

4 Capacity Building

4.1 What is the current level of interest in CDM/JI in your country?

4.2 Are any organisations looking for partners?

Do you have any other comments you would like to add?

Annex 3 Glossary of Terms

Annex 1 Countries	"developed countries" who have a set emissions target under the KP in 2008 to 2012
CDM	Clean development mechanism
CERs	Certified Emission Reductions
CERUPT	Certified Emission Reduction Unit Procurement Tender
CFCs	Chlorofluorocarbons
DNA	Designated National Authority
EB	CDM Executive Board
ECCP	European Climate Change Programme
EIA	Environmental impact assessment
ERUPT	Emission Reduction Unit Procurement Tender
GWP	Greenhouse warming potential
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
JI	Joint Implementation
KP	Kyoto Protocol
MF	Multilateral Fund (of the MP)
MP	Montreal Protocol
Non Annex 1	"developing countries" who do not have a set emissions target under the KP in 2008 to 2012
N_2O	Nitrous Oxide
NSS	National Strategy Study
ODS	Ozone depleting substance
PCF	Prototype Carbon Fund
PDD	Project Design Document
PFCs	Perfluorocarbons
PIN	Project Idea Note
POP	Persistent organic pollutant
PTFE	Polytetrafluoroethylene
RAC	Refrigeration and Air Conditioning
ROB	Dutch Reduction Programme non-CO_2 greenhouse gases
SF_6	Sulphur hexafluoride
TEAP	Technical and Economic Assessment Panel
UNEP	United Nations Environment Programme
UNFCCC	UN Framework Convention on Climate Change
UKCCPO	UK Climate Change Project Office
VROM	Ministry of Housing, Spatial Planning and the Environment (Netherlands)

Addagy Ltd:
www.addagy.com
Tel +44 1925 758756