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Risks and Chances of Combined Forestry and Biomass Projects under the Clean Development Mechanism

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Preface

The present study aims to assess the realistic potential and the major constraints of combining carbon sink and bioenergy use projects in the CDM. The report starts with an overview of the current state of biomass use in developing countries. These days, energy from biomass is considered a new and modern option in the industrialized world. In developing countries bio-fuels is still largely viewed as a traditional practice. CDM could help changing this, and the report shows the technological options. The study calls for a close integration of the Afforestation/Reforestation and Biomass use methodology work, also with the possibility to bundle these two kinds of project activities.
The report mentions the different standard works, including the new Climate, Community and Biodiversity (CCB) Project Design Standard to evaluate a matrix of four examples of combined Forestry & Bioenergy projects: Small-scale/large-scale Forestry combined with Small-scale/large scale Bioenergy.

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Summary

The Clean Development Mechanism (CDM) aims at reducing greenhouse gas (GHG) emissions, while at the same time taking up CO_2 from the atmosphere in vegetation by means of afforestation and reforestation. In spite of these options being complementary, rules and modalities for both project classes are being treated separately in the relevant decisions by the Conference of the Parties to the UN Framework Convention on Climate Change. The present study reviews the state of bioenergy use in developing countries, modalities and procedures under the CDM, and the potential for transaction cost reduction in climate change mitigation projects. There are four potential types of combinations in the matrix between small-scale – full-scale / afforestation & reforestation – bioenergy activities. We develop criteria for assessing sustainable development benefits and present an example project for each of the potential project types.

We find that the individual risks of single-category projects do not increase when combining project categories and that each combination holds potential for integrated sustainability benefits. Risks for local livelihoods do increase with project size, but a transparent, participatory planning phase is able to

counterbalance smallholders’ lack of negotiation power. Further research will have to develop concrete project examples and blueprints with approved CDM methodologies, thereby decreasing transaction costs and risk for all potential project partners.

1 Background: Why combine bioenergy and forestry?

The Clean Development Mechanism (CDM) aims at reducing greenhouse gas (GHG) emissions, while at the same time taking up CO_2 from the atmosphere in vegetation by means of afforestation and reforestation. In spite of these options being complementary, rules and modalities for both project classes are being treated separately in the relevant decisions by the Conference of the Parties to the UN Framework Convention on Climate Change. These decisions are summarized in Table 1 and will hitherto be referred to by their respective codes. Even the CDM Executive Board has different expert panels on methodologies for source reduction, sink enhancement, and small-scale projects. This separation pays tribute to the many theoretical and methodological differences, most of all in the enhancement and management of biotic carbon sinks, but in actual project practice, it will prove artificial in many respects. Options in the land use sector embrace the reduction of methane and N_2O as much as the enhancement of sinks in forests (and possibly other vegetation, which is, however, not part of the CDM for the first commitment period). Managed forests supply wood fuel for energy production and use, which in many cases replaces the use of fossil fuels.

Table 1: Relevant decisions for CDM project activities

Code	*Title*	*Reference*
11/CP.7	Land use, land-use change and forestry (part of Marrakech Accords)	UNFCCC 2001
17/CP.7	Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol (part of Marrakech Accords)	UNFCCC 2001a
21/CP.8, Annex II	Simplified modalities and procedures for small–scale clean development mechanism project activities	UNFCCC 2002
19/CP.9	Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol	UNFCCC 2003
14/CP.10 Annex	Simplified modalities and procedures for small-scale afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol and measures to facilitate their implementation	UNFCCC 2004a

The present study investigates into options resulting from the combination of CO_2 removal and bioenergy use projects in the CDM.

Theoretically, there are four subtypes of bioenergy projects. They can be grouped according to the criteria “residues – non-residues” and “annual – multi-annual cultures” (see Table 2). The scope of this study is limited to Type D. This is so, because under the CDM we consider combined activities, where both parts are planned and designed simultaneously as a mitigation activity. Using wood for production *per se* is not a mitigation activity. Therefore, Type B does not constitute an eligible CDM activity that could be combined with A/R. Neither would the use of annual energy crops allow for a combination between bioenergy and A/R activities. Furthermore, there are technical limitations for jointly using fuel wood and agricultural residues in one installation under developing country conditions.[1]

Table 2: Categories of biomass use for energy production

	Residues	***NOT residues***
Annual regrowth	*Type A* • *Agro-industrial residues, such as bagasse or rice husks*	*Type C* • *Energy crops (e.g. rapeseed)*
No annual regrowth	*Type B* • *Wood residues (e.g. from wood processing)*	*Type D* • *Forest products (e.g. wood pellets)*

Source: Dutschke 2005a

Production and use of fuel wood within one project increases the vertical range of production (Grubb et al., 2001). There are several practical aspects under which such a combination is worth investigating:

1. Changing from agricultural to silvicultural production normally implies a long-term market risk for landowners. A combined project can mitigate this risk by offering long-term contracts for energy fuel wood.

2. There is a risk of market leakage in bioenergy projects, resulting from increased fuel wood demand that may lead to increased deforestation or devegetation in areas outside the project boundary. Combined projects produce their inputs themselves, thereby avoiding this type of leakage risk.

3. The availability of ashes for fertilization and bioenergy for the processing of agricultural goods has the potential to increase productivity on agricultural areas outside the A/R area, thereby avoiding leakage that would arise from shifting cultivation of natural areas.

4. Depending on the previous use of the area, fewer workforces may be needed for forest cultivation. The use of forest products for bioenergy may compensate for job losses, should these occur.

[1] This may not be valid for agro-forestry residues. These constitute a special case that has not been considered in this study, due to restrictions in time and resources.

5. Modalities for small-scale CDM source reduction projects allow accounting for the replacement of unsustainably produced biofuels. A combined project may ensure that fuel wood is produced in a sustainable manner and at the same time benefit from A/R CERs.

6. Increased energy supply may enable the building up of a rural industry that processes products from roundwood, as a by-product of the A/R activity.

7. Combined projects can reduce transaction costs through common project design, group validation and joint monitoring routines.

8. Due to the disparity of criteria for small-scale activities in the emission reduction and A/R sectors, combined activities, while benefiting from reduced transaction costs, maintain their individual CDM scale characterization.

9. In order to reflect permanence risks, CERs from A/R activities expire after a certain period, depending on the project design, and their value is at risk for the buyer on each verification date occurring at a 5-year periodicity. Consequently, the market value of expiring CERs is only a fraction of that for CERs from energy projects (Dutschke et al., upcoming). CERs from the bioenergy part of combined projects can be used for mitigating investors' risks.

10. There is an incentive for the investor to transfer reliable, efficient energy conversion technology, in order to secure a constant CER flow (Grubb et al., 2001).

It is clear from the above information that the benefits of combined A/R and bioenergy projects will not arise automatically. Careful project design is needed, in order to adapt one activity to the needs of the other. As a consequence of the different project lifetimes and baseline validities under the different project modalities, the start of each activity and its repercussions for registration, design and finance need to be carefully weighed. The following paragraphs will investigate different aspects to be considered before starting a combined project. As a precondition for bioenergy projects, the current state of biomass energy in developing countries will be summarized. Transaction costs constitute a pertinent problem under the CDM. These are by definition, costs that do not contribute to financing the core activity. We will look into how they can be defined within the CDM project cycle, and how they can be reduced. Small-scale modalities and procedures are specifically intended to reduce transaction costs for CDM project activities below certain emission reduction or carbon removal thresholds. We will systematically look into both modalities and procedures, and standard methodologies, as far as they exist, to see how they could benefit combined A/R and bioenergy projects. Finally, the rules on financial additionality will be considered. Under the CDM, official development assistance (ODA) shall not be diverted. We will summarize the different interpretations on how ODA diversion could be defined, and propose how ODA may contribute to combined A/R and bioenergy projects.

1.1 Current state of biomass energy in developing countries

Forestry based fuel-switch projects fit perfectly in the international development agenda. The World Summit on Sustainable Development has proclaimed that access to reliable and cheap energy services should be broadened in developing countries. One of the goals of the new partnership for African development (NEPAD) is to guarantee access to electricity to at least 35% of the African people (especially in rural areas) within the next 20 years. This should go hand in hand with the promotion of an increasing share of renewable energy. GEF finances many rural electrification projects and the bilateral cooperation agencies (e.g. CIRAT Forêt, GTZ) are interested in cogeneration (thermal and electric energy generation) on the basis of fuel wood or charcoal in rural areas. Alternatives like photovoltaic installations have sometimes failed due to frequent cases of theft (e.g. in Guinea).

There is still a large technical potential for biomass all over the world. Table 3 shows the technical potential use of solid biomass and fossil primary energy use (PEU) by region in 2000.

Table 3 Technical potential, use of solid biomass, fossil primary energy use (PEU) by region (Source: FNR 2000)

		North America	Latin America & Caribbean	Asia[b)]	Africa	Europe	Middle East	former USSR	Total
wood	EJ/y	12,8	5,9	7,7	5,4	4,0	0,4	5,4	**41,6**
straw	EJ/y	2,2	1,7	9,9	0,9	1,6	0,2	0,7	**17,2**
dung	EJ/y	0,8	1,8	2,7	1,2	0,7	0,1	0,3	**7,6**
(biogas)[c)]	EJ/y	-0,3	-0,6	-0,9	-0,4	-0,3	0,0	-0,1	**-2,6**
energy crops	EJ/y	4,1	12,1	1,1	13,9	2,6	0,0	3,6	**37,4**
Total	**EJ/y**	**19,9**	**21,5**	**21,4**	**21,4**	**8,9**	**0,7**	**10,0**	**103,8**
use	EJ/y	3,1	2,6	23,2	8,3	2,0	0,0	0,5	**39,7**
PEU[a)]	EJ/y	104,3	15,1	96,8	11,0	74,8	15,4	37,5	**354,9**
use/potential	%	16	12	108	39	22	7	5	**38**
use/PEU[a)]	%	3	17	24	76	3	< 1	1	**11**
potential/PEU[a)]	%	19	143	22	195	12	5	27	**29**

a) PEU - fossil primary energy use and hydropower
b) the current use exceeds the available potential in Asia as a result of the higher use of biomass compared to what is growing again (i.e. there is no sustainable use of biomass)
c) potential for biogas using available dung potential

Currently, renewable energy sources supply about 14% of the world's primary energy use, predominantly biomass used for cooking and heating, especially in rural areas of developing countries

(Goldemberg et al. 2004). A main reason is that in rural areas, particularly in remote locations, transmission and distribution of energy generated from fossil fuels can be difficult and expensive.

Biomass energy covers a significant share of renewable energy systems worldwide. According to the World Bank, 50-60% of the energy in developing countries in Asia, 70-90% of the energy in developing countries in Africa comes from wood or biomass, and half the world cooks with wood. Some Sub-Saharan countries, as well as Ethiopia and Haiti, obtain more than 90% of their energy needs from biomass, and the situation is not expected to change in the near future. In terms of global wood consumption, fuel wood represents more than 50% (Schlamadinger & Jürgens 2004). In China, for about 800 million people and half a million small-scale farmers biomass is the only energy source. China uses 20% of the whole world bioenergy sources (Witt & Kaltschmitt 2004).

Technically seen, biomass power in developing countries commonly occurs in the form of direct combustion of biomass feedstock to produce heat and power. Anaerobic digestion to produce biogas for use in engines is also common. Producer gas, generated by thermo-chemical conversion, often represents a problematic option, where cleanliness and safety are concerned. Most feedstock comes from agricultural and forest industry residues. Sugarcane waste (bagasse) is common in tropical countries. Brazil and the Philippines are leading producers of biomass power.

To give a general overview, renewable energy markets in developed countries (including biomass) can be grouped into five basic categories:

1.1.1 Rural residential and community lighting, television, radio and telephony

Roughly, 400 million households, or 40% of the population of developing countries, do not have access to electricity. Household and community demand for lighting, television, radio and wireless telephony in rural areas without electricity has driven markets for solar home systems, biogas-fuelled lighting, small hydro mini grids, wind or solar hybrid mini grids, and household-scale wind turbines.

1.1.2 Residential and commercial cooking and hot water

Residential and commercial cooking and hot water in rural areas are supplied primarily by direct combustion of biomass — in the form of wood, crop wastes, dung and charcoal. In recent decades, the decline in forest resources in many countries has called attention to more efficient household use of biomass, as well as solar cookers. Markets for more efficient biomass stoves and solar cookers are found primarily in Asia and Africa.

1.1.3 Rural small industry, agriculture and other productive uses

'Productive uses' of renewable energy are those that increase income or provide other social services beyond home lighting, entertainment and increased conveniences. As incomes increase, rural populations become able to afford even greater levels of energy service. The major emerging productive uses of renewable energy are for agriculture, small industry, commercial services, and social services (such as drinking water, education, and healthcare).

1.1.4 Grid-Based Power Generation

About 3% of electric power capacity in developing countries is renewable, mostly hydropower in China and biomass power generation in a group of tropical countries with abundant vegetable oil, sugar cane, and/or forest products wastes. Hydropower, biomass power, geothermal power, and wind farms are all continuing and promising markets for grid based power generation. India leads the developing world in wind power and continues to expand, although not as aggressively as in the 1990s.

1.1.5 Transport fuels

Over 40% of automotive vehicle fuel used in Brazil in 2000 was ethanol, a liquid fuel derived from biomass (sugarcane in Brazil). Brazil represents more than two thirds of global ethanol consumption, due to extensive policies and infrastructure development over the past 20 years that have fostered both pure ('neat') ethanol cars and conventional cars using ethanol-petrol blends. Biodiesel is produced in Indonesia and Malaysia from palm oil.

Around half of all people in developing countries depend on fuel from wood, dung and crop residue, collectively known as ‘traditional biomass’. Three quarters of these live in China, India, and sub-Saharan Africa. The International Energy Agency has forecast that the use of traditional biomass will decrease in many countries, but is likely to increase in South Asia and sub-Saharan Africa alongside population growth. Overall, the IEA forecasts that by 2030, the total number of people reliant on biomass will not have changed significantly.

As shown above, traditional biomass plays an important role in almost all mentioned groups. In particular, residential and commercial cooking and hot water production in rural areas of developing countries are supplied primarily by direct combustion of biomass. In recent decades, the decline in forest resources in many countries called international attention to more efficient household use of biomass.

1.1.6 Improving biomass use

A considerable amount of development aid has been targeted towards improving the current use of biomass, based on the adaptation of traditional stoves to increase efficiency and limit adverse effects. Driven by public programs, household demand and declining resources, markets for more efficient biomass stoves are found in Asia and Africa.

Since 1980, many public programs have disseminated close to 220 million new, efficient biomass cooking stoves. The largest program, the Chinese Improved Stoves Program, disseminated 180 million such stoves. This program established local energy offices to provide training, service, installation support and program monitoring. It also fostered self-sustaining rural energy enterprises to build, install, and service the stoves. A government program in India has supported the distribution of more than 30 million improved stoves by subsidizing half their cost. However, surveys suggest that only one third of the stoves in the Indian program are still being used, and reveal that many stoves didn't save energy, broke down and were poorly constructed.

In Africa in the 1990s, over 3 million improved biomass stoves were dispersed. Markets and technology adoption have proven easier for reducing charcoal consumption (as opposed to wood), and for urban markets to save purchased fuel (as opposed to saving collected fuel). Kenya has led this market, with close to one million improved stoves. The Kenya ceramic jiko (KCJ) has been the most widely disseminated of all improved biomass stoves, being replicated in Uganda, Rwanda, Tanzania, Ethiopia, Sudan, and Malawi.

Improved stove designs fall into two broad categories, fixed-location, and portable models. The immobile stoves are generally massive and made from a combination of metal, clay, ceramic, or cement. These designs generally achieve energy conservation through insulation and are often ‘complete’ stoves, with an enclosed burning chamber and multiple openings or ‘burners’ for pots. Massive stove designs have been extensively tested, refined, introduced and re-introduced in Latin America and Asia. Portable stoves are generally constructed from metal with clay or ceramic liners, or as formed clay ‘burners’ that support one pot over an enclosed burning box.

The use of energy for income-earning activities in the rural industry energy sector is often substantial and is not easily distinguishable from pure household consumption, or it may simply not be measured. Examples include beer brewing, boiling sugar from cane, pottery, tobacco and copra drying, blacksmithing and baking. The energy needs of rural industries comprise lighting, process heat, motive or shaft power and, increasingly, electricity for computers and communication (WEA, FAO 1999).

1.1.7 Grid-Based Power Generation

Total world electric power capacity stood at 3,400,000 MW in 2000, with about 1,500,000 MW (45%) of this in developing countries (see Table 4). Electricity consumption in developing countries continues to grow rapidly with economic growth, which raises concerns about how these countries will expand power generation in coming decades. According to some estimates, developing countries will need to more than double their current generation capacity by 2020 (Martinot 2002). Capital-intensive options, such as coal and large hydro, have environmental and social repercussions that have increasingly taken on serious political and economic undertones.

Grid-connected installations can range in size from a few kilowatts to hundreds of megawatts. Given the right geographic resources and regional-specific costs of competing fuels, many of these technologies can produce electricity at competitive costs compared with conventional forms of electric power. If environmental externalities are factored into the market prices of competing fuels, a procedure which is still rare, grid-based renewable energy becomes even more competitive.

Table 4: Renewable grid-based electricity generation capacity installed, (Source: Martinot 2002)

Technology		**Worldwide capacity - all countries (MW)**	**Developing country capacity (MW)**
Small hydro power		43,000	25,000
Biomass power		**32,000**	**17,000**
Wind power		18,000	1,700
Geothermal power		8,500	3,900
Solar thermal power		350	0
Solar PV power grid		250	0
Total renewable power capacity		102,000	48,000
For comparison	Large hydro power	680,000	260,000
	Total global electric power capacity	3,400,000	1,500,000

1.1.7.1 Direct combustion

Direct combustion is the burning of material by direct heat. It is the simplest biomass technology and may be very economical if the biomass source is found nearby. This process ranges from burning biomass in a three-stone fireplace to burning crops in a fluidized bed boiler producing heat and steam, which then produces electric power.

Frequently, when generation is associated with industry, combined heat and power production becomes feasible. This practice is well established in several countries. Biomass is the primary feedstock for steam boilers used to drive steam turbine generators. Electricity market structures sometimes mean that there is little incentive to focus on efficiency or maximize electricity generation potential to service nearby rural communities. However, there is large scope for efficiency improvements, and this technology should continue to play an important role in areas where the concentration of people around large agricultural processing plants is sufficient to support grid electrification.

1.1.8 Biogas (anaerobic digestion)

Biogas digesters convert animal and plant wastes into a clean-burning methane-rich fuel usable for lighting, heating, cooking and electricity generation, on either household or community scales.

Biogas can be generated from cattle dung and animal wastes, and with substantially more difficulty, from some crop residues. Although these types of feedstock are frequently used directly as cooking fuel, in most areas they are not preferred fuels and only used when wood is not available. Biogas systems offer multiple benefits.

Because of these benefits, a number of countries have initiated programs - China and India on a large scale. China leads the world with 7.5 million household biogas digesters, 750 large- and medium-scale industrial biogas plants, and a network of rural 'biogas service centers' to provide the infrastructure necessary to support dissemination, financing and maintenance. India has also had a large program, with about three million household-scale systems installed.

Results have been mixed, especially in the early stages. The initial enthusiasm for biogas has thus been somewhat dampened by experience. As they requires relatively large amounts of animal dung, the niche for household biogas plants is likely to remain small.

1.1.9 Biomass gasification (producer gas)

Producer gas is generated in a thermo-chemical conversion process through partial oxidation in air of biomass feedstock. The basic principles of generating producer gas have been known since the 18th century. Producer gas derived from biomass has been used for domestic and industrial heating purposes, for cooking, for stationary power, and for motor vehicle applications. Part of the reason for renewed interest in producer gas technology is increasing concern about the adverse health effects of indoor air pollution caused by biomass and coal burned for domestic cooking and heating (chapter 3), and the large role that producer gas used in gas-burning stoves could help to reduce this pollution. The air pollution from these stoves is near zero. One problem posed by current gasifiers is that they produce substantial tars (condensable hydrocarbons that are scrubbed from the gas before delivery to consumers). If disposed of without adequate treatment to groundwater or surface water, these tar wastes would pose significant water pollution problems. In addition, the producer gas cooking option poses another public health risk: Typically, about 20% of producer gas is carbon monoxide—of which accidental leaks into houses can be lethal. Although some hydrocarbon impurities in the gas impart an odor to producer gas that is usually noticed before a lethal dose is inhaled, occasional accidents are inevitable. Therefore (as discussed below), safe, clean, advanced technological options for producing cooking fuel from biomass should be the focus of research and development.

1.1.10 Pyrolysis

Fast pyrolysis is a thermal decomposition process that occurs at moderate temperatures with a high heat transfer rate to the biomass particles and a short hot vapor residence time in the reaction zone. Several reactor configurations have been shown to assure this condition and to achieve yields of liquid product as high as 75%, based on the starting dry biomass weight. They include bubbling fluid beds, circulating and transported beds, cyclonic reactors, and ablative reactors.

Fast pyrolysis of biomass produces a liquid product, pyrolysis oil or bio-oil that can be readily stored and transported. Pyrolysis oil is a renewable liquid fuel and can be used for production of chemicals. Fast pyrolysis is now commercially successful for production of chemicals and is being actively developed for producing liquid fuels. Pyrolysis oil has been successfully tested in engines, turbines and boilers, and been upgraded to high-quality hydrocarbon fuels although at presently unacceptable energetic and financial cost. In some CDM countries, e.g. China, fast pyrolysis as a new conversion method is at the R&D-level.

1.1.11 Alcohol Fermentation

Fuel alcohol is produced by converting starch to sugar, fermenting the sugar to alcohol, and then separating the alcohol water mixture by distillation. Feedstock such as wheat, barley, potatoes, and waste paper, sawdust, and straw containing sugar, starch, or cellulose can be converted to alcohol by fermentation with yeast. Ethanol production is energy efficient as well, because it has a positive net energy balance, meaning it takes less energy to produce ethanol than the product ultimately created. Additionally, its by-product, distillers dried grains with soluble, is a nutritious livestock feed. Countries across the globe are investing in ethanol, with Brazil leading the world in ethanol production and consumption. In 2003, about 13 billion liters of bioethanol were produced in Brazil.

Experiences and several ongoing pilot projects in developing countries show that regardless of the preferred technique, projects need to go beyond the narrow view of the actual situation to look at what is applicable for the target community, and which resources are available. It is not sufficient to simply take hardware for renewable energy from industrial countries and put it into a developing country. The technology must be appropriate and adapted to the needs of the target community (Goldemberg et al. 2004).

1.1.12 Problems of bioenergy use in developing countries

Cost has been a major inhibitor to the widespread adoption of renewable energy. Over the past decade, however, there has been a substantial decrease in costs.

Technical problems include the lack of reliability and servicing and maintenance problems, which have been major concerns with past projects. Insufficient power supply is another frequent complaint; once communities have access to energy supply; suppressed demand turns out to be larger than expected.

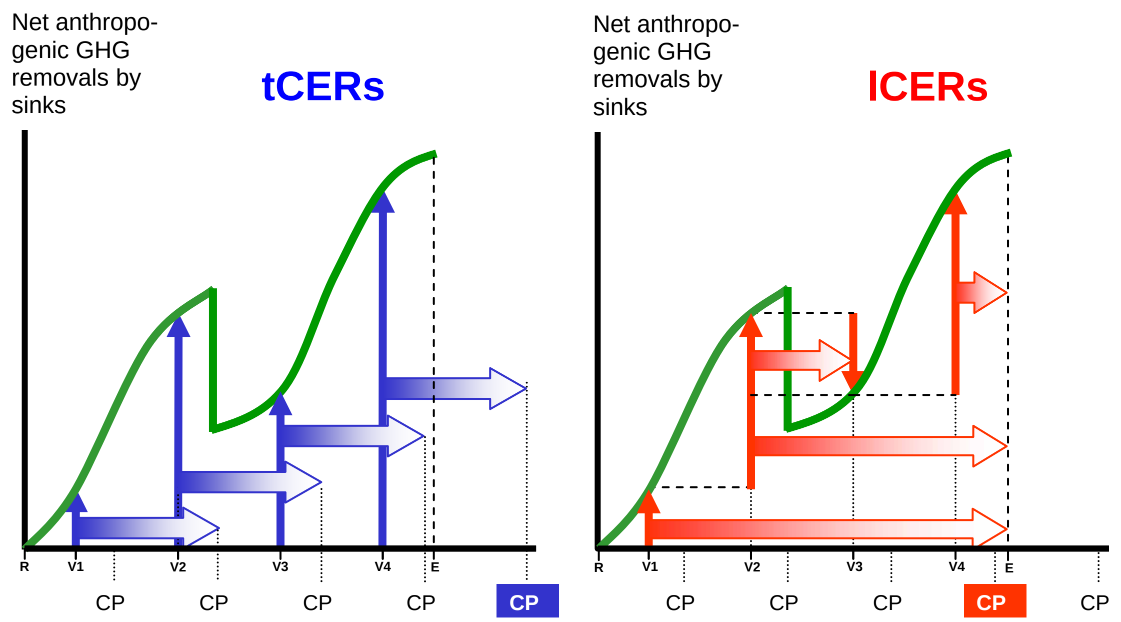
One of the major problems of current patterns of biomass use for energy is the low conversion efficiency. In households, most biomass is burnt in so-called three stone stoves with an average conversion rate of 10% (Kaltschmitt & Hartmann 2001). In urban areas or larger settlements, larger biomass powered plants are common, but due to maintenance problems, low technical standards and lack of knowledge about operating them, conversion efficiencies are of the same order of magnitude of roughly 10-15%. Industrial biomass plants are estimated to operate within the same efficiency range. In industrialized countries, average conversion rates of 70-75% are common.

1.2 Market value of CERs from afforestation and reforestation activities

At the time this study was being finalized, carbon values ranged around 5 – 8 EUR for a CER and nearly 30 EUR for a European Emissions Allowance (EUA). The reason for this spread is that CERs have exclusively been traded as forwards, and none has been delivered yet, while EUAs are real assets that have been formally allocated to comply with caps for individual installations (which are actually being enforced). As the first “real CER” vintage enters the market, prices will level out somewhere in the middle. Emission allowances from A/R have been excluded from the pre-Kyoto EU emission-trading period (2005 – 2007), and it is yet unclear whether they will be accepted at all for compliance under the European Emissions Trading System during the first Kyoto commitment period (2008 – 2012).

Decision 19/CP.9 created two types of CERs to reflect the potential non-permanence of carbon sequestration in A/R projects. These are *temporary* CERs (tCERs) and *long-term* CERs (lCERs). Both credit types have in common that their validity is limited and notified on the actual certificate. After the end of their validity, they have to be replaced. While tCERs expire after five years, lCERs expire at the end of the last full crediting period covered by the project crediting period. This means that in general tCERs cover one period more than lCERs under the same circumstances (see Figure 1). Replacement of tCERs can be done by any other type of emission allowance except for lCERs. Also, newly certified tCERs are accepted as a replacement for used tCERs. LCERs, on the other hand, can only be replaced by non-expiring allowances. Another common feature is that the buyer does not hold any liability during the commitment period in which they were certified. A/R projects need to be verified the first time at the discretion of the project participants, and exactly every five years thereafter. In the following commitment period, the holder is liable for replacement of the tCERs submitted for compliance. Unused tCERs expire as well, but they do not need a replacement. LCERs unused during the commitment period in which they were certified cannot be used for compensation thereafter. If a negative stock variation is assessed by the verifier between two verification dates, the respective part of lCERs stemming from the project will be cancelled and have to be replaced in the subsequent commitment period.

Figure 1: Total validity of lCERs and tCERs[2]



Vertical arrows = Tons of CO_2e
Horizontal arrows = lifetime of t/lCER

R = Registration
V1, …, V4 = Verification, certification and t/lCERs issuance
E = End of the project crediting period
CP1, …, CP5 = End of commitment periods

We can thus distinguish two basic risks faced by expiring CERs: the project risk revolving in five-year terms, and the replacement risk after expiry. The first risk type can be covered by any insurance scheme, basically discounting the value of the credits by a certain percentage, according to project type, growth region, discount rates in investor and host country and other risk factors perceived (Dutschke, Schlamadinger et al. 2005; Olschewski; Benítez et al. 2005). The second risk type cannot be assessed with the same degree of certainty, because it depends on the buyers' speculation about prices in the subsequent commitment period. These may vary extremely according to the assumptions made. Assuming the US ratifies the Kyoto Protocol by the end of the first commitment period, second commitment period prices could grow tenfold. On the contrary, if the climate regime is expected to fail, buying cheaper expiring CERs can turn out to be a good deal, because in this case, these would not need a replacement of any kind (Chomitz and Lecocq 2003).

Contractually, there is a difference between both types of expiring CERs. In the case that compliance is sought for only one period, the buyer will prefer tCERs. This may be the case e.g. where an installation is to be refurbished with lower-emitting technology in the subsequent commitment period. In this case, future surplus allowances will be used for up front compliance. The seller is then free to sell re-certified tCERs again to other buyers, until the end of the project lifetime. If a longer delay in replacement is sought by the buyer, he or she will have to close a contract with the seller over future delivery of newly-certified tCERs. This is different with lCERs; once these are transferred, they belong to the seller, as long as they are valid. Nevertheless, a contract is needed to divide the risk of expiry of a part of the lCERs once certified. Assume a certifier finds that only 80% of the carbon removals exist after five years, alternatively all lCERs ever sold by the project are devaluated accordingly, or the buyers of the last 20% of lCERs need to replace their credits over the next commitment period. Additionally, the project needs to keep track over its lCERs replaced before the end of their validity, because these reduce the risk of future carbon losses to cause consequences for the buyers.

To summarize, both types of expiring CERs show deficiencies in their legal construction and a dependence on future market expectation that make them highly speculative for buyers. While at first glance the lCER value appears to be superior to that of tCERs, tCERs are easier to handle on the market. Assuming there is a stable carbon price between two commitment periods, the value of a tCER over five years, depending on a buyer’s discount rate of 3 – 9 percent, may vary between 14 and 35 percent of the one of a CER. In the absence of a mechanism to secure A/R credits, they only represent an option value for the project. Under current price expectations, the pure carbon value will hardly motivate additional projects.

1.3 Transaction costs

In terms of climate-change mitigation projects, transaction costs (TACs) are costs related to generation and sale of emission permits (Michaelowa & Stronzik, 2002). Under the CDM, most TACs occur in the planning and design phase, before the actual start of the project. The first proceeds from the sale of CERs will have to cover TACs only. Given a value per ton of CO_2 equivalent to five USD, and minimum transaction costs estimated in the range of 30,000 to 50,000 USD, any project with an output

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inferior to 15 kilotons of CO_2 equivalents over its lifetime would be unfeasible under the current conditions of the CDM. Add to this the consideration of financing costs related to the high up-front share of TACs. Under current market conditions, GHG emission reduction projects can expect higher prices, while credits from A/R need to be calculated carefully, because the market signals for expiring CERs (tCERs and lCERs) are yet unclear.

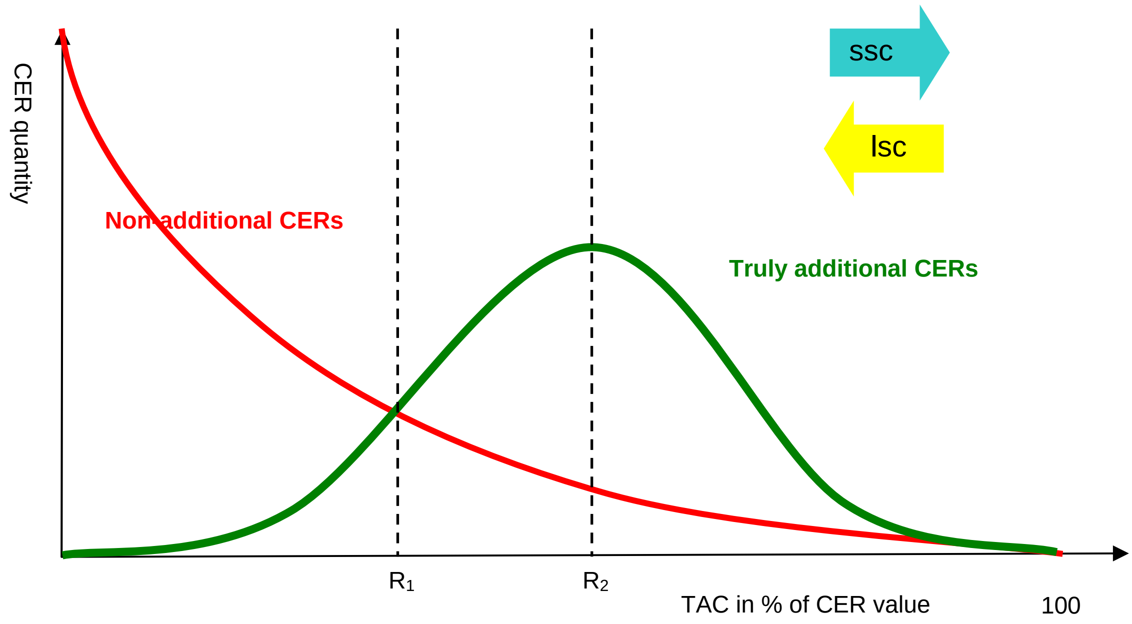
Transaction costs can be broken down in the following manner (Krey, 2004): First, there are costs that accrue from search and negotiation activities of the unilateral project developer, to find a buyer for the CERs. For bi- and multilateral projects, where the investors are direct project participants, costs of governing the project investment accrue to the investor. The second component consists of pure "GHG transaction costs". These costs arise from the tasks in the project cycle that accrue until the end of the (last) crediting period.

Table 5: Typology of CDM transaction costs

	Administration costs	**Control costs**
Upfront	Search costs Negotiation costs Approval costs Registration fee	PDD costs Validation costs
During project lifetime	Adaptation levy Project governance	Monitoring Verification & certification
Source: Krey 2004		

Reducing TACs in the field of search, contraction, approval and registration costs, or exempting them from the adaptation levy, will not risk environmental integrity. Control-related TACs do not fall from the sky, nor are they spent on unnecessary exercises. Most of the GHG components originate due to the incentive of both the investor and the host party to overstate emission reductions or net carbon uptake achieved by the project. If spurious emission allowances were to be created, the project-based system would not comply with its objective of finding a cost-efficient solution to climate-change mitigation. Thus, finding modalities and procedures for the CDM has been an optimization game, as represented in Table 5 (not to scale). The higher CER quality-related TACs present a better opportunity to exclude non-additional CERs and to single out truly additional CERs. Non-additional CERs compete with additional CERs, because they are available at zero or even negative cost. However, the more absolute numbers of truly additional CERs fall, the higher will be the share of TACs in the market price. There are two optima: one for the cumulate absolute numbers in additional and non-additional CERs produced (R_1), which could be denoted the "economic optimum", and another for the highest absolute number of truly additional CERs (R_2), the "ecologic optimum". While some free riding cannot be avoided completely, for environmental reasons, R_2 is the preferable option. **The environmental optimum will be reached, when an increase in control costs deters more additional than non-additional activities.** For full-scale projects, the optima will be moved to the left, i.e. additionality tests can be achieved at a much lower per-unit price. For SSC (acronyms should be capitalized) projects, both optima move to the right, because the same high quality standards will be prohibitive for small-scale projects.

Figure 2: Trade-off between control-related TAC and CER output



This is the rationale for the COP's intent to simplify modalities and procedures for SSC projects. Under the aspect of environmental integrity, however, quality control requirements should only be simplified if, due to a specific situation common to SSC activities, generic CDM risks may not apply to the extent that would justify the respective TAC share.

Still, for SSC A/R, Locatelli & Pedroni see the 8-kt threshold as an impasse. Even a TAC reduction of 80% will leave most SSC projects modeled by them unaffected (Locatelli & Pedroni 2004).

The project's CER output being the one variable, the other one is CER value. Obviously, expiring CERs are worth much less than one-off CERs issued for source reduction projects (Dutschke et al. 2005). Consequently, optimal control costs are lower per unit for expiring CERs than optimal per-unit costs of CERs from GHG source reduction activities. As expiration of lCERs and tCERs is an environmental safeguard, the emissions integrity risks of free riding are the same for the different optima of quality control in A/R and source projects. The COP would be well advised to find modalities and procedures that allow for flexibility, according to the free-rider risk of the individual project type. As the CER value varies over time, so will the optimum costs of quality assurance. Once the CER price doubles, modalities and procedures need to be revisited, in order to balance against the increased supply in non-additional activities.

1.3.1 Small-scale definition

Definitions for SSC projects are specific to the distinction between sinks and non-sinks. For the definition of SSC source projects, the following rules apply (Decision 17/CP.7, paragraph 6 c):

(i) *Renewable energy project activities with a maximum output capacity equivalent of up to 15 megawatts (or an appropriate equivalent);*

(ii) *Energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, by up to the equivalent of 15 gigawatt/hours per year;*

(iii) *Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually;*

There is an indicative list of simplified baseline and monitoring methodologies available for non-sinks SSC projects in Annex B of the Decision 21/CP.8 (UNFCCC 2002b). This positive list does not claim to be complete. The underlying philosophy is that project developers may submit new methodologies, which will be included on the list after approval.

SSC A/R projects are defined in Decision 19/CP.9 (Annex A, paragraph 1 (i)):

> *Small-scale afforestation and reforestation project activities under the CDM" are those that are expected to result in net anthropogenic greenhouse gas removals by sinks of less than 8 kilotonnes of CO2 per year and are developed or implemented by low-income communities and individuals as determined by the host Party.*

During COP 10, it was heavily discussed how to interpret the 8-kt limit. The final decision imposed the most stringent interpretation, according to which "a small-scale afforestation or reforestation project activity under the clean development mechanism will result in net anthropogenic greenhouse gas removals by sinks of less than 8 kilotonnes of carbon dioxide per year if the average projected net anthropogenic greenhouse gas removals by sinks for each verification period do not exceed 8 kilotonnes of carbon dioxide equivalent per year" (UNFCCC 2004b). Resulting project size estimates range between 204 ha for fast-growing species and quick afforestation, up to 3,500 ha for agroforestry systems (Locatelli & Pedroni, 2004). This is appropriate for smallholder forestry; however, it limits real-world project opportunities, because transaction costs related to CDM project development set lower limits for project feasibility.

1.3.2 Simplification options

GHG source reduction projects benefit from a simplified project design document (PDD) and from pre-approved baseline and monitoring methodologies. These are subdivided in three activity types, namely (i) renewable energy projects, (ii) energy efficiency projects, and (iii) other project activities. Actually there are 13 methodology subtypes plus one placeholder category for agriculture. Project developers are free to submit new simplified methodologies for approval, if they want to account for a different activity, or if the present simplifications seem disadvantageous for them. Baseline methodologies are usually simplified in the way that the pre-project emissions are assumed to remain constant in the baseline case, equivalent to baseline approach (a) in decision 17/CP.7 (UNFCCC 2001). These standard methodologies save project participants approval time and monitoring-related costs. The magnitude of this savings depends on the individual project subtype. There has not yet been enough experience that would allow for a cross-project comparison of cost savings achieved through these simplifications.

Currently, the development of indicative SSC standardized baselines for A/R is underway. COP 11/ MOP 1 in late December 2005 shall decide upon these. This paper is based upon a draft version released for public comment in July 2005 (UNFCCC 2005). The draft does not follow the philosophy of different project subtypes, but offers decision trees and default values for vegetation types. Its simplification options include:

1. If eligibility for a CDM reforestation activity can be demonstrated, there is no need to prove the one for an afforestation activity. This simplification could also be applied to any full-scale A/R activity, because modalities and procedures for both project types are identical.

2. The proposed methodologies distinguish between three types of A/R activities; “plantations”, “agroforestry” (including silvo-pastoral systems) and “restoration forests”. Taken together with the terms of reference for the simplified rules, as formulated under Decision 14/CP.10 (UNFCCC 2004a), a matrix for simplified methodologies could look like the one depicted in Table 6. Types GP and CP are likely to prevail, being the project types that are most relevant for combined forestry and energy CDM. The implementation of WP projects will in many cases lead to negative biodiversity and watershed effects. Additionally, draining wetlands will result in methane emissions. On wetlands, WR has is fairly likely to occur. The CDM as it stands today will not give enough incentive for natural forest restoration projects, but it may occur as a spin-off in national parks co-financed by CDM. Type SR may occur in social forestry projects that have the objective to implement street trees and public parks, but carbon benefits are likely to be small compared to costs.

Table 6: Project type matrix

	Production forestry	Restoration forestry
Grassland to forested land	GP	GR
Cropland to forested land	CP	CR
Wetland to forested land	WP	WR
Settlements to forested land	SP	SR

3. By default, only changes in above-ground biomass and below-ground biomass are considered.

4. Where no significant baseline carbon stock changes are expected within the project boundary, the baseline is by default taken to be zero (no variations).

5. Where significant baseline stock changes are expected, default rates may be taken from the IPCC Guidelines and Good Practice Guidance (GPG).

6. Default carbon stock values in the baseline case are taken from IPCC Guidelines and GPG.

7. No need for baseline monitoring

8. A confidence interval of 80% is sufficient.

9. A statistical error analysis is not required

This section will summarize the state of discussions around methodological issues surrounding CDM small-scale afforestation and reforestation. Besides some practical assessments of the draft modalities and procedures, one of the options discussed is to combine SSC A/R with CDM source reduction activities. The other option is to allow official development assistance (ODA) for SSC projects. It is still unclear, whether projects that exceed the minimum requirements by including more pools and/or GHG sources need an EB approval for their methodology.

1.4 Potential of transaction cost reduction through simplified modalities and procedures, and measures to facilitate implementation of small-scale A/R CDM activities

The purpose of small-scale activities under the CDM is to open the gate for the participation of developing countries' smallholders in the carbon business, thereby contributing to sustainable development of the host country and, at the same time, seizing hidden opportunities for GHG emission reduction or CO_2 removal. It is hoped that simplified modalities and procedures will bring these activities to life, as they reduce the transaction cost burden. The Marrakech Accords (UNFCCC, 2002) defined threshold values related to maximum output or emission reduction of those projects. Even though small-scale

(SSC) CDM has repeatedly been declared dead (PointCarbon, 2002), two SSC projects (La Esperanza and Cuyamapa hydroelectric projects) were among the first five projects to be registered. Also, for afforestation and reforestation (A/R) under the CDM, SSC modalities and procedures have been defined according to the threshold criteria agreed upon by COP 9. One criterion is that they are "expected to result in net anthropogenic greenhouse gas removals by sinks of less than 8 kilotonnes of CO_2 per year". Additionally, they shall be developed or implemented by "low-income communities and individuals as determined by the host Party" (UNFCCC, 2003). Locatelli & Pedroni (2004) take the rather disillusioned stance that "[s]implified M&P will hardly change CDM trade relations, but they can easily create the illusion that all possible efforts have been made to achieve a fair Kyoto Protocol treaty."

This section will define the term transaction costs and relate simplifications for small-scale activities in GHG source reduction and A/R activities to the reduction of transaction costs. A subsection will investigate further options for the reduction of transaction costs. The option of using official development assistance (ODA) in co-founding will be discussed in a further subsection.

1.5 Further options for the reduction of transaction costs

In order to decrease transaction costs, the current SSC simplification options could be complemented by some further rules and instruments. These relate to the determination of additionality, enhanced funding options, and the combination of A/R with the use of bioenergy.

1.5.1 Simplified additionality determination

The UNFCCC Technical Paper (UNFCCC, 2004c) suggests that the mere eligibility test for the land used for A/R, namely that it was not a forest on December 31st 1989, is an indication that barriers are too high to allow business-as-usual forestry. Also considering that low-income communities and individuals are involved in development or implementation, it seems reasonable to assume that for those groups, any long-term investment in tree planting is truly additional.

1.5.2 Small-scale fund

Little attention has been paid to Kyoto Protocol Article 12.6 yet, which reads: "The clean development mechanism shall assist in arranging funding of certified project activities as necessary". At first glance, the language appears to be outdated, as there are no certified activities in the actual CDM. However, the essence can be relevant for activities that contribute to a high degree to the double aim of the CDM. The SSC definition for A/R activities "developed or implemented by low-income communities and individuals as determined by the host Party" seems to provide sufficient arguments for channeling additional financing to those projects that would otherwise not come into existence. Several Latin American countries have suggested the creation of an SSC fund (UNFCCC, 2004a). There are several ways to arrange funding. Direct funding may work on a grant or on a concessional basis. Grants could help bridge the cash-flow gap created by the large up-front share of TACs. Experience in the area of micro credits in development assistance has shown that payment morality for these debts is better than in other commercial credit. Lost funds can be invested in the development of pilot projects that are highly replicable in other regions or countries. Moreover, guarantees can cover the risks of expiring CERs partly or completely, leading to a CER value comparable to the one of source reduction projects (Dutschke, Schlamadinger et al. 2005). A hedging fund for expiring CERs does not need to be costly. The fund could be fed by in-kind contribution of full-scale projects and managed by the World Bank or GEF. Table 7 summarizes options for CDM institutional finance. The risk implied with this type of financing is that activities are financed that do not provide sufficient benefit for their long-term operation. The need for financial contribution depends on the expected carbon market prices for the future. There could be a mix of loans, grants and bank guarantees, which would be adjusted for each commitment period. Eventual payback would revert into the fund.

Table 7: Financial instruments for arranging CDM funding under Article 12.6

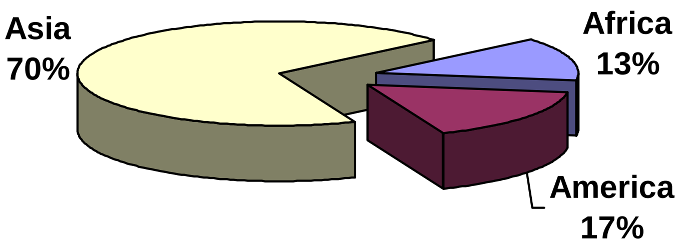
Barrier	Financial instrument	Comments
Negative cash flow as a barrier in the design phase	Loan payable on CER issuance & sale	Only where market conditions are prohibitive for commercial credit related to credit size (micro finance), availability or interest rate
Too little CERs to re-cover TACs	Grant	Only justified if one or more of the following conditions are met: • High positive externalities justify the invest-ment • TACs for follow-ups lowered • No non-TACs covered
Political uncertainties inhibit valuation of CER returns	Bank guarantee	Applicable in the CDM start-up phase and for expiring CERs from CDM A/R. where one or more of the following conditions are met: • Host country risks unspecific to the planned activity • Market risks related to the design of future commitment period • No commercial insurance mechanism avail-able

1.5.3 Role of ODA

In the previous section we studied the possibilities for reducing TACs. A CDM fund that subsidizes activities so that they receive extra benefits beyond the refund of TACs risks losing out on the economic effectiveness aspect of GHG reductions or sink enhancement. From an economic point of view, this extra subsidy is justified in the case that this funding is linked to positive externalities that most conveniently occur in the context of a CDM activity. A typical, but not exclusive, case is official development assistance (ODA). The Marrakech Accords disallow the diversion of ODA into the CDM, but to date there is no clear definition of what diversion conveys in this context. The OECD's Development Assistance Committee considers diversion the direct acquisition of CERs through ODA, including ODA project proceeds in form of CERs flowing back to the donor country.

On the other hand, it is conceivable that development objectives are reached in the most cost-effective way by bundling ODA with CDM activities. During the years 1973 – 1998, ODA to forestry totaled 8 billion US$, which is around 1 percent of overall ODA, but with a marked increase during the 90s. Around 100 million US$ is spent annually on forestry by bilateral and multilateral ODA donors, two thirds of it being for afforestation (OECD, 2000).

Figure 3: Regional distribution of forestry ODA in the 1990s



(Source: OECD, 2000, own calculations}

There are several options for ODA to take advantage of CDM A/R activities.

1. ODA forest development programs can build up institutions and capacity, and identify concrete project development opportunities for the private sector. This approach has been adopted in practice by most donors. ODA agencies look back on decades of institutional ties in the host countries, and CDM investment can benefit from those.

2. ODA projects can engage in forest conservation and forest restoration on areas deforested since 1990, while identifying neighboring areas that are eligible under the CDM. On one hand, this procedure will lower the risk profile for CDM investors, on the other, scarce ODA resources will be complemented by private finance.

3. ODA afforestation can be designed and registered as CDM project. Proceeds from the sale of CERs will be used to expand the aid program.

4. Alternatively, a donor-run CDM project can be taken over by the private sector after the end of ODA funding. Attracting investors into a successfully running project is much easier than convincing them to invest in a risk country. Again, the ODA engagement will reap additional benefit that would not have been achieved without ODA engagement in the CDM.

As stated above, the aim of the CDM cannot be to subsidize unprofitable activities, because these would not be economically sustainable after the end of funding. Nevertheless, if ODA involvement in the CDM contributes more to development targets (like the reduction of vulnerabilities, education and poverty alleviation) than an alternative ODA engagement, ODA money can hardly be considered diverted.

Option 1, involvement of ODA, is widespread and undisputed. However, if one looks at the regional distribution of CDM capacity and institution building programs, the bulk of them take place in emerging economies, like China, India and Brazil. These countries will provide the largest CER quantities anyway and feature little financial constraints. Under aid aspects, this may be considered regional diversion of ODA, as CDM profitability should not be the primary concern of aid. Options 2 to 4 are likely to meet criticism, because they are conceived as development projects. The central question is then, whether ODA can be considered business as usual, which is another aspect of financial additionality. Considering the high volatility of ODA allocation over time and regions, these options are hardly predictable. A case-by-case evaluation of financial additionality seems therefore unavoidable.

1.6 Combined bioenergy projects

For a variety of reasons, the integration of bioenergy and forestry activities has been proposed (Grubb et al., 2001). Under TAC aspects, combining A/R activities with the use of fuel wood produced in one CDM project has the following advantages:

1) The project controls a longer chain of custody, thereby precluding many negative external effects that may arise.

2) In the same way, as the project boundaries are wider, carbon leakage can be avoided.

3) Until expiry of the tCERs or lCER issued for the A/R activity, the source reduction activity will have produced so many definitive CERs that these will be able to replace the expired units.

4) The quantitative small-scale limits expressed in GWh or kt CO_2e activity type will not apply, as different units are involved within related, but different activities.

5) TACs can be reduced. However, project development, validation, monitoring and verification costs will not decrease drastically, as compared to single-activity projects

A combination of source reduction and A/R activities may make SSC activities more attractive. For the combination of forestry and energy projects, however, several questions remain unanswered. To date, there is no experience in such projects, but the coming months will show how they are treated by the EB. The following issues remain to be resolved:

Competences between both Methodology Panels: A combined biomass project will have two methodological elements, one for biomass production, and the other for its use, both of which are interconnected in a combined project. As an example, a project may consist of suppressing wood collection by producing firewood for household use. As things stand, certifiers (designated operation entities) would need to submit one part of the methodology to the CDM Methodology Panel and the other part to the A/R Working Group. This does not help either one of the panels in achieving an integrated understanding. It would be logical therefore, to select two panel members, one from the Methodology Panel, and the other from the A/R Working Group for compiling the inputs, and to select one expert each from both Panels' Roster of Experts. This line of thinking seems to have guided the decision in Annex 8 of the 20th EB Meeting that reads: "When a proposed new methodology may have implications for carbon pools it shall, in addition to being assessed by the Methodologies Panel, be reviewed by the afforestation and reforestation working group (A/R WG) with regard to its validity". Both, Methodology Panel and A/R WG have already started cooperation with respect to bioenergy projects.

Accounting for CERs: Combined projects will result in two different types of CERs; the production part will yield lCERs or tCERs, as the case may be, and for the user side, non-sinks CERs will be claimed. As stated above, CERs will be much more of an economic incentive than tCERs or lCERs.

1.7 Preliminary conclusions

In the section above, we have differentiated transaction costs between administrative and control (or quality assurance) costs. While administrative costs can be cut down without any environmental risk, reducing quality requirements will always invite free riding. While in practice free riding cannot be avoided completely, the environmental optimum will be reached where an increase in control costs deters more additional than non-additional activities. The variable being *percentage of CER returns*, control costs should be positively correlated, first with project size, and second with the CER price development. As a consequence, small-scale activities should be privileged in terms of control costs, as for the quantities involved fewer non-additional projects will be submitted. This is even more so for A/R activities that generate expiring CERs with a much lower per-unit value. However, there is a risk that modalities and procedures related to CER quality assurance will be understood as static by the COP. On the contrary, we pledge for flexibility within these rules, in order to adapt them to changed market conditions. In the case of souring carbon prices, these rules would need to be revisited.

An international SSC forestry fund, as proposed by several Latin American Parties, has several potential means to make SSC more attractive, ranging from a bank guarantee, to loans or grants in different compositions. Its principle aim should be to reduce transaction costs for SSC projects, not to subsidize the projects themselves. This may, however, include a bank guarantee for expiring CERs, increasing the achievable price of lCERs and tCERs issued for the net carbon uptake achieved by these activities.

It has been argued above that, in order to avoid market distortion, an SSC fund should only subsidize TACs, but not the core activity. This is different in case the project has quantifiable side benefits that can be piggybacked in a cost-effective way. This would be the case for co-financing by the Adaptation Fund or by ODA. In the authors' opinion, ODA diversion can only be determined in a case-by-case manner, if an alternative investment would contribute more to the aid objective.

Due to the way SSC activities are defined for source reduction and for A/R activities, there is no composite criterion for determining a bundle of both as small-scale. Our interpretation is that small-scale activities may form part of a combined project between A/R and biomass fuel change, both from the forestry *and* the energy side. Combinations of this kind will benefit quality and credibility of both activities involved, while at the same time contributing to lower transaction costs. For practical implementation, however, several institutional and procedural questions still need to be resolved.

2 Methodological approach of this study

Today, energy from biomass is considered a relatively new and modern option in the industrialized world. It is supported by government policies aiming at environmental management and based on advanced industrial technologies. In parts of developing countries, the same can be observed, but the use of bio-fuels is still largely viewed as a traditional practice.

What actually matters is not the label “modern” or “traditional”, but whether or not bio-fuels serve the users in a way that is efficient, clean, convenient, and reliable, and at the same time remain economically and environmentally sound. Today, all these requirements can be met in the industrial, domestic, and utility sectors,; whether for generating heat, power, or a combination of both. “Modern” needs not be associated with electricity generation in full-scale power plants only.

In general, for the conversion of different biomass types several technologies are possible, as shown in the following schemes.

Figure 4: Types of biomass

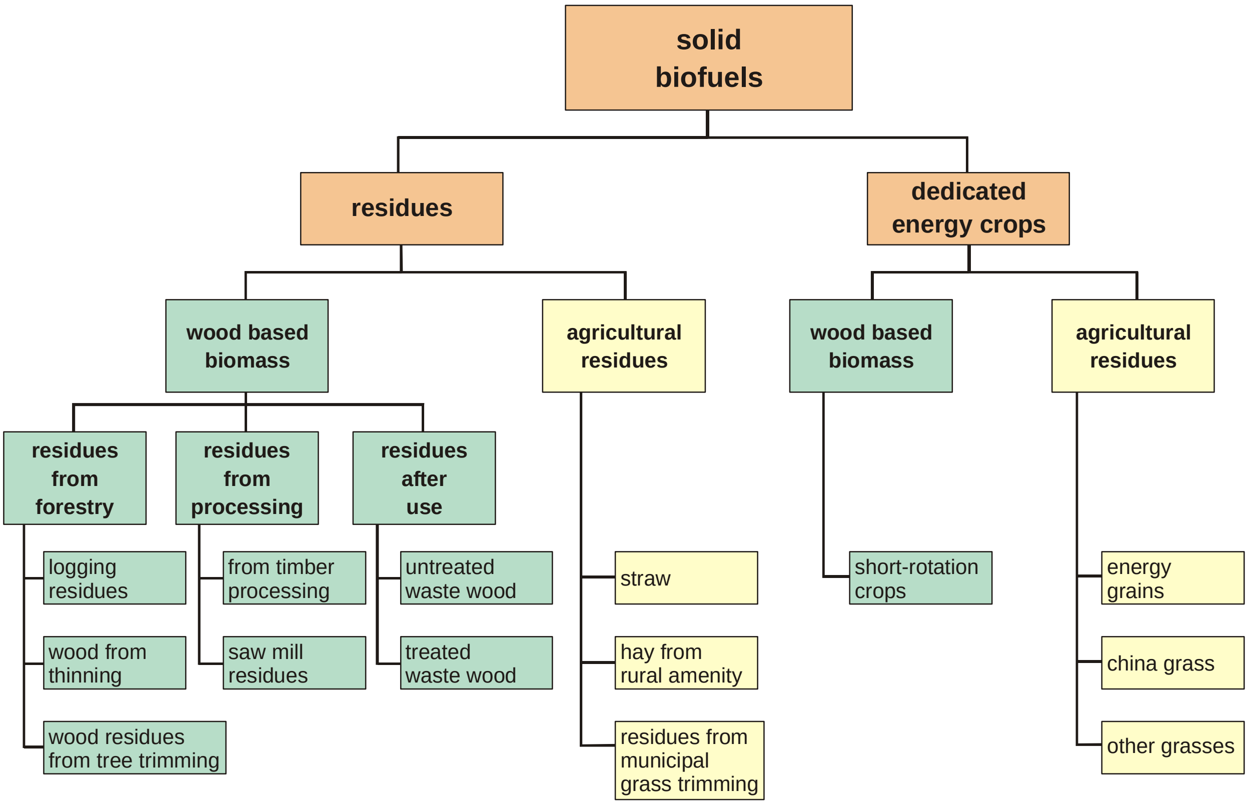
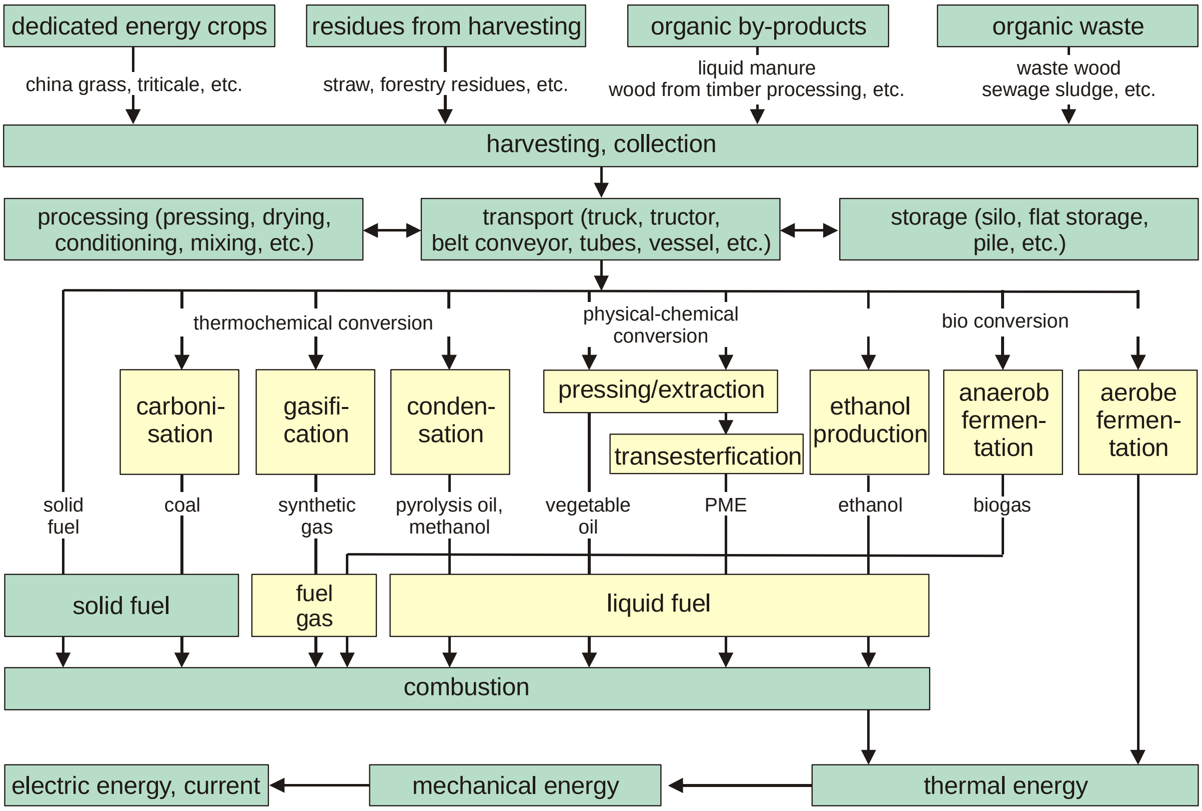


Figure 5: Technologies for biomass conversion

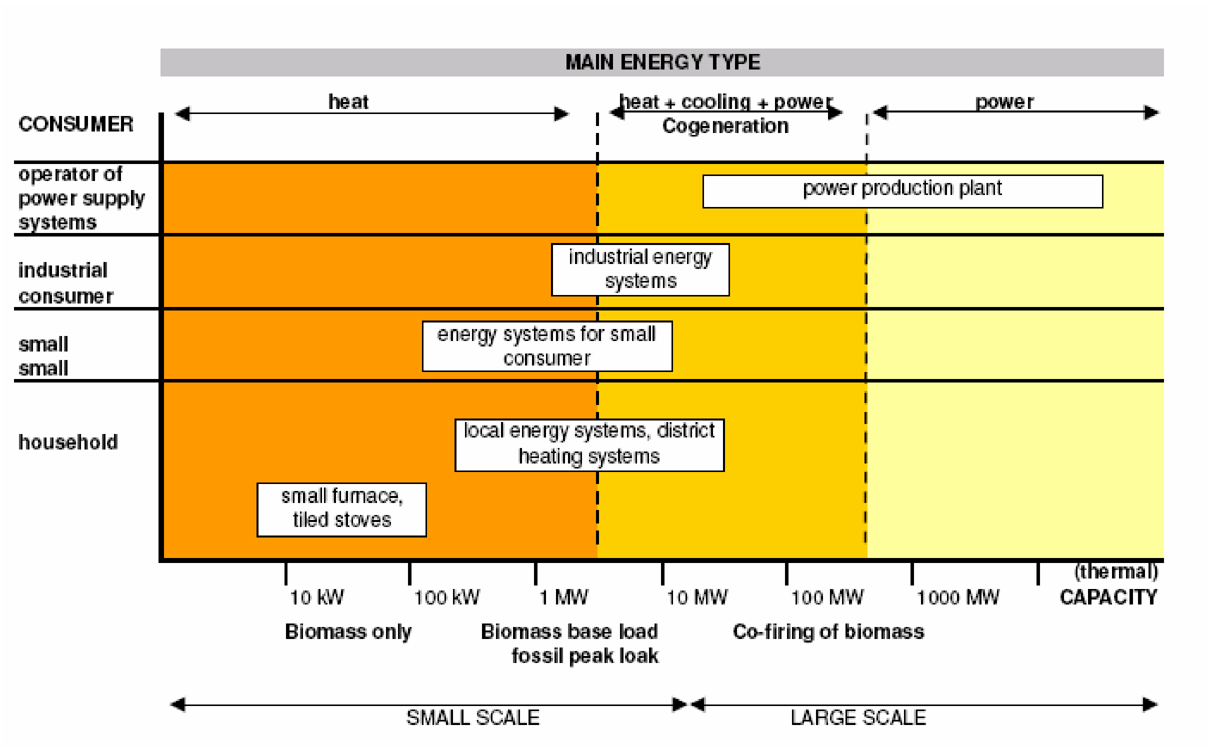


Therefore, and especially for combustion technologies, two main bio-energy project versions are emerging on the market:

- Small-scale projects that focus on heating plants with sizes of up to about 15 MW,, and
- Larger scale projects that aim at partial replacement of fossil fuels, e.g. district heating plants.

As a result of different site situation and special demands of the consumer, there is no exact boundary between these two types. The following scheme shows the current use of biomass applications, depending on consumer type and capacity, roughly separated in small-scale and full-scale installations.

Figure 6: Application area of biomass installations



To reveal the basic differences between these types, a technical introductory description is given in the following section.

2.1 Small-scale bio-energy projects

The objective of small-scale bio-energy projects is to support municipalities in switching smaller district heating systems (DHS) from fossil sources to wood fuel. This involves supporting the afforestation of marginal agricultural land and improving forest management, in order to ensure an adequate wood fuel supply. This type of project has a parallel focus on social and environmental benefits, and offers the opportunity to invest in 'image building', as well as the sound financial returns and carbon credits it offers.

Existing district heating systems provide heat for public buildings (e.g. schools, hospitals, town halls etc.), and are generally operated by municipal authorities. Because of high fossil fuel costs, communities have to spend about one third of their annual budget on energy. Many installations are outdated and inefficient and consequently often cause excessive environmental pollution. For the first project type it is planned to install biofuel-fed energy systems using state-of-the-art technology and meeting proven clean air standards. The technology is tested, and reliable, comprehensive feasibility studies have been carried out in targeted countries.

By planning and installing such small-scale systems from a technical point of view it is required to focus on the following points:

- Investment has to keep to a low level, as the resulting annual costs are very dominant in the range of expenses per year. This could be achieved by integration of local companies producing parts of the installation that do not require a high level of engineering and technical know-how.
- In contrast, the costs of biofuel play a minor role compared to full-scale projects.
- As a consequence of the above – investment in special detail-equipment (e.g. air cleaning systems, control system) is limited - the requirements on biofuel-quality are relatively high. Therefore the biofuel-specifications (e.g. dimension, water content, ash content) are limited too, and need to be precisely elaborated.
- For the same reason, co-firing either biomass to fossil fuel or several bio-fuels in a mix is for those projects seldom an feasible option.
- Only combination of a biofuel-system and a fossil fuel system is an alternative. The biofuel system will operate in parallel to the existing fossil (liquid) fuel boilers. The latter will e.g. start operating only in cold days to cover the peak load. In the base-load phase, only the biomass boilers will operate.

Technical solutions for small-scale energy systems (mainly based on wood-fuel) are available and the following state-of-the-art combustion technologies could be considered.

Table 8: Main groups of combustion technologies for wood fuel

combustion techniques	wood fuel	usual capacitity
Dual-chamber furnace	wood chips	35 kW - 3 MW
Underfeed furnace	wood chips, saw dust	10 kW - 2,5 MW
Cross feed furnace	wood, bark, raw and green wood fuel	> 25 kW
Fluidised bed combustion	wood, bark, green wood fuel	> 10 MW
Blow-in combustion	sawdust	> 200 kW

All (wood) combustion technologies are largely developed and thoroughly proven, at least in industrial countries. Technologies to use other kinds of biomass are available on the market in some cases, but long-time operating experience is very rare.

Looking at the usual capacity, the first three combustion groups are suitable for such biomass projects. There is no "best" technique. Underfeed furnaces and cross-feed/grate furnaces are mainly used for capacities smaller than 3.000 kW.

A profitable production of electrical energy and feed-in in the local grid in addition to the production of heat is rarely possible in this capacity range. Some biofuel projects in industrial countries try to launch ORC-technology (Organic Rankin Cycle), starting at a capacity level of about 500 kW. Other technologies to produce electricity, e.g. gasification and electricity production using an Otto engine or micro gas turbine do not represent a reliable technology for a long-term operation, in particular in areas without quickly accessible technical support.

In terms of the appropriate fuel logistics, in most cases already available technical equipment could be used (and should be used if available), e.g. tractors or tractor-drawn trailers. This could be useful to keep the investment low. Amounts of fuel for such projects are not large enough to create a need to invest in a special logistic chain with special equipment.

2.2 Full-scale bio-energy projects

The second project option aims at a partial fuel switch in larger district heating plants with an annual heat production volume of around 500 GWh. These plants usually run on fossil fuel. The fuel switch aims at using biomass for covering base-load heat production and power generation, thus using it most efficiently. A boiler with an appropriately designed capacity running on biomass can cover large portions of annually needed heat production and supply heat for power generation, mainly using the steam process.

Coming with the higher capacity of full-scale plants, the demand for biofuel increases compared with smaller installations. Additionally, the specific calorific value of biofuel is lower than the one of fossil fuels. Existing plants are designed for a specific (fossil) fuel throughput. If approximately 10 % of the thermal output of the furnace is supplied by biomass, the fuel flow almost doubles by volume. Often storages or intermediate storages are required.

Thus, special equipment (conveyors) and several means of transportation (railway, ship) have to be considered to meet the requirement of increased biofuel handling. Only a well-elaborated logistical supply chain can guarantee an efficient, economical, and environmental friendly process up to the plant, where the energy conversion process itself happens.

2.3 Energy Conversion by co-combustion

There are three options for co-combustion: direct, indirect, and parallel co-combustion. Direct co-combustion is combustion of biomass with fossil fuel in a single combustion chamber. Indirect co-combustion means combustion of fossil fuel with previously gasified biofuel, and parallel combustion requires at least two boilers, as biomass is burned in one and fossil fuel in another.

In an optimal situation, co-combustion of biofuel with fossil fuels derives benefits from both fuel types and provides some “extra” advantages. These could be, for example, the reactions between different chemical elements originating from biofuel and fossil fuel. These interesting reactions include the reactions between sulfur and aluminum silicates in the fossil fuel and alkalis in biomass ash. Alkalis work the same way as limestone, or dolomite absorbing the sulfur, resulting in lower sulfur dioxide emissions in the flue gas. Another example of mutual interests is the chlorine-binding capacity of fossil fuels. The sulfur level of biofuels is generally quite low. However, in some cases, the chlorine content of a biofuel may be elevated, which means there is a higher risk of boiler corrosion. Another benefit of co-combustion is the better use of local energy sources, decreased demand for waste disposal and land filling, making more efficient use of resources, and saving fossil fuel reserves. However, improper choices of fuels, boiler design, or operating conditions could minimize or even negate many of the advantages of co-combustion, and in some cases may even lead to equipment damage.

With regard to biomass, co-combustion in large plants creates a potential for high electric efficiencies due to high steam parameters and technical measures for efficiency improvement. Therefore, co-combustion in large thermal power plants can lead to an overall saving of fuels in comparison to independent fossil and biomass plants. The possibility of co-firing biomass in coal-fired boilers offers a huge potential worldwide.

The production capacity of a co-combustion plant is typically 50 to 700 MW_e, and there are a few units between 5 and 50 MW_e. The most common technology is pulverized fuel combustion. The most suitable technology, however, is fluidized bed combustion, at least if the amount of biomass in the fuel flow is high, especially when the moisture content of the biomass is high. The suitable commercial technology is already available for new co-combustion plants, but the challenge is to develop suitable technologies for retrofitting existing plants.

Fuel flexibility, i.e. combustion of fuels with varying relative amounts of coal and biomass, poses new challenges for plant operators. Especially understanding the deposition formation and behavior is a key issue in optimizing plant operation and in securing plant performance and high availability.

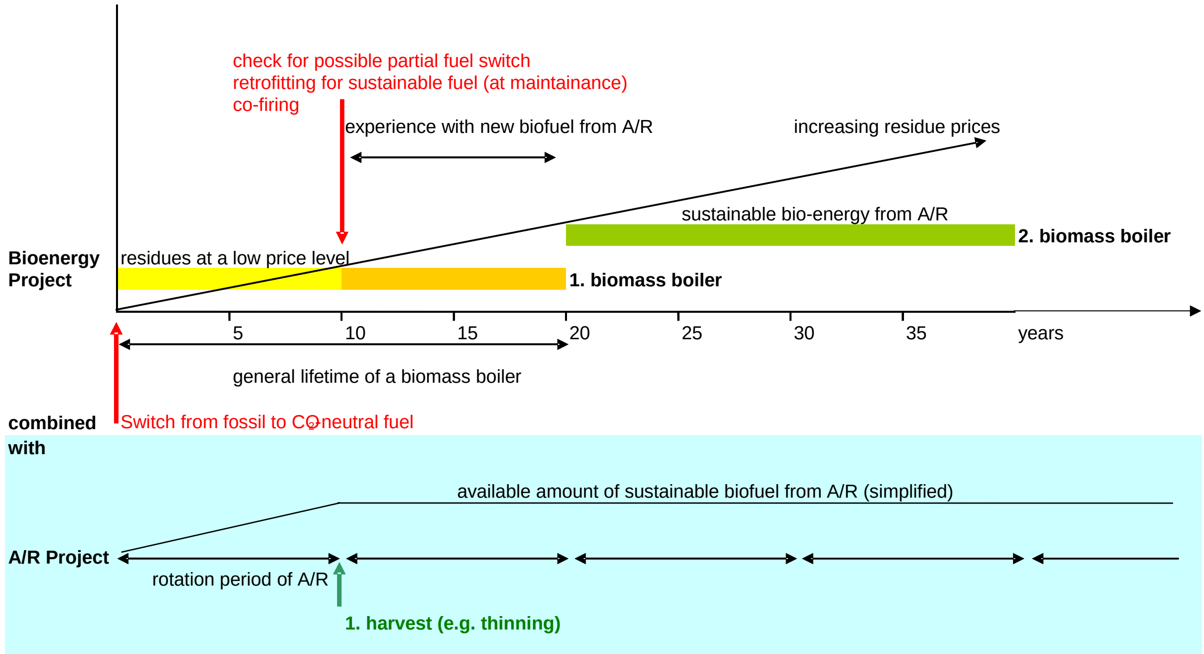
As a result, full-scale bio-energy projects are complex and require a multitude of special equipment and a lot of technical know-how (e.g. turbine), in particular if electrical current is produced. Furthermore, (partial) fuel-switch has to be based on a reliable infrastructure and a well-designed supply-chain. Nevertheless the combination of the wide variety of technical requirements offers enough space for integrating local industry and staff, e.g. for assembly and installation (furnace) in terms of an effective joint venture to put the whole project on an economic base.

2.4 Combination of bio-energy and A/R-projects

In the focus of combining bio-energy and A/R-projects several options are possible.

The following scenario shows an interesting way of starting a parallel development of both project types at the same time.

Figure 7: Scenario: for increasing residue price level due to higher prices for fossil fuel and higher demand of other residue based installations (example: waste wood CHP plants in Germany after Renewable Energy Law, fuel switch to green wood)



An important issue while planning a bioenergy project is to always ensure the availability and homogeneity of the projected fuel. Due to starting processes and naturally limited growth of trees, A/R-projects need time to deliver sustainable fuel supply. The first harvest activities (thinning) of A/R-projects can be expected after approximately 10 years (rotation period), depending on wood species, climate and soil.

To have the positive environmental effect of being able to switch from fossil to bio-fuel right from the start, bio-energy projects have to make use of material that is already available on the market. In most cases these could be unused bio-residues, e.g. from a sawmill, with similar specification and quality.

Many forest and wood processing regions in developing countries have a considerable potential of unused bio residues – these days often available at a low price or even a fee could be taken for disposal service. On one hand, the increasing demand for these residues will most likely have the side-effect of rising prices. On the other hand, the availability of these co-products offers a possible and economical way to produce heat (and power) immediately, by using bio-energy sources instead of fossil fuel in a short period of time.

Furthermore the similar quality of residues and A/R-woodchips offers a technologically feasible “fuel switch" from bio-fuel to bio-fuel after first rotation period, starting partially with co-firing of the two bio-fuels and retrofitting of the installation if necessary. Necessary modifications could be made during process based, regular maintenance periods. Once the installation runs sufficiently, the use of more and more fuel from A/R leads to a full switch to sustainable energy. Technical experience during operation using the bio-fuel in the first boiler will help optimize the design for the new bio-energy system after the lifetime of the first one.

In this manner, bio-Energy systems will be improved, so that they become state-of-the-art, even in developing countries aiming for efficiency rates achieved in industrial countries.

2.5 Criteria for project evaluation

Positive impacts on the socioeconomic welfare and on the environment are a major potential of combined biomass energy & LULUCF projects. However, a set of criteria should be observed in the planning and execution of CDM projects to make sure that positive impacts compensate for any unwanted impacts regarding the target population or the environment.

In the context of biomass & LULUCF, such criteria involve three different projects types:

- Criteria for CDM afforestation & reforestation (A/R) projects (according to UNFCCC stipulations and voluntary additional standards)
- Criteria for non-CDM agricultural projects in non-Annex 1 countries generating bioenergy (according to voluntary standards)
- Criteria for CDM bioenergy projects (according to UNFCCC stipulations and voluntary additional standards)

In the following, such obligatory and recommendable additional criteria will be outlined for the three project types and their combinations (A/R-bioenergy, agriculture-bioenergy), taking into account the presence of many overlapping criteria. From the many existing standards and guidelines (Kapp, 2004), the criteria are taken from the following organizations, considered to be among the most relevant to the topic:

- PDD for A/R projects (EB of UNFCCC)
- WWF Gold Standard
- FSC Generic Standards

- CCBA Standards
- IETA & The World Bank Validation & Verification Manual

These organizations are briefly introduced. Their social criteria for acceptable climate or forestry projects are then resumed in a tabular form, along with our own recommendation for suitable social criteria. Projects fulfilling the suggested criteria are likely to support sustainable development, and can more easily be accepted by the stakeholders and observing NGOs. With this, the barriers against implementation could be lowered.

In the discussion of various project types based on case studies, the proposed list of social and environmental criteria will be used to evaluate their potentials and constraints.

2.5.1 PDD for A/R projects (EB of UNFCCC)

The Marrakech Accords stipulate that a Project Design Document (PDD) is required for CDM and JI Projects. In the Guidelines for the implementation of Article 6, the PDD is described as a basis for project verification (determination) procedure (UNFCCC, 2002), and a description of the PDD content is given in the "Modalities and procedures for a clean development mechanism" (UNFCCC, 2002a). A PDD for A/R was decided upon in Decision 19/CP.9 (UNFCCC, 2003), and the Executive Board (EB) stipulated, at its 15th meeting (September, 2004), a series of documents relevant to CDM afforestation-reforestation (A/R) projects[3], including:

- Annex 6. CDM-A/R-PDD: Project Design Document for afforestation and reforestation projects - Version 01
- Annex 7. CDM-A/R-NMB: Proposal for a new baseline methodology for A/R project activities
- Annex 8. CDM-A/R-NMM: Proposal for a new monitoring methodology for A/R project activities

According to Decision 19/CP.9, an A/R PDD has to include the following information regarding social issues:

(a) Socioeconomic impacts of the project (local communities, indigenous people, land-use rights, employment, food production, cultural and religious sites, access to firewood and other forest products), including those outside the project boundary. If negative socioeconomic impacts of the project are considered to be significant by project participants or the host country, a socio-economic impact assessment (SIA) has to be carried out;

[3] Accessible under: http://cdm.unfccc.int/EB/Meetings

(b) Description of monitoring and mitigation measures to address eventual significant negative environmental or socioeconomic effects of the project;

(c) Stakeholder comments, including a description of the stakeholder process, a summary of the received comments and a report on how these comments have been taken into account;

2.5.2 WWF Gold Standard

The "Gold Standard: Quality Standards for CDM and the JI" of the World Wide Fund for Nature or World Wildlife Fund (www.panda.org/climate) provided the first independent best practice benchmark for CDM (Clean Development Mechanism) and JI (Joint Implementation) greenhouse gas offset projects, but presently excluding LULUCF projects. It offers project developers a tool with which they can ensure that the CDM and JI deliver credible projects with real environmental benefits and, in so doing, give confidence to host countries and the public that projects represent new and additional investments in sustainable energy services.

The Gold Standard was initiated by WWF in conjunction and consultation with a wide range of environmental, business and governmental organizations, and on the basis of work already carried out by other groups. Formal endorsement is currently being sought from the Climate Action Network (CAN – the umbrella group of environmental NGOs within the UNFCCC).

The Gold Standard builds upon guidance given by the Executive Board in its Project Design Document (PDD). The Gold Standard sets out a best-practice code on many issues in the PDD and incorporates a small number of extra screens necessary to deliver real contributions to sustainable development in host countries, as well as long-term benefits to the climate. In order to meet the Gold Standard, projects must pass through three basic screens:

- A project type screen, comprising the sustainable energy technologies needed for long-term climate protection;
- An additionality and baseline screen, to ensure that carbon credits are backed by bona-fide emissions reductions;
- A sustainable development screen, based on tried and tested rapid appraisal methods and direct public consultation, ensuring that projects contribute to sustainable development and meet the needs of local stakeholders.

Project developers wishing to have projects validated and verified under the Gold Standard should follow the same procedures as any other CDM or JI project. However, they should instruct the Designated Operational Entity (DOE)[4] to base its work on the Gold Standard Project Design Document (GS-PDD) and technical appendices, instead of on the basic CDM Project Design Document (CDM PDD). The aspects that need to be validated and verified are clearly indicated in the GS-PDD. The certificate of the DOE that the Gold Standard has been met will be sufficient to demonstrate compliance. A sample of projects will be independently audited by the Gold Standard steering committee to ensure that validation and verification are being consistently carried out to the highest standards and that the Gold Standard's integrity is being maintained.

Regarding social sustainability and development, a project activity must be assessed against a specified matrix of sustainable development indicators, as addressed in the Appendix B.

The Gold Standard is supported by many NGOs within the ***Climate Action Network (CAN)*** – a worldwide umbrella of over 340 NGOs working to promote government and individual action to limit human-induced climate change to ecologically sustainable levels – are still skeptical about the use of LULUCF for climate mitigation. This is manifested by the elimination of such projects from the project types feasible for the WWF Gold Standard.

If the majority of the NGOs represented in CAN maintain their strict position to reject LULUCF as a compensation measure for fossil fuel use at all, this conflict cannot be resolved by any certification scheme.

2.5.3 FSC Generic Standards

The Forest Stewardship Council (FSC, www.fsc.org) is an independent, not-for-profit, non-governmental organization based in Bonn, Germany, that provides standard setting, trademark assurance and accreditation services for companies and organizations interested in responsible forestry. Founded in 1993, FSC's mission is to promote environmentally appropriate, socially beneficial and economically viable management of the world's forests. FSC forest management standards are based on FSC's 10 Principles and Criteria of responsible forest management.

FSC's governance structure ensures that FSC is independent of any single interest group by requiring an equal balance in power between its environmental, social and economic chambers as well as a balance between interests from North and South. FSC is considered to be the strictest mayor label and is supported by most environmental NGOs like WWF or Greenpeace, and social NGOs like various Labor Unions. Criticism was put forward that FSC did not have an independent accreditation body. Nev-

[4] Operational entities are certifying agencies designated by the CDM Executive Board to carry out validation and certification within the relevant project scope.

ertheless, the independently working accredited certification bodies (certifiers) are occasionally controlled by FSC.

The distinctive FSC trademark enables customers to recognize responsible forestry products in stores around the world. Major retailers in Europe, North America, South America and Asia ask for FSC certification when ordering forest products so they can assure their customers of the origin of the products they are buying.

Over the past 10 years, 42 million hectares in more than 60 countries have been certified according to FSC standards while several thousand products are produced using FSC certified wood and carrying the FSC trademark. FSC operates through its network of National Initiatives in more than 30 countries. With this it is the most distributed international forest standard based on yearly on-site validations of the adherent individual forest enterprises or forest owner groups.

It can be resumed that FSC has rigorous performance-based criteria covering all aspects of sustainability: ecological, social and economic. It has proper standard setting, certification and accreditation procedures. Economic, social, and environmental interest groups decide within the FSC on equal terms. The FSC is the only program able to certify around the world, whatever the size and whatever tenure system (FERN, 2001).

2.5.4 CCBA Standards

The Climate, Community & Biodiversity Alliance (CCBA) is a global alliance promoting integrated solutions to land management. It has designed a triple-benefit voluntary set of standards (www.climate-standards.org) to identify and certify land use projects that reduce global warming while conserving biodiversity and water resources, and alleviating poverty. It was open for global peer review and comment from June through October 2004. The revised Standards were tested on a dozen sites around the world. Based on testing and additional comments received, an internationally renown review team has modified the Standards into their current first official version, which was published in May 2005.

Member companies are BP, GFA Terra Systems, Intel, SC Johnson, and Weyerhaeuser, The second pillar of membership are the non-governmental institutions Conservation International, the Hamburg Institute of International Economics, The Nature Conservancy, and the Indonesian research NGO Pelangi. Other institutions helping revise the Standards and ensure broad input include the World Agroforestry Center (formerly ICRAF) in Kenya, the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) based in Costa Rica, and the Center for International Forestry Research based in Indonesia.

While the CCB Standards are primarily designed for LULUCF projects that reduce or sequester GHG emissions they can, however, evaluate land management projects outside of the Kyoto Protocol arena.

The Standards will work in developing, developed, or emerging economies and can be used for projects with private investment, public investment or a combination of both. They are intended to help companies, conservation organizations, governments and international funding groups to efficiently identify cost-effective carbon emission reduction projects that also have a positive impact on biodiversity and local communities.

To earn certification, a project must satisfy minimum requirements in each of the areas climate, biodiversity, and communities. A project must also score 50 out of 100 points for each of the components. This scoring system will enable CCB-rated projects to compare to one another.

The scoring system of the draft standard looks at several factors in the three integrated categories:

- Climate Change: The climate standards identify a variety of factors to quantify the amount of carbon emissions reduced or absorbed by land based projects including baselines, additionality, leakage, monitoring and the permanence of the climate benefit;
- Community: The community standards identify land-based carbon projects that involve local communities in the design and operation of land management projects and produce real and verifiable benefits for project communities;
- Biodiversity: The biodiversity standards identify projects that enhance landscape management by restoring and/or maintaining local plant and animal species populations, their associated genetic variability, and their habitats, restoring and/or maintaining biological connectivity, and conserving or enhancing water resources.

The Project Design Standards is the first of two sets of standards the CCBA intends to develop. These "Design" Standards evaluate and score projects that are still in the planning stage. These Standards will be followed by Project Implementation Standards. The "Implementation" Standards will be used to periodically evaluate whether planned activities were carried out successfully.

2.5.5 IETA & World Bank Validation & Verification Manual

Validation and verification activities establish the credibility of greenhouse gas projects, their eligibility as Clean Development Mechanism (CDM) or Joint Implementation (JI) projects and their emission reductions. In 2002, the International Emissions Trading Association (IETA) and the World Bank Carbon Finance Group / Prototype Carbon Fund (WB PCF) initiated the process to establish a common ***CDM and JI Validation & Verification Manual (VVM)***, which replaces the World Bank's Prototype Carbon Fund's (PCF) earlier Preliminary Validation Manual, issued in November 2000. It can be used by a wide range of stakeholders involved in developing, financing, validating and verifying CDM and JI projects. It shall guarantee the quality and ensure the transparency of the validation and verification process to enhance trust in the work of third party validators and verifiers, and allow third party validators and verifiers to work in a consistent manner, promoting fair and equal treatment of projects.

Det Norske Veritas Certification (DNV) has lead the development. Input to this revision was also provided by TÜV Süddeutschland and KPMG, and comments were received from several other certification bodies applying for CDM designation.

This first draft was published on the IETA web site in May 2003, and subsequently made available for road testing in the fall of 2003. All leading validators & verifiers have used the manual subsequently. In March 2004, the final draft was made available. The formal launch of the manual occurred during the CarboExpo in Cologne in July 2004. The Validation and Verification Manual is available online at http://www.vvmanual.info. It provides guidelines for the validation and verification process, serves as a tool for third-party validators and verifiers, and contains templates for validation and verification reports. Checklists are comprehensive and can be updated by the user to reflect any particular needs of the project (e.g. forestry projects) or amendments of the regulatory framework for CDM and JI projects. The manual helps to provide a top quality service leading to high-quality projects. The VVM is also a valuable tool to support staff training and prepare applicant entities for accreditation as DOE.

The manual builds on the existing requirements, modalities and procedures for CDM and JI projects. But it also includes some optional elements such as “initial verification”, which is performed at project start-up. In each case, it is the responsibility of the user to adjust the manual’s templates to the particular needs of a project, and to amend the manual to reflect new UNFCCC decisions on CDM and JI. Already during the development of the manual, all major applicant entities and prospective DOEs (DNV, TÜV, SGS, KPMG, JQA) started to use the manual. They have adopted the manual’s standard checklists and reporting format and have integrated the manual into their standard operational procedures.

2.6 Assessing Social Aspects of Sustainable Development

Article 12 of the Kyoto Protocol requires that CDM projects contribute to sustainable development (SD) in the host country. The idea is to achieve dual benefits (climate change mitigation and development) through a market mechanism. During the last 40 years, development approaches evolved significantly from a rather narrow technical view of technology transfer, to a broader socio-economic view of rural development (Holding Anyonge 2002). Hence, designing a policy framework for a market mechanism for sustainable development in non-Annex I countries needs to be seen in the context of this evolution of approaches. There is a common agreement that CDM projects should meet state-of-the-art standards of current development projects (social learning, stakeholder participation and ownership, holistic and systems thinking, etc.). However, experiences from ‘classical’ development projects show that social sustainable development is an input-intensive and time-consuming process.

The social acceptability of climate projects has been discussed and defined by leading DOEs and DOE applicants. In a comprehensive table (Appendix B.1), the criteria from the different key organizations are summarized, followed by a recommendation on suitable criteria for sustainable forest climate projects. The many criteria in this table, including overlapping formulations of the different organizations, can be further summarized into seven essential social criteria that absolutely must be fulfilled in high standard CDM projects acceptable to the critical public:

1. Involvement, no displacement and due compensation of local community & indigenous people
2. No tenure rights in dispute
3. Stakeholder information and comments invited and taken into account with grievance resolving mechanism
4. Social impacts assessed and mitigated
5. Contribution to poverty alleviation, livelihood improvement, rural economy and employment
6. Capacity building and training of local people
7. Respecting health & safety regulations and worker rights

A review of the literature on the potential of CDM projects for sustainable development shows that there is a huge gap between theoretical project design and implementation requirements claimed by the scientific community, and the necessary practical requirements for project validation. In general, project proposals focus on the potential income surplus for the beneficiaries of carbon storage when discussing the sustainable development criteria for CDM. However, these figures are not put into relation with household resources (labor, land, capital) and the local institutional setting. No estimates are offered on the net effect of the investment on the community/household economy. Households are rationally acting entities, so how can we assume that the additional income compensates sufficiently without looking at opportunity costs, labor input, and risks of corruption? Without a proper institutional set-up, benefits will most likely be absorbed by powerful local authorities, thus not adding to poverty alleviation, but to further social stratification. Within the current policy discussion, there is a tendency to overestimate sustainable development potentials of CDM projects. Land-use based CDM projects are considered to have a high potential for sustainable development, however, a critical assessment of their development benefits has not been undertaken so far (Brown 2004, Gundimeda 2004).

Going into such detail and providing answers to these questions would exceed this study’s framework. This study assesses full-scale and small-scale projects, affecting both the macro- and micro-level.

Thus, we offer a comprehensive discussion framework that has to be adapted to individual project settings to achieve more detailed results.

The purpose of this section is thus twofold:

(1) To localize this study within the ongoing discussion on CDM potential for SD among researchers and practitioners, and to give a background on key elements and how they are used in the context of this study (such as ‘sustainable development’, ‘beneficiaries’, ‘forest resources’ and ‘participation’).

(2) To derive a set of indicators for assessing project set-ups regarding their SD potential.

2.6.1 Literature overview and conceptual framework

Which “sustainable development” are we talking about? The ongoing discussion among researchers on sustainable development effects reveals (a) that there is no common understanding of what kind of sustainable development is meant, and (b) regardless of the type of sustainable development that has been targeted so far, the projects’ social effects have been very low, or even negative (Gundimeda 2004).

The Kyoto Protocol does not offer a definition of ‘sustainable development’. In the context of this study, we refer to ‘sustainable development’ as “development that meets the needs of the present without compromising the ability of future generations to meet their needs”, including the aspect of improved equity by giving special attention to increasing the well-being of the less advantaged population.

2.6.2 Micro- and macro-level effects

To analyze the potential of combined projects for sustainable development within the framework of this study requires distinguishing micro- and macro-level effects. Energy efficiency and fuel switch projects can have both micro- and macro level effects that are relatively easy to define and measure (labor allocation at the household level, share of power/ heat provided from bioenergy plants, share of population with access to safe and ‘clean’ energy sources, dependence on fuel imports, etc.). Macro-level effects of LULUCF projects are considered to be rather low compared to other CDM projects. Instead, influencing land use, vegetation type, management and benefit sharing mechanisms, has significant impacts on (rural) livelihoods.

The selection and monitoring of macro-level development indicators is comparatively easy. However, agreeing on and monitoring indicators for micro-level effects of LULUCF projects is much more complex:

2.6.3 Heterogeneity among the potential beneficiaries

First, there is the identification of the potential beneficiaries of land-use based CDM projects. Within the development discourse, this group is frequently described as ‘the community’[5], ‘the village’, or ‘the poor’. The idea of ‘community’ is in many ways similar to the ‘unitary model’ of the ‘household’ in economic literature. Social institutions (the community/ the household) are considered homogeneous groups based on commonality, interdependence and shared of values, aims, and interests amongst its members. Multiple individuals are supposed to behave as a single entity (Schoeffel 1997; Mosse 1998). In practice, the heterogeneity of socio-economic assets and individual utility functions among community members/ family members/ sub-group members (classified according to occupation, class, caste, ethnicity, or gender) makes social cohesion vulnerable. Thus, the ‘community’ / ‘family’ as a social institution is not a static commodity but constantly involved in the dynamic process of identification and reorganization. For instance, gender, as one category, is extremely difficult to discuss. ‘Women’ at the level of policy formulation identified as one target group, are positioned within society according to different socio-economic assets. Thus, their interests are shaped in multiple and sometimes conflicting ways (Meinzen-Dick 2001, Cooke 2001). In this context we continue to use the vision of “community as a spatial unit, as a social structure, as a set of shared norms” (Agrawal 1999: 633), since it is an attractive model for policy formulation. However, it should be kept in mind that:

> Community groups are composed by multiple actors with multiple interests and perceptions of development priorities (e.g. income generation, local property rights, electrification etc.).

To conclude this section: ‘the beneficiaries’ is a heterogeneous group with diverse educational background and driven by forces from different utility functions. To create a solid understanding of the project among the community and to assure long-term social acceptance (and a sense of ownership and commitment), it is crucial that **information dissemination** concentrates on all different subgroups. During the project design phase, as well as during implementation, the **involvement of representatives from local stakeholders** (women groups, producer organizations, farmer groups etc.) is emphasized. The project can have effects on **population characteristics** (through the influx or outflow of temporary workers, capacity building of local population, on ethnic and racial distribution etc.), as well as on **community and institutional structures** (employment/ income characteristics, interest group activities etc.). LULUCF CDM projects are considered to have a significant

[5] Agrawal (1999) offers a historical overview of the concept of community. He describes the linkage of the concept to analyses of social transformation in the 19th century. The term was used for classification of societies along an evolutionary path (‘underdeveloped‘, ‘developing’, and ‘ developed’ societies). He construes the actual popu-

impact on employment opportunities. However, it is reported that cash income opportunities that are above the traditional village rate are primarily absorbed by non-poor households, especially when work is provided by government agencies (Kumar 2002). Thus, the effect on poverty alleviation can be limited.

2.6.4 The economic importance of common pool resources

Second, there is the identification of the underlying social scenario, which we could define as ‘socio-economic baseline’ (corresponding to the climate-change terminology), here referred to as the baseline for the type of resource use and management, as well as it’s contribution to rural livelihoods in a without-project-situation. The following considerations focus on forest-climate projects (A/R, forest conservation).

Carbon sequestration in forestry projects is restricted to area with low opportunity costs, hence which is not used for agricultural production. In general, this is barren land, pasture land or degraded forest which is not divided and organized as separate parcels of private property. Thus, in this context we refer to the land / forest resources, as **common pool resources**[6]. The institutional arrangements[7] that govern these resources differ among the settings, still most of them are characterized by multiple and overlapping property rights, varying degrees of access and informal[8] regulatory regimes. Although benefits delivered by these resources are frequently marginalized in economic analysis, micro-level studies in rural India have shown that common pool resources are crucial for sustainable livelihood strategies of the poor. They fulfil the function of **safety nets**, particularly in times of agricultural crisis. Gundimeda (2004) summarizes that in rural India (a) 12 –25% of the

larity of the community concept within policy design for natural resource management as a relict of the romantic image of the ‘noble savage’ who is supposed to be the best manager of the resource.

[6] A ‘common pool resource’ (or ‘commons’) is considered as “a natural resource (or a durable facility of human design and construction) that is shared by a community of producers or consumers” (Oakerson 1992: 41). The commons are shared like public goods, but like private goods, the share that is consumed by one individual is not available for others. Thus, the commons cannot be shared without limits. Without coordination, individuals are likely to use too much too fast, so that the resource cannot replenish the supply, and marginal product of the commons as a whole diminishes. If the community of consumers does not find alternative patterns or uses, destructive competition or conflict is likely to follow (consequently followed by resource depletion or degradation of facilities). This outcome is characterized by Hardin (1968) as the ‘tragedy of the commons’ (cited in Oakerson 1992).

[7] Davis and North (1971, cited in Gatzweiler 2001) distinguish between ‘institutional arrangement’ and ‘institutional environment’. Institutional arrangements are the forms of contract or arrangement (‘the play of the game’) that are composed and applied for particular transactions. The institutional environment is the surrounding set of institutions (or ’rules of the game’) within which people and organizations develop and implement specific institutional arrangements (such as national laws, policies, international laws and treaties). Concerning informal institutions (such as social customs, conventions, norms) the distinction is not always so clear. Commonly accepted institutional arrangements (such as norms, traditions) can become part of the institutional environment. (Gatzweiler 2001)

[8] Informal institutions (such as conventions, traditions, codes of conduct, values and norms) supplement formal institutions (such as laws, policy rules, property rights). Both types of institutions can either be complemented by each other or compete with each other (Guggenheim 1992).

poor household income is contributed by common pool resources (fuel wood, fodder, edible products), and (b) the poorer the household, the more important common pool resources are for daily survival. According to data provided by the International Energy Agency (IEA, 1996: II.289-308, III.31-187), wood fuels provide on average about 20 percent of total energy supply in the developing world. However, this can amount to 80 percent or more in some countries (e.g. Nepal, Uganda, Rwanda, Tanzania).

> The poorer the household, the higher its dependence on common-pool resources for everyday life.

Limiting the right to access and use of these resources (through land privatization, or reorganization of property rights) within a CDM project can have disastrous effects on the rural poor (Gundimeda 2004). Thus, an assessment of livelihood vulnerability and dependence on CPRs (food supply, residential stability, household resources) is required to derive **adequate compensation** mechanisms (alternative land for grazing, fuel wood collection etc.). Rural communities in Mexico consider **secure land use** or **land tenure rights** a major aspect of sustainable development within CDM projects (Brown 2004).

In many cultures, fuel wood and fodder are collected by women and children. Thus, they are the ones who 'manage' the common pool resources; despite this, they are often not involved in decision-making processes on resource management, which leads to the issue of 'participation'.

2.6.5 The myth of 'Community participation'

During the 1980s, with the increasing prominence of indigenous and ethnic claims, the idea that communities should be empowered and take responsibility became popular within the development discourse (Agrawal 1999)[9]. It was advocated that 'grass root' communities should manage their own affairs, to make the process more 'demand-driven'. Thus, 'community management' and 'community participation'[10] have been promoted as the missing key to development. However, results did not meet expectations and 'participation' turned out not to be the overall remedy to assure sustainable development. The incorporation of people's knowledge into the planning and executing of de-

[9] This popularity in developing countries stems from governments' incapability to satisfy the demand for public services at the level of small communities. National governments mainly appreciate community-based approaches to development as cost-effective solutions.

[10] The term 'community participation' is used in various connotations. It describes the involvement of small, unorganized groups into planning processes, as well as the collaboration between formal local institutions and central governments. It is a tool that is applied in different scale settings (Cooke 2001, Narayan 1995) and for differing purposes. Community-based development projects have been popular with NGO's, since direct collaboration with the state apparatus is considered to be inefficient and frustrating (Schoeffel 1997). Following pragmatic policy interests, community participation is regarded as a way to minimize costs for service delivery (Mosse 2001).

velopment programs is often very selective and depends on local relations of power. To make a decision-making process public does not consequently mean to make it democratic. Local hierarchies will always dominate the knowledge voiced. The question that appears is ‘Whose reality counts?’ (Axinn 1997, Mosse 1998, Schoeffel 1997 & 2001, Cooke 2001).

> Participation does not necessarily include participation of ‘weaker parties’ but empowerment of the already powerful within the communities.

This does not necessarily mean that local hierarchies *per se* have a negative influence on the initiation of a CDM project. The presence of a key person for promotion of the project within the community is essential for the establishment of an institutional arrangement for project set-up; although the drawback is that this person would have ambiguous functions (Katko 1992). Stressful heterogeneity can be overcome by **innovative institutional arrangements**, given the prerequisite that people share a common understanding of their situation, and that they trust one another. Brown (2004) discusses the issue that project participants perceive potential carbon revenues to be too low to compensate for labor input and to provide an incentive for long-term commitment to the project. Furthermore, villagers hesitate to trust that benefits will be transferred to them. Thus, sound information on the project, and clear arrangements for benefit transfer and labor distribution are essential for long-term positive effects on the social situation (social life means going out to bars, meeting friends, etc.).

However, the question remains: What effect can combined projects have on improving equity and contributing to poverty alleviation?

2.6.6 The effect of social capital

The development of new strategies to manage common pool resources depends to some extent on the types of experience people have had with other local organizations. Appropriators that have had experience with alternative methods of co-ordination are expected to have fewer difficulties in finding new strategies to manage a common pool resources. Thus, it is most likely that CDM projects will concentrate on communities or villages that have proven successful with collective action and that are not poor in their local context (Gundimeda 2004). This social capital corresponds to a certain level of wealth. Accordingly, it can be assumed that poorer communities will not be approached through the CDM.

The conclusion is not that CDM projects have no potential to contribute to poverty alleviation and local level sustainable development. Instead, the conclusion is that CDM projects have a potential to increase the gap between the local rich and the local poor.

Still, one could argue that allowing the local rich to create 'micro-growth-centers', with positive effects triggering down to the local poor in the long run, through improved visibility of the region in the national context. Good reasons for fostering CDM can be found. Nevertheless, it is essential to differentiate the discussion when it comes to the question of net benefits for the local population.

To conclude this section, expectations placed on CDM project's potential for SD should be realistic: different project set-ups have different target groups and address different SD parameters. There is no cheap method to achieve overall sustainable development through CDM. In order to avoid CDM A/R projects only serving to feed the image campaign of companies in Annex I countries, and to avoid development concepts being reverted to concepts of mere technology transfer (common during the 1970s), immediate action is needed to set evaluation standards . This study attempts to contribute to this process by highlighting points of action.

2.6.7 Indicators for social assessment

In the following section, a comprehensive indicator list is presented, which serves as an evaluation checklist for this study. The foundations for this checklist are the "Guidelines and principles for social impact assessment", developed by the Inter-organizational Committee for Guidelines and Principles for Social Impact Assessment (1994)[11]. Further amendments are based on a questionnaire used by Brown at al. (2004), and adjustments to the framework of this study have been made. The focus of the present study is the combination of full-scale and small-scale forest sink and bioenergy projects. Since they have effects on different levels (micro- and macro-level) and in different fields, the list is quite comprehensive. Nevertheless, not all indicators are relevant for all projects. During the analysis, we focus on specific aspects for each project.

The list of indicators derived does not claim to be complete; still it offers a checklist of aspects that should be taken into consideration.

Indicators are divided into four groups:

(1) Pre-condition indicators, describing aspects that are considered crucial for overall outcome.

[11] This tool was developed to assess potential social consequences of the adoption of new policies or the implementation of new programs or large projects in the context of the U.S. National Environmental Policy Act of 1969.

(2) Project Design Indictors, for the discussion of social aspects during the process of planning and starting the project. Project set-up is a sensitive process, requiring reorganization at a local level. Disregard of the local setting can lead to long term reluctance among the population. In order to assure long-term commitment and social acceptance, special attention has to be paid to the process of design and initial implementation. Project Design Indicators are similarly relevant for both large and small scale projects.

(3) Sustainable Development Indicators that focus on a more detailed assessment of long-term social effects. These indicators are classified into five categories, each category being supplemented by sample indicators. Sustainable Development Indicators differ depending on the project type. For instance, the effect of small-scale projects on population characteristics (migration of temporary workers) is considered rather low. However, full-scale projects can have a significant impact on the influx of temporary workers.

(4) Monitoring Indicators focus on social institutions for conflict resolution, the fulfillment of project commitment to 'invest' into the community, and on long-term monitoring of selected SD indicators.

Table 9: Indicators for socio-economic assessment

Indicator group	Key	**Indicator**
Pre-condition	A0a	**No displacement** of local communities, except on a voluntary basis.
	A0b	**Social impact assessment** according to international standards for big infrastructure projects for LSC combined projects, if considered appropriate.
Project Design Indicators	A1a	**Information dissemination** on project scope and purpose to local stakeholders and population. There is clear understanding of the project set-up and objectives.
	A1b	**Involvement of local stakeholders** (administrative agencies, interest groups etc.) in project preparation (invitation for comments, settlement of disputes etc.). At least two public consultations.
	A1c	**Participatory site-selection** (identification of an agreement on boundaries involving local communities, with focus on minorities)
	A1d	**Settlement of land use conflicts** (applying participatory LUP, identification of alternative land resources for grazing etc.)
	A1f	Calculation and agreement on **compensatory payments** for land use changes to individuals/ the commune.
	A1g	The entity (individual households/ communities/ local governments/ companies) holds **land tenure rights** or **long-term use rights** for the project sites. These rights are commonly agreed upon.

Indicator group	Key	**Indicator**
Sustainable Development Indicators	A2a	**Population characteristics** (influx or outflux of temporary workers, seasonal residents, capacity building of local population, ethnic and racial distribution)
	A2b	**Community and institutional structures** (Employment/ income characteristics, employment equity of local population with focus on minority groups, industrial/ commercial diversity, presence of planning and zoning activity, Interest group activity, size and structure of local government)
	A2c	**Political and social resources** (distribution of power and authority, leadership capability and characteristics, interested and affected publics)
	A2d	**Individual and family changes** (perceptions of risk, health, safety, worker rights, residential stability, attitude towards project, household resources (land, labor, capital), food supply, farm household auto-investment capacity, off-farm employment)
	A2e	**Community Resources** (community infrastructure, food supply, land use patterns, cultural and historical resources, access to: water, health, education, clean energy services)
Monitoring Indicators	A3a	Establish process of hearing and responding to **community grievance.**
	A3b	Monitoring of proportion of **project costs spent in communities** (local salaries, infrastructure, training)
	A3c	Reporting on selected **sustainable development indicators** (A2a-A2e).

2.7 Environmental integrity

The environmental integrity and thus acceptability of climate projects has been discussed and defined by the above-mentioned leading organizations. In the comprehensive table (Appendix B.2), the criteria from the different key organizations are summarized, followed by a recommendation on suitable criteria for sustainable forest climate projects. The many criteria presented in this table, including many overlapping formulations of the different organizations, can be further summarized into 14 essential environmental criteria that must be fulfilled in high standard CDM projects acceptable to the critical public:

1. Project compliance with environmental legislation of host country
2. Forest practices
    a. No environmentally harmful practices and written guidelines: no conversion of, or negative impact (e.g. desertification) on native ecosystems, no soil erosion, no reduction in water quality and quantity, no alteration of natural disturbance regimes (e.g. fire)
    b. Assessment of, and safeguards to protect rare species
    c. Establishment of protection areas

   d. Control of inappropriate hunting, fishing & trapping
   e. Design & diversity of plantations should promote the protection or restoration of natural forests (more than two tree species, uneven age, irregular spacing, no genetically modified species, only controlled use of non-invasive exotic species, native species preferred)
   f. Careful site preparation techniques
   g. Management plan with explicitly stated objectives and strategies regarding plantation and natural forest conservation
3. Environmental impact assessment, mitigation & compensation
   a. EIA if negative impacts are considered significant by project participants of the host country
   b. EIA, inside and outside project boundary, habitat based and with biodiversity indicators
   c. Existence of plans and strategies for impact mitigation
   d. Implementation of credible mitigation and, where necessary, compensation measures

4. Monitoring Plan
   a. Collection and archiving of relevant data concerning environmental impacts
   b. Description of planned monitoring and remedial measures to address significant impacts

The projects' templates will be checked against the 14 essential environmental criteria.

However, as the German Federal Environmental Agency (Umweltbundesamt) points out, the environmental impact of a given climate project also depends on the nature of biodiversity of the ecosystem to be replaced. E.g. climate projects on former croplands may be of higher priority than similar projects on grazing land (Choudhury et al., 2004) (see Appendix C). But even with this prioritization, certain evaluation problems are likely to arise, because many disturbed or otherwise degraded lands (e.g. overgrazed areas with open soil patches, fire disturbed, dry, and low-fertility lands) are important habitats for specialized flora and fauna. This leads to the conclusion that the 14 essential criteria should be applied with care, taking into account the very specific situation of each project situation.

2.8 Legal and institutional aspects

The CDM is a type of foreign direct investment (FDI). Therefore, it depends on what investors would call a “beneficial investment climate”. This term embraces among other factors, that there is a stable and reliable political regime, property rights are respected, legal titles are enforceable, rules on capital export are in place, import tariffs and procedures are transparent, and that corruption is kept at tolerable levels. It is important for long-term investment, like forestry or full-scale energy production, that these conditions be met over long periods. The country risk is a gradual composite indicator for reliability of all the above conditions.

Furthermore, there are legal and institutional requirements specific to the CDM. First, the host country needs to be a participant in the UN Framework Convention on Climate Change, and have ratified the Kyoto Protocol. In many countries, getting the parliament to pass legislation is a costly enterprise. As a part of this legislative process, the government needs to designate a national CDM authority (DNA). This organism does not necessarily belong to the state administration; it can also be an independent body. As many developing country governments fear that the CDM could interfere with sovereignty, they install a council composed of a variety of ministries overlooking the DNA’s work, which tends to make the process slow and inefficient. A DNA should be staffed by at least two experts and one assistant. The additional task of reporting back to an inter-ministerial committee may increase the workload far beyond that point. Depending on the wage level, a 6-digit annual budget needs to be calculated for staff and equipment alone; the overhead, like office and communication costs not included. A rough estimate by the Peruvian DNA assumes a cost of around 4,800 US$ per project approval (Cigarán, Iturregui 2004). On the other hand, in a competitive market, it is not easy to recover these costs from potential investors. In concrete terms, investors will hardly be prepared to pay more than 10 – 20,000 EUR for full-scale CDM project approval. From the investor’s perspective, and given actual Carbon prices, this means losing between 2 and 4 kilotons of CO2 equivalents in transaction costs. Thus, below a minimum of five to ten approved CDM projects per year, setting up a DNA in a country less favored by FDI is in many cases an effort that will not pay off during the first commitment period, as it can only be justified if institution building reaps additional benefits for governance. For this reason, these efforts are often supported by bilateral and multilateral ODA. In order to save organizational costs, a DNA could even serve a group of countries. Once a DNA has been built up, much remains to be done before projects can be evaluated. As sustainability is defined by the host country, criteria and guidelines for project submission need to be established.

In addition, if a country wants to attract A/R activities, a national forest definition within the threshold ranges of Decision 11/CP.7 (UNFCCC 2001) needs to be determined. This definition refers to the condition of the project area before and during an afforestation or reforestation activity. Forest definitions have become an issue for Annex I countries that want to record LULUCF for compliance with their Kyoto targets. It was decided that afforestation would be considered growing trees on areas where there were no forests fifty years before the beginning of the activity. For reforestation, only those lands would be available where no forest existed before the Kyoto base year 1990. In order to take account of the national differences in climate and vegetation, certain ranges of thresholds were defined by COP7, within which each country would pick the most adequate value, in accordance with its FAO reporting practice. According to these definitions, a forest is defined by a minimum area of 0.05 to 1 ha, a crown cover of 10 – 30 percent, with a tree height ranging between two and five meters. Furthermore, "[y]oung natural stands and all plantations which have yet to reach a crown density of 10-30 per cent or tree height of 2-5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest". In choosing threshold values, the government needs to take into account the country's FAO inventory practice, as well an estimate for the overall A/R project potential over the different climatic and ecological zones of the country. Finding suitable forest definition thresholds is a task underestimated by most DNA's. It usually involves the ministries of agriculture and forestry. This choice is uniformly valid for the whole country, and will have impacts over the whole commitment period in the following areas:

1. Area size: For any minimum area below 1 ha, it will become extremely costly to determine whether the area in question was deforested before 1990, as well as to define the A/R activity's boundaries, and it will make monitoring more expensive.
2. Project area eligibility: Setting the crown cover and height thresholds too low will make activities ineligible in places, which were to be considered forests in 1989, or any later date before the project start.
3. Activity eligibility: Setting the crown cover and height thresholds too high will make activities in areas of low fertility ineligible, because no change from non-forested to forested land is involved. This will put a restriction on land rehabilitation and will benefit plantation forestry.
4. There seems to be a gray area in the wording of Decision 11/CP.7 in relation to the definition of "trees". Host country governments may wish to restrict this definition, to exclude non-woody species like palms, bamboo, or bushes.

In summary, hosting CDM projects is a challenging and costly task for the host country's administration, and it is even likely that many potential host countries will refrain from participating in the CDM as a consequence.

3 Project Analysis

In the following section, various types of forestry project proposals will be evaluated against the essential social and environmental criteria suggested in chapters 2.6 and 2.7. The A/R-project part will generate tCERs or lCERs. Taking into account that the proposed project types will be valued higher on the market for their multiple social and environmental benefits, a CER price of € 7 has been chosen. For the expiring lCERs, a much lower price of € 1.5 / tCER (i.e. value of an expiring CER over one commitment period) is assumed as the basis for preliminary economic estimates.

Table 10: Project typology for combined A/R and bioenergy projects

	Small-scale A/R	Full-scale A/R
Small-scale energy	**Type I**	**Type III**
Full-scale Energy	**Type II**	**Type IV**

We will analyze all possible combinations between small-scale and full-scale projects in the forestry and bioenergy sectors. Table 10 sums up the typology applied.

3.1 Type I (small-scale forestry & full-scale bio-energy)

An interesting option for A/R-projects can be to expand ongoing social forestry development projects with additional CDM funds and join a fuel switch component. In this way, existing project infrastructure can be used and only incremental costs have to be covered by the CDM project. This could allow the social benefits of such projects to be greatly boosted, while still meeting the condition of not diverting ODA funds to CDM projects. The following box presents a project idea for such annexed CDM projects developed for the Global Mechanism/IFAD in Guinea (Kapp & Diallo, 2003). At this point in time, the project still lacks financing

Table 11: Summary of the "Guinean village group afforestation & fuel wood generation project idea"

Item	Reforestation component	Bioenergy component
Project participants	Village communities	rural town municipality
Project developer	NGO	municipality
Size (area or output)	4,000 ha	1 MW (= 8,760 MWh/year)
CDM-Project period (years)	20 years	21 (3 times 7)
Technology	Reforestation of degraded agricultural or pastoral land supported by a development NGO	Combined heat and power (CHP) generation on the basis of wood chips, replacing light oil
Production / consumption	40,000 m^3/year of round wood (estimated)	15,000 m^3 of wood chips/year
Carbon credits (t CO_2-eq.)	1,270,000 tCERs, 60,544 tCERs for 1st commitment period	2,760 CERs/year
Potential carbon credit income	€ 90,816 during the 1st commitment period	€ 19,320 /year
Social benefits	Long-term income for about 400 rural families	Local resource utilization and jobs, save hot water and electricity for hospital
Environmental benefits	Increased biodiversity, recovery of native vegetation ecosystems due to fire suppression and the cessation of grazing, climate protection, FSC certification foreseen	Reduced sulfur emissions, climate protection

3.2 Type II project (small-scale forestry & full-scale bio-energy)

This type of project embraces small-scale afforestation or reforestation implemented by small farmers or small communities, with an average net carbon uptake of less than 8 kt CO_2/year during each verification period. These small-scale activities are linked to a full-scale (> 15 MW) industrial or communal heat and/or power plant consuming fuel wood energy. In practice, this combination would be difficult to realize, because even with the reduced requirements for small-scale projects (no adaptation tax, reduced registration and administration fees), transaction costs will remain a substantial share of the expected carbon income of such projects. In our example, the first verification is realized in year 8. Bundling several small-scale forestry project activities for group validation, verification, and/or certification may be an economically more attractive venue, and recommended to ensure a sustainable energy source for full-scale bio-energy components. However, bundling is only possible up to the specified threshold for small-scale projects.

This combined activity could also be realized as a Type IV project (fsc Forestry – fsc bioenergy), an option that was identified during a fact-finding study in Northern Vietnam (Kapp 2004a), thus promising a further decrease of transaction costs.

Table 12: Summary of the "Community reforestation and co-firing of cement factory in Hoa Binh province, N-Vietnam" project proposal

Item	Reforestation component	Bioenergy component
Project participants	1,000-2,000 households, household groups, local organizations or villages	State-owned cement factory
Project developer	Four district authorities or higher level (provincial authority, ministry)	factory or higher level
Size (area or power)	1,400 ha	96 MW
CDM-Project period (years)	30	21 (3 times 7)
Technology	natural regeneration and reforestation	co-firing of 10% wood chips replacing 2,500 t of fossil coal
Production / consumption	21,000 m³/year (round wood)	9,250 t (wood chips)
Carbon credits (t CO_2-eq.)	3,331,000 tCERs	5,610 CERs/year
Potential carbon credit income	€ 544,000 during the 1st verification period	€ 39,270/year
Social benefits	Employment, income	No additional benefits
Environmental benefits	Erosion control, increased biodiversity, fire control, forests with native species, climate protection	Reduction of sulfur emissions, climate protection

3.3 Type III (full-scale forestry & small-scale bioenergy)

The following example describes a partially implemented project in the Republic of Moldova. The baseline study, carbon sequestration and emission reduction studies, as well as the monitoring protocol for the afforestation project, was established in 2003 (Kapp et al., 2003), commissioned by the World Bank's Prototype Carbon Fund (PCF). The background information for the added municipal fuel switch component is transposed from several project development studies on this subject in the neighboring country of Bulgaria (Kapp & Schulte, 2002, 2002a; GFA 2004, 2004a), also on behalf of the World Bank. The total crediting period is 60 years (20 years baseline validity with two baseline renewals). The first forest stock verification would occur in year eight of the activity.

Table 13: Summary of the "Moldova soil conservation project & municipal district heating system" project idea

Item	Reforestation component	Bioenergy component
Project participants	State forest administration and village communities	town municipality
Project developer	State forest administration	municipality
Size (area or output)	14,500 ha	3 MW
CDM-Project period (years)	15 years (or more)	

Item	Reforestation component	Bioenergy component
Technology	Reforestation of degraded agricultural or pastoral state and municipal land	District heat generation on the basis of wood chips, replacing light oil
Production / consumption	67,000 m³/year of round wood (estimated)	20,000 m³ of wood chips/year
Carbon credits (t CO_2-eq.)	25,883,000 over 30-year lifetime 645,000 tCERs for 1st commitment period	5,100 CERs/year
Potential carbon credit income	€ 967,000 in 1st commitment period € 340,000 (PCF)	35,700 € /year
Social benefits	long-term income in 151 mayoralties, municipalities and local communities	local resource utilization and jobs, sav hot water and heating for public buildings and households
Environmental benefits	increased biodiversity, recovery of native vegetation ecosystems due to fire suppression and the cessation of grazing, climate protection	reduced sulfur emissions, climate protection

3.4 Type IV (full-scale forestry & full-scale bio-energy)

The methodology for a combined full-scale forestry and full-scale bioenergy project has been presented to the CDM Executive Board on various occasions (NM0002, NM00029 and NM0104), and was rejected on all occasions. Besides other methodological problems, the main criticism is related to the fact that the project and its underlying methodology avoids (otherwise, meaning unclear) an ongoing sector-wide fuel switch from charcoal to coke. No methodology was presented to account for the A/R activities going on at the same time, as the area in question was a pre-existing plantation.

The following description of the project activity is based on the PDD and Baseline Study available on the UNFCCC site, and on the company's presentation on the internet[12]. For the sake of exemplifying a Type IV project, we assume that an A/R activity complements the avoided fuel change. We further assume that the project area is eligible under the CDM. Under the assumption of a pure Eucalypt plantation on a project area of 230,000 ha harvested every 7 years, and an annual area productivity of 23 m^3 (a moderate value under Brazilian circumstances), the cumulate project uptake would be 4.600.000 m^3. Furthermore, assuming that no pre-project vegetation was removed, the A/R element would render approximately 4.2 Mt CO_2 equivalents. Over a 30-year crediting period and a first verification in year seven, this amount would be certified five times.

[12] http://www.vmtubes.com.br/

Table 14: Summary of "Vallourec & Mannesmann Tubes (V&M do Brasil S.A.) Fuel Switch Project"

Item	Reforestation component	Bioenergy component
Project participants	Privately owned subsidiary of the steel factory	Privately owned steel factory
Project developer	Hypothetical case	Steel factory
Size (area or output)	230,000 ha	455,000 t of steel
CDM-Project period (years)	28 years	21 (3 times 7)
Technology	7-year rotation Eucalypt plantation	Continued use of charcoal from 1,640 carbonization kilns avoids the potential use of coke
Production / consumption	4.6 million m³/year of round wood (estimated)	260.000 t/year of charcoal (estimated)
Carbon credits (t CO_2-eq.)	4,2 Mt tCERs over 5 consecutive commitment periods	0.82 million CERs /year
Potential carbon credit income	€ 6,3 million for the first commitment period	€ 5.73 million /year
Social benefits	1,885 people employed (total forest subsidiary and steel factory)	None
Environmental benefits	Increased biodiversity, recovery of native vegetation ecosystems due to fire suppression and the cessation of grazing, climate protection, FSC certification and ISO 14,000	Reduced sulfur emissions, climate protection

4 Conclusions

The present study has analyzed feasibility, risks and benefits of combining energy and afforestation/ reforestation projects under the CDM. In the absence of commonly recognized indicators for sustainability, the study has undertaken the goal of synthesizing indicators from various sources.

Applying these sustainability criteria, projects that integrate GHG emission reduction *and* removal usually show advantages over single activities. In no case are risks of combined projects higher than those of single activities.

Due to the heated debates over the accounting of land use, land-use change and forestry (LULUCF) under the Kyoto Protocol, the regulatory framework for both CDM GHG emission reduction and carbon removal projects is disband. Project integration leads to further complexity in project design and promotion.

4.1 Economic and financial aspects

Under micro-economic aspects, it will be advantageous for bioenergy projects to develop their resource base by integrating fuel wood plantations, and increase consumers' purchasing power for the energy produced at the same time. Similarly, through project integration, plantation projects can secure a stable fuel wood demand. The up-front financing necessary for afforestation can be justified if long-term contracts secure stable prices. At the gray area between full-scale and small-scale (our types II and III as presented above), there will inevitably be friction. In order to counterbalance the market power of large operators, coordination costs for smallholders will accrue. The mere combination of different project types will hardly lead to a decrease in transaction costs, because as things stand, both project activities will have to be submitted separately, and validation, verification and certification will have to follow different procedures. Eventually there may be cases where monitoring can use common resources.

4.2 CDM methodology and combined projects

Combined projects add to methodological complexity and need to adhere to two different modalities and procedures. The CDM Executive Board has installed two different panels for assessing GHG emission reduction and CO_2 removal projects, and a third one for small-scale projects. A lack of overlapping expertise and coordination in the panels and in their Roasters of Experts can lead to mistaken methodology appraisal. While combined projects contribute to sustainable development priorities in an integrated manner, doubts may arise concerning project additionality: As prices contracted between the two project parts are virtually opaque, there may be cross-subsidies between both. It is conceivable that additionality be proven by a barrier test in one activity, and an economic additionality test in the other, thereby circumventing an overall additionality assessment. In the present study, we have refrained from such speculations; these problems will have to be discussed in actual methodology development and submission.

4.3 Effect on poverty alleviation and sustainable development

This section identifies generic socio-economic risks of project types I to IV and how to mitigate them. Preconditions, project design indicators, and sustainable development indicators are interlinked.

For full-scale projects, a social impact assessment has to be carried out if any negative impact is considered significant by the project participants or the host party (UNFCCC 2003). If carried out properly, it will cover all risks related to the planned activity. As a minimum precondition, however, displacement of local communities needs to be avoided. As bioenergy installations are not land-consuming, this risk is higher, the larger the areas involved in the A/R activity. The specific projects presented under type I and II foresee planting on farm property or communal land. Displacement is unlikely, because local communities will be directly involved in planning and implementation. Besides, resettlements would be contradictory to A/R SSC modalities and procedures, because, as a precondition, these activities are expected to directly involve stakeholders. In the case studies for project types III and IV, the displacement risk could be excluded. Nevertheless, it is a generic risk that all full-scale A/R activities face.

There is, however, a risk that minorities and poor households will be excluded from the project through the subtle influence of local authorities seeking to strengthen their position by allocating bigger portions to political friends. This risk can be reduced by a transparent planning process. Information dissemination plays a pivotal role for all project types. In a related manner, risks derive from informal or unclear use and property rights. Smallholders often dwell on occupied private or state lands, for which they hold informal or customary rights only. This risk is not specific to project size. Legal uncertainty threatens local communities' or individuals' negotiating power towards local elite or foreign project partners. On the other hand, participatory land-use planning procedures and site selection can add to legal certainty by formalizing land-use rights and stipulating appropriate compensation for the loss of e.g. grazing grounds on communal lands. Legal clarity can thus be a co-benefit of a well-implemented project activity.

For the bioenergy component, a clear energy price structure is key. Before the start of the project, consumers may benefit from illegal or semi-legal energy access, be it in the form of e.g. illegal fuel wood logging, or non-enforced energy bills. In these cases, there will be no willingness to pay for goods and services provided by the project, putting its economic viability in peril. Also, low-income communities may not be able to pay for newly available heat and power ,and may see themselves excluded from the project, which leads to social distortion. The risk can be addressed by applying flexible participation arrangements, like household-based metering and adapted payment schemes. Furthermore, the project may be able to offer positive effects for household economies through rehabilitation of degraded land, off-farm employment, residential stability (enhanced livelihoods through rural electrification), positive impacts on community infrastructure, and access to clean energy services.

Risks for population characteristics are scale-dependant. Job creation and rural electrification in SSC projects will reduce working force migration in most cases. Capacity building is a likely consequence of community involvement in planning and operation. A higher workforce demand for larger projects may lead to population inflow, the consequences of which may be positive or negative. For full-scale bioenergy installations, importing skilled labor force from outside the project region can lead to the marginalization of local populations.

4.4 Further research needs

The present study has reviewed issues from different policy arenas, biomass energy, forestry, sustainable development indicators, and climate change mitigation methodology. The scope has been reduced to fuel wood produced for these purposes. Due to methodological uncertainty, cookbook-style concrete guidance for project developers is not feasible at the moment. Future studies could include residues from harvested wood products, which is just another open question under a future climate regime. The development of proper socio-economic sustainability criteria was undertaken in order to evaluate our sample projects. It would be desirable to intensify this evaluation, so that a wider array of project categories can be tested. Finally, the sample projects used are derived from partial feasibility studies, while project combination was done as a hypothetical exercise. Presently, there is a lack of methodology for most biomass-related CDM activity types. Concrete project studies could endeavor to develop generic methodologies for integrated A/R and biomass energy projects, thereby limiting transaction costs and risk for potential project developers. Project blueprints with pre-approved methodologies will offer incentives for stakeholders to venture into combined projects with proven sustainable development benefits.

5 Policy Recommendations

- There is a need for commonly agreed upon minimum sustainability criteria that CDM projects have to fulfil.

- Currently, fuel wood collection is one major driver for devegetation and deforestation. There is a wide array of forest biomass use and a huge potential in developing countries for biomass efficiency improvements.

- The combination of bioenergy and afforestation/ reforestation activities under the CDM can in many ways lead to socio-economic benefits on the local scale. Risks involved in either project categories are not increased by their combination.

- Notwithstanding a future interpretation of the non-diversion clause, Overseas Development Assistance (ODA) and other financial instruments should be bundled in order to facilitate integrated CDM project planning. Among these, there could be a small-scale fund as stipulated under Kyoto Protocol Article 12.6.

- None of the four possible combinations between afforestation / reforestation and bioenergy, small-scale and full-scale activities is *per se* unrealistic.

- It is among the limitations of the Kyoto Protocol and its related rules and institutions that they currently do not offer incentives for integrated project planning.

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Risks and Chances of Combined Forestry and Biomass Projects under the Clean Development Mechanism

APPENDIX

Joint study commissioned by
Hamburg Institute of International Economics (HWWA)
UNEP Risoe Centre on Energy, Climate and Sustainable Development (URC)
United Nations Environment Programme (UNEP)

With contributions by
GFA Consulting Group
ETA Energieberatung A.G.

APPENDIX

A. Detailed project descriptions

A.1. Project I: Guinean village group afforestation & fuel wood generation project idea

Guinean village group afforestation & fuel wood generation project idea

Project outline

The basis of this project is the ongoing work of a French-Guinean NGO, ESSOR, which has been cooperating in the Fouta Djallo region of Guinea. The project idea was discussed with the director of ESSOR in Labé. The ongoing ESSOR project is promoting small village plantations summing up to annually 400 ha of multipurpose tree species. Due to the contributions in form of labor and land of the involved village groups, to whom the plantations belong and who will benefit from the wood production, shelter, fodder and soil protection function, the average total cost for the ESSOR project is about 320 €/ha. According to the director, it would be possible to expand the annual plantations with a total additional area of 800 ha per year for the following 5 years, with incremental costs of 130 €/ha. The additional plantations with a total of 4,000 ha would thus amount to € 520,000. Aiming at a crediting period of 20 years, CDM project development costs would arise in the order of € 200,000 and a forest group certification (FSC) could cost around 40,000. This raises the total CDM forestry sink project cost at €760,000 (= €190/ha).

Carbon effects

The average tree growth rate being about 10 m³/ha/year, a total of 1.1 million lCERs will be generated over 20 years. Verification, certification and selling of lCERs could be realized in the 5th, 10th , 15th and 20th year. Depending on the expected market prices for lCERs, a part, all, or more than the CDM development costs could be recovered though the sales, leaving all the timber benefits to the local village groups. Guinea has accessed the Kyoto Protocol on 07/09/00, but has not yet designated a national CDM authority.

Fuel switching alternatives

Regarding wood production, it is suggested to use the higher quality for commercial timber and the lower quality for local construction and fuel wood. Four options could be realized over a crediting period of 21 years (3 times 7 years) individually or in combination:

(1) Fuel wood is actually in high demand for cooking and (part of the year) heating. As most of the present fire wood and charcoal come from destructive felling (forest mining), switching to renewable fuel wood produced on a sustainable basis is eligible under small-scale CDM.

(2) The first option would be accompanied by the use of efficiency improved cooking & heating stoves, by the use of which some 50% of fuel wood could be economized, which however can only generate CERs, if the fuel wood demand is not covered by plantation wood.

(3) Another part of the produced wood could generate electricity and hot water in small district cogeneration plants, e.g. for a rural hospital. Actually, electricity in Guinea is provided by 20

thermal and 8 hydroelectric power stations. However, many rural areas, like in the Fouta Djallo, do not yet have access to the electric grid and are too far away from hydroelectric generation locations. A wood chip based power plant would in these circumstances be constructed instead of a business-as-usual fossil oil fed thermal station, earning an amount of CERs equivalent to the tons of CO_2 otherwise released from fossil fuel burning. Fuelling a smaller power station of 1 MW (= 8,760 MWh/yr) will need about 15,000 m^3 of wood chips [1]. By avoiding the alternative use of 875 t of light oil [2] the project could generate 2,760 CERs, that could fetch annual revenue of € 19,320, assuming a market price of € 7/t CO_2 equivalent. The wood chips could be taken from a part of the CDM forestry project plantations. If from the mean annual growth of 10 m^3/ha/yr half of the wood (the lower qualities) would go into chips, an area of about 1,100 ha would be sufficient to secure a sustainable supply [3].

(4) Alternatively, a wood gasification engine could be installed with the wood gas fuelling a combustion generator. Wood gasification plants are produced with a power of a dozen kWe to a couple of MWe and production costs of € 1,000 – 2,000 / kWe.

A resume of the quantitative characteristics of the project proposal is provided in the following table:

Table A1: Social & environmental evaluation scheme of the "Guinean village group afforestation & fuel wood generation" project idea

(A) Socio-economic aspects

Indicator group	Key	**Indicator**	**Assessment**
Pre-condition	A0a	No displacement of local communities.	No displacement of local communities will happen.
	A0b	LSC require a comprehensive social impact assessment.	No LSC.
Project Design Indicators	A1a	**Information dissemination** on project scope and purpose to local stakeholders and population. There is clear understanding of the project set-up and objectives.	This is the continuing policy of the executing NGO.
	A1b	**Involvement of local stakeholders** (administrative agencies, interest groups etc.) in project preparation (invitation for comments, settlement of disputes etc.). At least two public consultations.	Local stakeholders actively involved in tree planting on family grounds.

[1] Energy content of wood chips: 0.6 MWh/m^3 (i.e. each kg of solid wood can generate 4 kWh, and of this 1 kWh electricity.

[2] 1 m^3 of wood chips (water content 35%) is equivalent to 70 l or 58 kg of light oil. One ton of light oil emits 3.158 t de CO_2.

[3] 1 m^3 of wood chips is equivalent to 0.36 m^3 of solid wood.

Indicator group	Key	**Indicator**	**Assessment**
	A1c	**Participatory site-selection** (identification of an agreement on boundaries involving local communities, with focus on minorities)	This is common practice of the NGO project.
	A1d	**Settlement of land use conflicts** (applying participatory LUP, identification of alternative land resources for grazing etc.)	This is common practice of the NGO project.
	A1e	Calculation and agreement on **compensatory payments** for land use changes to individuals/ the commune.	Compensation is offered in form of support to the forestation. and the trees belonging to the involved families.
	A1f	The entity (individual households/ communities/ local governments/ companies) holds **land tenure rights** or **long-term use rights** for the project sites. These rights are commonly agreed upon.	This is the case in the traditional rural areas.
Sustainable Development Indicators	A2a	**Population characteristics** (influx or outflow of temporary workers, seasonal residents, capacity building of local population, ethnic and racial distribution)	People are not employed but actively involved in the project activities. On-the-job-training takes place. No ethnical discrimination.
	A2b	**Community and institutional structures** (Employment/ income characteristics, employment equity of local population with focus on minority groups, industrial/ commercial diversity, presence of planning and zoning activity, Interest group activity, size and structure of local government)	Employment equity of local population is checked by the NGO.
	A2c	**Political and social resources** (distribution of power and authority, leadership capability and characteristics, interested and affected publics)	No negative impact on political and social resources.
	A2d	**Individual and family changes** (perceptions of risk, health, safety, worker rights, residential stability, attitude towards project, household resources (land, labour, capital), food supply, farm household auto-investment capacity, off-farm employment)	No special health or safety problems involved in the forestry and heat & power plant.
	A2e	**Community Resources** (community infra-structure, food supply, land use patterns, cultural and historical resources, access to: water, health, education, clean energy services)	No negative impacts on community resources.

Indicator group	Key	**Indicator**	**Assessment**
Monitoring Indicators	A3a	Establish process of hearing and responding to **community grievance.**	Existence of such grievance resolving mechanisms essential in the NGO project.
	A3b	Monitoring of proportion of **project costs spent in communities** (local salaries, infrastructure, training)	This should be included in the project monitoring plan.
	A3c	Reporting on **sustainable development indicators** (B1-B5).	Will have to be realized in the project monitoring plan.

(B) Environmental aspects

Indicator group	Key	**Indicator**	**Assessment**
Precondition	B0a	No conversion of, or negative impact (e.g. desertification) to **native ecosystems.**	Reforestation of degraded grazing or agricultural lands.
	B0b	No e**nvironmentally harmful forest practices** and written guidelines: no soil erosion, no reduction in quality and quantity of water, no alteration of natural disturbance regimes (e.g. fire)	Anthropogenic fires are reduced. Reforestation involves the use of a proportion of exotic species, plantation consume some ground water but also prevent erosion. No environmentally harmful forest practices occur.
	B0c	**Environmental impact assessment** if negative impacts are considered significant by project participants of host party.	No negative environmental impacts.
	B0d	No persistent or unnecessary **pesticides** are used.	No pesticides are used.
	B0e	Project design complies with **environmental legislation** of host country.	This is the case.
Forest Practices Indicators	B1a	Assessment and safeguards to protect **rare species**.	This will have to be observed.
	B1b	For LS-projects: establishment of **protection areas**.	Criterion does not apply in a small-scale forestation project.
	B1c	Control of **inappropriate hunting**, fishing & trapping.	This will have to be observed.
	B1d	Design & diversity of plantations should promote the protection or restoration of natural forest (more than two tree species, uneven age, irregular spacing, no genetically modified species, only controlled use of non-invasive exotic species, native species preferred).	Several species (native and non-evasive exotic) will be used in the reforestation. No genetically modified species. Plantations will relieve wood harvesting pressure from native forests.
	B1e	Careful **site preparation** techniques.	Site preparation techniques are adequate. No harmful techniques

Indicator group	Key	Indicator	Assessment
			will be used.
	B1f	**Management plan** with explicitly stated objectives and strategies regarding plantation and natural forest conservation (if relevant).	Basic plantation management plans at NGO project level. No strategies regarding natural forest conservation.
Environmental impact Indicators	B2a	Study of **environmental impacts** (biodiversity, habitat, natural ecosystems, landscape, incl. impacts outside project boundaries) if negative impacts are considered significant by project participants of host country.	No significant negative impacts expected.
	B2b	Existence of plans and strategies for impact mitigation. Implementation of credible mitigation measures(e.g. in case of loss of habitats).	No significant negative impacts expected.
	B2c	Assessment/ calculation of compensation needs. Implementation of credible compensation measures.	No significant negative impacts expected.
Monitoring indicators	B3a	Collection, archiving and analysing of relevant data concerning environmental impacts.	This is part of the CDM project requirements.
	B3b	Description of planned monitoring and remedial measures to address significant impacts.	No significant negative impacts expected.
		Make all information necessary to assess environmental impacts available to all stakeholders.	This is part of the CDM project requirements.

The "Guinean village group afforestation & fuel wood generation" project idea would easily fulfill the essential social and environmental criteria and can thus be recommended as a beneficial Combined Biomass-Energy & Forest Carbon Sink Project for sustainable development to potential investors.

A.2. Project II: Community reforestation and co-firing of cement factory in Hoa Binh province, N-Vietnam

Community reforestation and co-firing of cement factory in Hoa Binh province, N-Vietnam

Project outline

During a fact finding study in November 2004, a selection of potential afforestation/reforestation (A/R) areas has been visited in the communes of Yen Mong (262 ha), Thong Nat (400 ha), Tu Son (150 ha), Vinh Tien (160 ha), Hop Thanh (200 ha), Dan Hoa (80 ha) and Cuoi Ha (320 ha), all situated in Hoa Binh province. In the Feasibility Study for new social forestry projects with co-financing through the German development cooperation (KFW 7), an area for new forestation of 4,000 ha has been identified in Hoa Binh province, about evenly distributed over the districts of Kyson, Luongson, Kimboi and the town district of Hoa Binh. The district authorities would develop the projects, or alternatively the projects could be bundled or presented as a full-scale CDM project. In the preparation phase of the KFW7 Forestry Project, land ownership will be checked; community land-use planning and land allocation will be completed before any planting.

With an estimated market price of 2 €/lCER, the carbon income over 30 years is 1,200 €/ha. If, depending on the baseline condition (see below), each of the four districts could include about 350 ha in the CDM project component, total benefit would be some € 420,000, less transaction costs (estimated at around € 50.000) for CDM project development, forestation costs (88,000 €) and recurrent project costs, including the periodic verification & certification (6 times about € 10,000).

In view of an easier acceptance as CDM project it is recommended to get a forest management and wood chain of custody group certification by the Forest Stewardship Council (FSC), the most consistent internationally recognized forest certification scheme. However, this may involve substantial efforts and costs for the project participants to adapt management according to FSC principles & criteria plus the certification cost and annual auditing fees.

In the reforestation with indigenous species the average commercial wood growth is 15 m³/ha/year (Knut Sturm, pers. com.) and the total average production from 1,400 ha amounts to 21,000 m³/year. Over half of the produced wood, mainly outlet of thinnings, crown parts, strong branches and less valuable stems, shall be used for the production of wood chips. Wood from other non CDM forest plantations in the districts will be added, especially during the first years of the plantation. The afforestation project links with the bioenergy component as follows:

The cement factory of Hoa Binh uses a boiler with a capacity of 960 MW. The factory produces annually 100,000 t of cement, consuming 25,000 t of coal, imported from Quang Ninh province over 500 km by boat. The coal is purchased at 510,000 Dong/t (factory gate price), equivalent to € 25,5/t. The coal price has more than doubled since 1995, reflecting national inflation rate. For the cement industry a co-firing with 10% of dry wood chips is technically feasible to maintain the high temperature of about 1,000 °C for the clinker making process. There are three main options:

- Mixing of wood and coal before combustion in the same boiler,
- Combustion of wood on a separate grate and feeding of the heated gases into the coal boiler, and
- Gasification of biomass and feeding the gas into gas burners located in the boiler.

The cheapest variant of direct co-combustion in a pulverized coal boiler is through mixing pre-treated wood chips and coal in the coal yard or on the coal conveyor belt, before combustion in the same boiler. Many coal- and oil-fired boilers permit multi-fuel flexibility. About 3,7 t of wood chips can replace one ton of fossil carbon. Thus, about 9,250 t of wood chips (equivalent to about 20.000 m³ of round wood) are needed annually to replace 2,500 t of coal. Co-firing is only financially feasible if a factory gate price of less than € 8.7/t of wood chips can be achieved[4]. This might be possible, as bigger quantities of firewood are sold at about € 5/t, a price to which chipping costs have to be added. The generated CER value for the cement industry are in the order of € 39,000 annually at a market price of € 7/CER, or € 819,000 over 21 years minus transaction costs.

[4] Feasible price for 1 t of wood chips less than € 25,5/ 3,7 + € 7 CER price/3,7 = 8.78 €/t

Baseline and carbon effects

In most of the lands some form of shifting cultivation has been practiced and forest cover has been removed 10-20 years ago. Due to the inclination of slopes, erosion and diminishing fertility, cultivation periods are confined to 2-5 years, and many field are presently abandoned. It remains unclear if in each case alternatives to the inconvenient work on these remote fields have been found (as some local people stated), or if this is the fallow phase of a continuing cultivation cycle. Many scattered remnant patches of the native forest in different phases of degradation and succession exist. Consequently seedlings, saplings or re-sprouts mostly of pioneer tree species and shrubs are present on the abandoned fields and could develop into a secondary forest in a period as short as 15-20 years if no further disturbance occurs. As rural population is increasing (over 2% of population growth) and people tend to have nowadays more livestock (mostly water-buffalos and cattle), the fallow areas on the slopes are used for grazing. Besides, firewood for cooking, heating in winter, and selling is cut from the re-growing trees. Occasionally, fires for cleaning the fields get out of control and burn uphill into the fallow lands.

During the preparation phase of the project, baseline-relevant information has to be analyzed with an emphasis on two eligibility criteria:

- The area has to be free of forest cover since 1990 (precisely since the 31.12.1989)
- Agricultural or pastoral use of the area, including burning and firewood collection will only be given up if alternative income through CDM reforestation will be realized

As long as the Vietnamese CDM National Authority (CAN) has not decided on a concretization of the CP.7 definition of “forest”, the area selection criteria have to use the strictest interpretation, i.e. a minimum forest area of 0.05 ha with more than 10% crown cover of trees with the potential to reach a minimum height of 2 m at maturity in situ, including young stands which have not yet reached this crown cover percentage. As one factor of the project site conditions besides soil or climate is the ongoing land-use, tree saplings have no potential on these sites to reach a height of over 2 m and 10% of crown cover. Thus, it may be safe to estimate that at least 35% of the project sites (1,400 ha) may comply with the CDM requirements.

During CDM project implementation, the land-use on neighboring areas will be periodically monitored. If local people give up their exploitation on these areas and natural tree succession starts, a similar amount to the sequestered CO_2 has to be deducted from the CDM project sites.

Based on to an average growth for suitable native tree species (e.g. *Chukrasia tabularis, Cunninghamia chinensis*) of 15 m³/ha/year, the total generated carbon credits over a e.g. commitment period of 30 years can be estimated at 600 lCERs/ha5.

Other reforestation areas, where the land-use history is not clear enough or existent tree saplings present a problem for CDM eligibility may additionally be used to generate verified emission reductions (VERs). Still, the credibility of these credits depends on a well-argued baseline case.

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[5] The short-term tCERs have to be replaced every 5-10 years and will fetch even lower prices than the lCERs. Depending on market price relations between both types and considering transaction costs, the choice between tCERs and lCERs has to be made at the beginning of the project. The approximate calculation of the present report concentrates on the generation of lCERs.

The baseline of the cement factory is the continued use of 25,000 t of fossil coal per year (business-as-usual case). Thus 5,610 CERs could be generated annually by replacing 2,500 t of coal with renewable wood-energy over a project lifetime of 3 times 7 years. If during this time significant coal price changes should occur and other cement factories should decide to stop using fossil coal, the baseline has to be adapted.

Social impacts

The project brings additional social (employment, social organization) and economic benefits, and it contributes to sustainable development in a poor rural province. Although the Agricultural Ministry (MARD) is the project responsible, CDM funds shall be transferred directly to the respective community accounts in a transparent way, including constant financial monitoring. Positive experience from previous KfW afforestation projects of establishing a saving account system for the cooperating farmers will be used to generate long-term benefits to the farmers and safeguard the forestation success. From the community accounts, funds will be channeled into cooperating households, household groups, local organizations or villages to whom the forest areas were previously allocated via the so called red book certificate system. Bank accounts are opened in the name of the household representative, chosen by the household. The proportion of women has been between 30-50% (Kraienhorst, 1999). It can be expected that some 1,000-2,000 households become involved in the community forestry activities.

Environmental impacts

Through the reforestation or natural forest regeneration of 1,400 ha of mostly eroded and degraded slopes, positive effects are expected in view of diminished water erosion, increased biodiversity, reduced fire impacts and climate protection. No significant negative impacts are expected. Chipping and transportation require as little as 1-2% of the energetic content of the chipped wood. The co-firing of wood-chips reduces the sulfur emissions from fossil coal and avoids the increase of CO_2 in the atmosphere.

A resume of the quantitative characteristics of the project proposal is provided in the following table:
Table A2: Summary of the "Community reforestation and co-firing of cement factory in Hoa Binh province, N-Vietnam" project proposal

Table A2. Social & environmental evaluation scheme of the "Community reforestation and co-firing of cement factory in Hoa Binh province, N-Vietnam" project proposal

(A) Socio-economic aspects

Indicator group	Key	**Indicator**	**Assessment**
Pre-condition	A0a	No displacement of local communities.	No displacement will happen in the social development forestry project. State land will be allocated and the project participants get a direct inheritable user right over the land (red book certificate).
	A0b	LSC require a comprehensive social impact assessment.	The forestry component is small-scale. In the full-scale energy component there should be a social impact assessment of the additional use of wood-chips
Project Design Indicators	A1a	**Information dissemination** on project scope and purpose to local stakeholders and population. There is clear understanding of the project set-up and objectives.	Project work will be done through the People's Committees of the communities. Stakeholder information, invited comments and grievance resolving mechanisms shall be established at this level. At the cement factory, the involvement of workers should be assured.
	A1b	**Involvement of local stakeholders** (administrative agencies, interest groups etc.) in project preparation (invitation for comments, settlement of disputes etc.). At least two public consultations.	Local communities and households are directly involved in the forestry project preparation and execution. There will probably be more than two public consultations.
	A1c	**Participatory site-selection** (identification of an agreement on boundaries involving local communities, with focus on minorities)	Site-selection is part of the project preparation and local communities are directly involved in this process.
	A1d	**Settlement of land use conflicts** (applying participatory LUP, identification of alternative land resources for grazing etc.)	Inherent in the land allocation process.
	A1e	Calculation and agreement on **compensatory payments** for land use changes to individuals/ the commune.	Payments are made through the CDM mechanisms channeled into a saving book system to each of the involved households.
	A1f	The entity (individual households/ communities/ local governments/ companies) holds **land tenure rights** or **long-term use rights** for the project sites. These rights are commonly agreed upon.	Land-use right allocation is for long-term and is hereditary.

Indicator group	Key	Indicator	Assessment
Sustainable Development Indicators	A2a	**Population characteristics** (influx or outflow of temporary workers, seasonal residents, capacity building of local population, ethnic and racial distribution)	Ethnically the project will involve several groups. People will reforest on lands allocated to them.
	A2b	**Community and institutional structures** (Employment/ income characteristics, employment equity of local population with focus on minority groups, industrial/ commercial diversity, presence of planning and zoning activity, Interest group activity, size and structure of local government)	All local groups will be involved as well as the local governments. Employment characteristics in the cement industry have to be checked.
	A2c	**Political and social resources** (distribution of power and authority, leadership capability and characteristics, interested and affected publics)	No negative impact on political and social resources.
	A2d	**Individual and family changes** (perceptions of risk, health, safety, worker rights, residential stability, attitude towards project, household resources (land, labour, capital), food supply, farm household auto-investment capacity, off-farm employment)	No special health or safety problems involved in the forestry component. This has to be checked and assured in the energy switch component as well.
	A2e	**Community Resources** (community infra-structure, food supply, land use patterns, cultural and historical resources, access to: water, health, education, clean energy services)	No negative impacts on community resources.
Monitoring Indicators	A3a	Establish process of hearing and responding to **community grievance.**	Will have to be realized in the project monitoring plan.
	A3b	Monitoring of proportion of **project costs spent in communities** (local salaries, infrastructure, training)	Will have to be realized in the project monitoring plan.
	A3c	Reporting on **sustainable development indicators** (A2a-e).	Will have to be realized in the project monitoring plan.

(B) Environmental aspects

Indicator group	Key	Indicator	Assessment
Precondition	B0a	No conversion of, or negative impact (e.g. desertification) to **native ecosystems.**	No conversion or other negative impacts expected.
	B0b	No e**nvironmentally harmful forest practices** and written guidelines: no soil erosion, no reduction in quality and quantity of water, no alteration of natural disturbance regimes (e.g. fire)	All criteria are met. Anthropogenic fires are reduced and reforestation or natural regeneration will involve native species

Indicator group	Key	Indicator	Assessment
	B0c	**Environmental impact assessment** if negative impacts are considered significant by project participants of host party.	No significant negative impacts existent.
	B0d	No persistent or unnecessary **pesticides** are used.	Presently not foreseen, but has to be checked during project execution.
	B0e	Project design complies with **environmental legislation** of host country.	The project is developed by the Vietnamese state district authorities and therefore complies with the national legislation.
Forest Practices Indicators	B1a	Assessment and safeguards to protect **rare species**.	Although no specifically rare species are expected on the formerly pastoral or agricultural lands, an assessment should be obligatory, also in view of a possible FSC certification.
	B1b	For LS-projects: establishment of **protection areas**.	Not applicable to SC-projects. However, especially steep areas could be totally protected.
	B1c	Control of **inappropriate hunting**, fishing & trapping.	The reforestation area will be supervised.
	B1d	Design & diversity of plantations should promote the protection or restoration of natural forest (more than two tree species, uneven age, irregular spacing, no genetically modified species, only controlled use of non-invasive exotic species, native species preferred).	Only native tree species are foreseen so far.
	B1e	Careful **site preparation** techniques	Site preparation techniques are not specified yet. However it is likely that no machines will be used.
	B1f	**Management plan** with explicitly stated objectives and strategies regarding plantation and natural forest conservation (if relevant).	This will be the case.
Environmental impact Indicators	B2a	Study of **environmental impacts** (biodiversity, habitat, natural ecosystems, landscape, incl. impacts outside project boundaries) if negative impacts are considered significant by project participants of host country	No significant negative impacts expected.
	B2b	Existence of plans and strategies for impact mitigation. Implementation of credible mitigation measures.	No significant negative impacts expected.
	B2c	Assessment/ calculation of compensation needs. Implementation of credible compensation measures (e.g. in case of	No significant negative impacts expected.

Indicator group	Key	Indicator	Assessment
		loss of habitats).	
Monitoring indicators	B3a	Collection, archiving and analysing of relevant data concerning environmental impacts.	This will be part of the CDM project requirements.
	B3b	Description of planned monitoring and remedial measures to address significant impacts.	No significant negative impacts expected.
	B3c	Make all information necessary to assess environmental impacts available to all stakeholders.	This should be realized by the participatory approach of the project.

The "Community reforestation and co-firing of cement factory in Hoa Binh province Project" will very likely fulfil the essential social and environmental criteria and can thus be recommended as a beneficial Combined Biomass-Energy & Forest Carbon Sink Projects for sustainable development.

A.3. Project III: Moldova soil conservation project & municipal district heating system project idea

Moldova soil conservation project & municipal district heating system project idea

Project outline

The objective of the project is to restore the productivity of 14,500 hectares of degraded agricultural lands for rural communities with planted forests and to build up community capacity to manage 5,400 hectares of these lands. Planting degraded pasturelands with tree and shrub species adapted to adverse conditions such as poor soils and erosion will provide urgently needed fuel wood and timber to rural communities. About 20% of Moldova's territory is estimated to be prone to landslide hazards. Landslides have affected about 44% of human settlements in the past. Agricultural land is particularly at risk, due to soil disturbance and loss of vegetative cover. Large areas of agricultural land have been lost. Afforestation and reforestation have the potential to stabilize the land against landslides.

The PCF will assist in this effort through its participation in a project that will plant trees on degraded lands. The Moldova Soil Conservation Project pilots one of the first purchases of emission reductions under the Land Use, Land-Use Change, and Forestry aspect of the Clean Development Mechanism of the Kyoto Protocol. The Emission Reductions Purchase Agreement includes a series of innovative clauses addressing the issue of permanence. The Project is expected to be among the first CDM afforestation and reforestation activities submitted for registration to the Executive Board of the CDM.

Plant species will include a large variety of native and semi-naturalized species. On land of sufficient quality, *Quercus robur, Fraxinus excelsior*, and many other species of trees and shrubs can be planted. On the most degraded lands, less-demanding species such as *Robinia pseudoacacia* and *Gleditsia triacanthos* have to be used. All 1,891 afforestation plots, with an average of seven hectares each, will consist of at least two species. As soil conditions improve, within 20 or more years, an effort will be made to reintroduce more native species to recreate the old forests typical for Moldova.

Project lands belong either to Moldsilva, the national government forestry agency, or to local communities. With communal land, there are two possible courses of action. The community may decide to delegate planting and management to Moldsilva for 10 years, after which the land will be returned to the communities with a number of contractual obligations regarding protection and management. Alternatively, the community may decide to relinquish the land to Moldsilva indefinitely. In both cases, the community has an incentive to transfer the land to Moldsilva given the advanced degradation of the land and its very low sometimes negative economic value — land tax is due, even when the arable topsoil has been lost.

Carbon effects and purchasing agreements

Over a period of about 15 years[6], the project is expected to sequester 1.8 million tons of CO_2 equivalents, around 1.4 million tons in the vegetation and 0,4 million tons in the soil. The total Emission Reductions Purchase Agreement value with the PCF (only vegetation) is estimated at around US$5.1 million.

Moldsilva is the project developer. It will fully finance the estimated US$14 million needed over the first 4 years of the project, while the PCF will purchase the emission reductions resulting from carbon sequestration in above- and below-ground vegetation. Avoided losses in soil carbon stocks resulting from the project have been estimated but will not be part of the PCF purchase.

Social impacts

A social assessment study has been realized during the project preparation process (OPINA, 2003). Project implementation will offer new jobs and income mainly to the rural population; many villagers mentioned that they expected additional jobs. Employment opportunities may involve soil preparation, planting, weeding, tending, guarding, thinning and ultimately harvesting. For the project, the afforestation activities are by far more important; most of the thinning and harvesting activities will take place after project’s end. Because the poverty in rural areas, people from the local communities consider job creation the big benefit for them and their community.

Due to the increasing number of animals in rural localities in the last decade and long droughts in summer period, the issue of pastures is severe. In almost every locality, the lack of pastures or their bad quality was mentioned. In every locality studied, it was mentioned that the most degraded lands and pastures were selected for afforestation. A quality improvement of the remaining pastures seems important.

The decision of transferring the lands for afforestation was taken by the Local Council of Mayoralty of the villages. To avoid conflicts between local people and local authority the population was involved in some cases (Balti county, Chiscareni community). Thus, members of the commune were at the sites and together with the local authorities took the decision to transfer the plots for forestry planting. In other cases, local authorities had conducted information campaigns among the population, with adequate explanations (Balti county, Dumbravita community, Orhei county, Cucuruzeni community).

Taking into consideration the social-political specificity of Gagauzia Autonomy Region, the decision to transfer the lands for afforestation was taken by the local authorities, without the involvement of local communities.

[6] With the new crediting periods specified in CP.9, a project period of 20 years is now more likely.

In general, the local communities agree with the idea of afforestation because people are aware that afforestation will stop sand movement and soil degradation and they hope that the forest could positively affect the local climate. However, an additional information campaign should be conducted among the rural population concerning the necessity of afforestation on degraded lands. Afforestation will also have a positive effect on neighboring agricultural fields. Yields can increase significantly, since the hydrological regime will be improved and wind erosion and drought occurrence reduced. In the Balti County, afforestation will help to stop landslides.

Because the problem of insufficiency of firewood in many localities is acute, there is an opportunity to supply local people with firewood.

In both areas, the direct and indirect benefits are higher than the provision of firewood and of other natural resources. The perceived local communities' benefits consist primarily of the improvement of the agricultural land and of living conditions. The other expectations envisaged by the community population connected with afforestation, are climate change, the attraction of rain, and appearance of some new green areas, which could embellish the local landscape.

The monitoring protocol of the project-attributable socio-economic benefits relative to baseline conditions will include the following general indicators: poverty reduction, employment generation, community participation, equity, environmental awareness.

Environmental impacts

During project preparation, potential environmental impacts have been assessed and a screening procedure was proposed to ensure that no area within the project will be afforested where significant negative impacts on biodiversity and the environment are likely. For the purposes of screening, account shall be taken of the direct and indirect effects of the planned afforestation on biodiversity (fauna and flora), soil, water, air, climate and the landscape. The screening will be undertaken by properly trained Moldsilva staff prior to the commencement of any afforestation activity and using registration forms.

The environmental assessment can be resumed as follows:

<u>Environmental benefits</u>: The establishment of forest vegetation contributes to:

- conservation of soils, diminishing the erosion processes (superficial and depth erosion) and landslides;
- infiltration of water in soil and maintenance of favorable hydrologic regime of soils;
- increase in the humus layer through organically depositions (about 3-5 t/year/ha), with direct influence on soil fertility;
- creation of an intern climate regime (air and soil);
- mitigation of wind erosion;
- regeneration of soil profiles;
- bringing on the surface of new quantities of mineral substances absorbed by plant roots and included in small biological circulation;
- activation of biochemical processes;
- contribution to increasing of soil productivity of adjoining agricultural lands (by 12-15%).

The following <u>hazards</u> have to be considered for soil conservation effects of the project planted forests:

- Pure coniferous plantations without any broadleaf mixtures or shrub layer may cause a slow acidification of the soil. All plantations of larger scale of *Pinus* or *Picea* should therefore contain a certain fraction of broadleaf species;
- Especially in the southern dryer parts of the country, forest fires may occasionally occur. Here tree species that are able to survive and coppice after such fires (*Quercus*, *Robinia*, etc.) should be preferred and proper fire protection measures have to be included in the plantation design;
- Forest canopy may be fairly open if an important number of trees should not grow well or die on adverse planting sites, due to calamities (insects, e.g.), or if thinning is not been done properly. Monitoring may have to detect possible failures that should be corrected immediately;
- If harvesting involves clear-cutting, these areas should be limited in seize (1-3 ha), which is especially important on slopes, and should be reforested in the same year.

None of the cited risks is considered to be either very high or not to be manageable with a careful project design, good monitoring and professional project implementation.

Biodiversity benefits: The afforestation of the project land units will result in a bundle of biodiversity benefits. Vegetation cover will be increased by using species appropriate for the location in question. The diversity of flora will be increased through the planting of over 20 native species of trees and shrubs. Grasses and other types of herbaceous vegetation will also reappear. This will provide for greater structural diversity and an increase in the diversity of habitats available for native fauna. Faunal diversity will also increase correspondingly. The connectivity of habitats will also be improved which will lead to increased species dispersal, greater ecological functionality of the sites, and in the longer term, stronger regional sustainability of biodiversity.

Biodiversity hazards: One potential hazard may be associated with the application of insecticides, should this prove necessary in certain locations. Over the past several years, two insecticides, “Dimilin 25 EK” and occasionally “Karate” have been used for the protection of forests from pests in Moldova. The former does not affect mammals and avifauna, bees and most insects as it targets the larval stage of a narrow range of forest pests such as the silkworm. Nevertheless, the hazard pertains to the persistence of the chemicals in the environment, their bioaccumulation in fauna through different pathways, and the potential dispersal of effects beyond project sites. In addition, the planting of non-native species, primarily *Robinia pseudoacacia*, *Quercus rubra* and *Gleditsia*, while understandable from a socio-economic perspective, is not desirable from the native biodiversity conservation point of view.

Indicators for biodiversity monitoring comprise: Floral species diversity in project sites relative to control sites; avian species diversity in project sites relative to control sites; and floral community dominance index and native/exotic species ratio in project site and adjacent control sites.

Wood of lower quality from afforestation in Moldova could generate primarily hot and chilled water in small district boiler systems, e.g. for a rural hospital. According to experience in most buildings of the country there are more or less old operational oil (light industrial boiler fuel) fired boilers. They can be combined with new equipment of the biomass-boilers to work together in a joint heating system. So a practical method for the heating system consists of two parts: the wood fueled boiler(s) and the already installed fossil fueled boiler(s). The capacity of a biomass-boiler should be sufficient to cover the main part of the annual heat demand; normally more than 80 % of the total heat demand. The heat capacity of the boiler systems should allow introduction of hot water supply to all the buildings.

The heat capacity of the boiler system has to be designed in a way, allowing adequate heating of the building even on the coldest day (design temperature). On such days the boiler system works with maximum load (= 100 %).

It is considered that the biomass boilers cover the base heat demand of the buildings for external temperatures not lower than minus 5 degrees Celsius. When the temperatures are lower than minus 5 °C, both boilers cover the load - the biomass boiler(s) and the oil fired boiler. The biomass one is to be loaded up to the name plate capacity, while the oil fired boiler covers the peak demand.

These heating installations, e.g. for hospitals, normally have capacities of several hundred kW up to 1 or 2 MW. An example for designing a joint heating system is given in the table below.

Table A3: Annual energy demand and main data of all variants

		Town X			Town Y
		School	Hospital	Hospital & School	School
• total annual heat demand	MWh/a	1.087	836	1.112	591
• designed heat capacity of **biomass-boiler**	kW	2 x 300	1 x 300	2 x 300	1 x 300
• percentage of heat capacity of biomass-boiler	%	77	50	75	72
• lowest part load of the biomass-boiler	%	30	30	30	30
• efficiency of the biomass-boiler at maximum load	%	80	80	80	80
• efficiency of the biomass-boiler at lowest part load	%	50	50	50	50
• calculated average efficiency of the biomass-boiler	%	69,6	68,1	70,4	61,1
• annual full operation hours of the biomass-boiler	h/a	1.750	2.497	1.788	1.743
• annual heat production of the biomass-boiler	MWh/a	1.050	749	1.073	523
• coverage of annual heat demand by biomass-boiler	%	96,6	89,6	96,4	88,4
• annual fuel energy requirement of the biomass-boiler	MWh/a	1.509	1.100	1.524	856
• installed heat capacity of the **peak load boiler**	kW	1 x 995	1 x 639	1 x 639	1 x 638
• lowest part load of the peak load boiler	%	20	20	20	20
• efficiency of the peak load boiler at maximum load	%	75	75	75	75
• efficiency of the peak load boiler at lowest part load	%	55	55	55	55
• calculated average efficiency of the peak load boiler	%	54,3	52,4	53,4	52,4
• annual full operation hours	h/a	265	145	207	165
• annual heat production	MWh/a	37,0	87,2	39,5	68,4
• coverage of annual heat demand	%	3,4	10,4	3,6	11,6
• annual fuel demand of the peak load boiler	MWh/a	68,1	166,3	74,0	130,5

The notional fuel demand, that will be covered by Moldsilva, would be for this example about 5,000 m³ wood chips per year. The following table shows the amount of fuel needed for the respective buildings/towns.

		Town X			Town Y
		School	Hospital	Hospital & School	School
• total annual heat demand	MWh/a	1.087	836	1.112	591
• designed heat capacity of **biomass-boiler**	kW	2 x 300	1 x 300	2 x 300	1 x 300
• calculated wood chips demand; water content = 45%	[t/a]_45%	603	440	609	342
• notional wood chips demand; water content = 45%	[t/a]_45%	664	484	670	376
	[t/a]_atro	324	236	327	184
	[Sm³/a]	1.986	1.448	2.006	901

		Town X	Town Y
		in total	in total
• notional wood chips demand; water content = 45%	[t/a]_45%	1.334	376
	[t/a]_atro	652	184
	[Sm³/a]	3.991	901

If from the mean annual growth of 4,6 m³/ha/yr half of the wood (the lower qualities) would go into chips, an area of approx. 780 ha or about 112 plantation plots (average of seven hectares) respectively would ensure a sustainable supply. Approximately 18-19 installations with an average fuel demand of 5,000 m³ (space) can be supplied by woodfuel supplier cultivating the 14,500 hectares in Moldova. Freightage, depending on the location and connectivity of the plots will be a determining factor.

Another option for a state-of-the-art energy system is a cogeneration plant, producing heat/chill <u>and</u> electricity. To ensure an electrical efficiency factor of at least 15 %, e.g. using the Organic Rankine Cycle, higher capacities and more wood-fuel per installation will be needed, additionally requiring a constant heat/chill consumption.

Exemplary fuelling a larger power plant of 3 MW (6,000 h/yr operation time → 20,000 MWh/yr) will need about 20,000 m³ of wood chips[7]. Under the same assumption of tree growth and 50% fuel wood utilization, an area of about 3,100 ha or 440 plantation plots would finally be sufficient to secure a sustainable supply. On the other hand 4-5 installations in this capacity range could be supplied by the reforestation project.

[7] Energy content of wood chips: 1 MWh/m³, thermal efficiency 90%, electrical efficiency 15% (small scale), approx. 6,000 h/year at full load

Generating power in smaller, decentralized installations for own requirements, e.g. using a steam engine or Stirling engine, would technically feasible today, but economy has to be checked carefully depending on individual site conditions.

Table A4. Social & environmental evaluation scheme of the "Moldova soil conservation project & municipal district heating system" project idea

(A) Socio-economic aspects

Indicator group	Key	**Indicator**	**Assessment**
Pre-condition	A0a	No displacement of local communities.	No displacement of local communities will happen.
	A0b	LSC require a comprehensive social impact assessment.	A social impact assessment study has been undertaken.
Project Design Indicators	A1a	**Information dissemination** on project scope and purpose to local stakeholders and population. There is clear understanding of the project set-up and objectives.	Information campaigns were conducted by the local authorities.
	A1b	**Involvement of local stakeholders** (administrative agencies, interest groups etc.) in project preparation (invitation for comments, settlement of disputes etc.). At least two public consultations.	Local stakeholders were informed through the community councils and could comment in, where necessary several public meetings. Process described in the SIA.
	A1c	**Participatory site-selection** (identification of an agreement on boundaries involving local communities, with focus on minorities)	This was the practiced, although the decision to transfer the lands for afforestation was sometimes taken by the local authority without the involvement of local communities.
	A1d	**Settlement of land use conflicts** (applying participatory LUP, identification of alternative land resources for grazing etc.)	Land use conflicts are handled on the community council level. Not all areas were jointly visited previous to land use decision.
	A1e	Calculation and agreement on **compensatory payments** for land use changes to individuals/ the commune.	Compensation is offered in form of support to the forestation. and access to the wood produced from the trees.
	A1f	The entity (individual households/ communities/ local governments/ companies) holds **land tenure rights** or **long-term use rights** for the project sites. These rights are commonly agreed upon.	This is the case in the traditional rural areas in Moldova.

Indicator group	Key	Indicator	Assessment
Sustainable Development Indicators	A2a	**Population characteristics** (influx or outflow of temporary workers, seasonal residents, capacity building of local population, ethnic and racial distribution)	People are temporarily employed and involved in the project activities. On-the-job-training takes place. No ethnical discrimination.
	A2b	**Community and institutional structures** (Employment/ income characteristics, employment equity of local population with focus on minority groups, industrial/ commercial diversity, presence of planning and zoning activity, Interest group activity, size and structure of local government)	Information given in the SIA study.
	A2c	**Political and social resources** (distribution of power and authority, leadership capability and characteristics, interested and affected publics)	No negative impact on political and social resources expected.
	A2d	**Individual and family changes** (perceptions of risk, health, safety, worker rights, residential stability, attitude towards project, household resources (land, labour, capital), food supply, farm household auto-investment capacity, off-farm employment)	No special health or safety problems involved in the forestry component. Positive attitude towards the project documented in the SIA study. General rural poverty conditions.
	A2e	**Community Resources** (community infra-structure, food supply, land use patterns, cultural and historical resources, access to: water, health, education, clean energy services)	No negative impacts on community resources.
Monitoring Indicators	A3a	Establish process of hearing and responding to **community grievance.**	Existence of such grievance resolving mechanisms in the local government structure and its relation to the state forestry administration.
	A3b	Monitoring of proportion of **project costs spent in communities** (local salaries, infrastructure, training)	This is documented in the project accounting.
	A3c	Reporting on **sustainable development indicators** (B1-B5).	This is realized in the project monitoring plan.

(B) Environmental aspects

Indicator group	Key	Indicator	Assessment
Precondition	B0a	No conversion of, or negative impact (e.g. desertification) to **native ecosystems.**	Reforestation of degraded grazing or agricultural lands. A screening procedure is proposed to ensure that no area within the project will be afforested where significant negative impacts on biodiversity and the environment are likely

Indicator group	Key	**Indicator**	**Assessment**
	B0b	No e**nvironmentally harmful forest practices** and written guidelines: no soil erosion, no reduction in quality and quantity of water, no alteration of natural disturbance regimes (e.g. fire)	Anthropogenic fires are reduced. Reforestation involves the use of 20 native and 3 exotic species, plantation consume some ground water but also prevent erosion. No environmentally harmful forest practices occur.
	B0c	**Environmental impact assessment** if negative impacts are considered significant by project participants of host party.	No significantly negative environmental impacts. However, a EIA has been undertaken in the project preparation.
	B0d	No persistent or unnecessary **pesticides** are used.	Over the past several years, two insecticides, “Dimilin 25 EK” and occasionally “Karate” have been used in Moldova for the protection of forests from pests. The use of these pesticides should be restricted in the project.
	B0e	Project design complies with **environmental legislation** of host country.	This is the case.
Forest Practices Indicators	B1a	Assessment and safeguards to protect **rare species**.	This will be observed in the Monitoring Plan.
	B1b	For LS-projects: establishment of **protection areas**.	Control plots will be established and monitored.
	B1c	Control of **inappropriate hunting**, fishing & trapping.	This will be controlled.
	B1d	Design & diversity of plantations should promote the protection or restoration of natural forest (more than two tree species, uneven age, irregular spacing, no genetically modified species, only controlled use of non-invasive exotic species, native species preferred).	Several species (native and non-evasive exotic) will be used in the reforestation. No genetically modified species. This will provide for greater structural diversity and an increase in the diversity of habitats available for native fauna. Faunal diversity will also increase correspondingly. The connectivity of habitats will also be improved which will lead to increased species dispersal.
	B1e	Careful **site preparation** techniques.	Site preparation techniques are adequate, although mechanized in many cases. No harmful techniques will be used.
	B1f	**Management plan** with explicitly stated objectives and strategies regarding plantation and natural forest conservation (if relevant).	Forest management plans existent according to national laws. No natural forest involved.

Indicator group	Key	**Indicator**	**Assessment**
Environmental impact Indicators	B2a	Study of **environmental impacts** (biodiversity, habitat, natural ecosystems, landscape, incl. impacts outside project boundaries) if negative impacts are considered significant by project participants of host country.	No significant negative impacts expected. However, an EIA has been conducted during project preparation.
	B2b	Existence of plans and strategies for impact mitigation. Implementation of credible mitigation measures.	No significant negative impacts expected.
	B2c	Assessment/ calculation of compensation needs. Implementation of credible compensation measures (e.g. in case of loss of habitats).	No significant negative impacts expected.
Monitoring indicators	B3a	Collection, archiving and analysing of relevant data concerning environmental impacts.	This is part of the CDM project requirements for the Monitoring Plan.
	B3b	Description of planned monitoring and remedial measures to address significant impacts.	No significant negative impacts expected.
		Make all information necessary to assess environmental impacts available to all stakeholders.	This is part of the CDM project requirements.

In conclusion, the Moldova soil conservation project & municipal district heating system project combination fulfills the essential social and environmental criteria and can thus be recommended as a beneficial Combined Bioenergy & A/R Project. Improvements are still possible by creating grievance solving mechanisms and by reducing in future the dominance of exotic or naturalized species.

A.4. Project IV: V&M do Brasil Fuel Switch Project

Vallourec & Mannesmann Tubes (V&M do Brasil S.A.) Fuel Switch Project

Project outline

The V&M project consists of investments to enable the maintenance of charcoal-based production of steel in Minas Gerais, Brasil, funded through the sale of carbon credits in the context of the Clean Development Mechanism (CDM) of the Kyoto Protocol. The extra income derived from the sale of carbon credits will increase the profitability of charcoal-based steel production avoiding the decline of this industry, which would lead to the absorption of this market share by coal-based steel mills. The project involves the avoidance of coke for the production of steel, by using charcoal from sustainably managed (certified to the Forest Stewardship Council standards) tree plantations of V&M FLORESTAL, a subsidiary of V&M do Brasil. The planted area comprises 230,000 ha, of which some 128.000 ha are eucalyptus plantations. In parallel, the project plans to increase the efficiency of its existing 1,640 carbonization kilns, thus avoiding the emissions of methane and particulates. Parties involved in this project: Brazil as host country and as potential buyer of credits, Japan (Toyota Tsusho) and The Netherlands.

Baseline and carbon effects

The baseline scenario identified for this project, in the absence of carbon finance and/or other financial incentives, is that the company would have converted its steel mill to operate with coke in October 2001. This shift would have led to a large shift into a greenhouse gas (GHG) intensive steel production processes. Carbon trading, providing an incentive for the use of charcoal, could play a vital role in preventing/reverting this trend. This is the same baseline developed by EcoSecurities for the World Bank's PCF first investment in Brazil, the Plantar project, which has already been successfully validated by the certification company Det Norsk Veritas (DNV).

Each ton of steel produced with charcoal from renewable sources avoids 1.8 ton of fossil CO_2 released to the atmosphere. Thus, the project has the capacity to generate 17.2 million tons of CO_2 emission reduction equivalents over a 21-year timeframe from fuel switch for the industrial activities (use of charcoal as opposed to coke). Another 3.8 million tons CO_2 reduction had been claimed by the project from methane capture in carbonization activities of the current charcoal production process, but in not likely to be recognized, because the baseline is coke use[8].

Social impacts

The project brings collateral social (employment, health, and labor conditions) and economic benefits, and it contributes to sustainable development objectives of the Brazilian Government. V&M currently employs 1,885 people, a substantial proportion of which is involved in forestry activities. The social activities are developed through the Annual Program of Community Integration Activities (PAAIC) in collaboration with the civil society, private and governmental institutions, as well as NGOs. The

[8] Compare comment by Axel Michaelowa (2003) to NM 0002 - "V&M do Brasil Fuel Switch Project" on the above cited EB Meth Panel web site.

activities aim to integrate the company and its collaborators in the neighboring communities and to participate in community development actions. Monitoring of social benefits uses the following instruments and indicators:

- Employment records updated on a monthly basis to monitor personnel turnover, new hires, etc.
- Company's internal health record: the company will monitor occupational health in order to detect whether the company has substantially improved the health condition of its employees. This program will be based on internal health records; and records of absenteeism due to sickness
- Continuation of the existing programs related to social and environmental quality, i.e., FSC certification and ISO 14,000, which also serve as indicators of the company's commitment to social and environmental quality.

Environmental impacts

Environmental benefits are expected for biodiversity and local air quality. No impact is expected in relation to the steel mill, given that the project will not directly alter its operations. However, as the existing steel mill will not be converted, there will not be a series of negative impacts related to the alternative use of coke, e.g. sulfur emissions, etc.

The current high levels of hydrocarbons and particulates in carbonization areas will be reduced by the introduction of more advanced kiln designs, improving overall air quality in the carbonization areas. This is also likely to result in a reduction of respiratory diseases among staff working in this area. Again, these effects are no improvement as compared to the baseline with coke utilization.

In order to produce raw material for charcoal production, V&M will have to invest in large areas of sustainably managed forest plantations. Here, the V&M project is expected to bring a series of benefits in relation to biodiversity:

- The plantations are certified to the standards of the Forest Stewardship Council. The standard requires forest operations to ensure the maintenance of biodiversity within managed areas. The company also has ISO 14,000 certification.
- Maintenance of plantation-based charcoal production reduces the pressure on native forests. Currently, V&M still uses charcoal from native forests in its pig iron mill derived from legal and authorized deforestation conducted by third parties outside its areas. With the development of the project, V&M will become fully self-sufficient in charcoal from its sustainably managed plantations.
- According to a baseline biodiversity study conducted for the PCF-Plantar project, in the same region, "the major biodiversity benefit of this type of project is the recovery of native vegetation ecosystems due to fire suppression, and the cessation of grazing on degraded savannah-type *cerrado* lands that occur in their properties' "legal reserves". The establishment of a percentage varying according to ecosystems of legal forest reserve areas is a law widely non-enforced in Brazil. Exactly the same benefits can be expected from the V&M project.

- Fire suppression - according to the baseline study for the PCF-Plantar project, “fire suppression is the single most important biodiversity benefit of the project. By continuing its current fire monitoring and control system, the project could allow the *cerrado* and other native vegetation ecosystems on its land holdings to partially recover their original species composition through the process of secondary succession….”. The same effects can be expected from the V&M project. Additionally, V&M already provides neighboring landholders with the benefit of a series of fire watch towers, expanding the impact of the fire protection program.

Table A5. Social & environmental evaluation scheme of the V & M project

(A) Socio-economic aspects

Indicator group	Key	**Indicator**	**Assessment**
Pre-condition	A0a	No displacement of local communities.	No displacement of local communities has happened.
	A0b	LSC require a comprehensive social impact assessment.	No SIA, but main audit and yearly audits of the FSC certification check for social and other impacts
Project Design Indicators	A1a	**Information dissemination** on project scope and purpose to local stakeholders and population. There is clear understanding of the project set-up and objectives.	Such mechanisms are an essential part of FSC certification and will therefore be taken duly into account.
	A1b	**Involvement of local stakeholders** (administrative agencies, interest groups etc.) in project preparation (invitation for comments, settlement of disputes etc.). At least two public consultations.	The existing FSC certification guarantees that local communities were involved as stakeholders in the project design. The Annual Program of Community Integration Activities (PAAIC) allows for a broader involvement of local people.
	A1c	**Participatory site-selection** (identification of an agreement on boundaries involving local communities, with focus on minorities)	Boundaries of the private estate are not in dispute.
	A1d	**Settlement of land use conflicts** (applying participatory LUP, identification of alternative land resources for grazing etc.)	Such mechanisms are an essential part of FSC certification and will therefore be taken duly into account.
	A1e	Calculation and agreement on **compensatory payments** for land use changes to individuals/ the commune.	The existing FSC certification guarantees that compensations were paid, if applicable.

Indicator group	Key	**Indicator**	**Assessment**
	A1f	The entity (individual households/ communities/ local governments/ companies) holds **land tenure rights** or **long-term use rights** for the project sites. These rights are commonly agreed upon.	The steel company holds land tenure rights, and the forest certification also makes sure that no tenure rights are in dispute.
Sustainable Development Indicators	A2a	**Population characteristics** (influx or outflow of temporary workers, seasonal residents, capacity building of local population, ethnic and racial distribution)	Characteristics of the 1,885 workers employed are recorded. There is on-the-job training and the Annual Program of Community Integration Activities (PAAIC) allows for a broader involvement of local people.
	A2b	**Community and institutional structures** (Employment/ income characteristics, employment equity of local population with focus on minority groups, industrial/ commercial diversity, presence of planning and zoning activity, Interest group activity, size and structure of local government)	Employment equity of local population is checked with the FSC certification.
	A2c	**Political and social resources** (distribution of power and authority, leadership capability and characteristics, interested and affected publics)	No negative impact on political and social resources.
	A2d	**Individual and family changes** (perceptions of risk, health, safety, worker rights, residential stability, attitude towards project, household resources (land, labour, capital), food supply, farm household auto-investment capacity, off-farm employment)	No special health or safety problems involved in the forestry and steel factory component.
	A2e	**Community Resources** (community infra-structure, food supply, land use patterns, cultural and historical resources, access to: water, health, education, clean energy services)	No negative impacts on community resources.
Monitoring Indicators	A3a	Establish process of hearing and responding to **community grievance.**	Existence of such grievance resolving mechanisms essential in FSC certification.
	A3b	Monitoring of proportion of **project costs spent in communities** (local salaries, infrastructure, training)	This should be included in the project monitoring plan.
	A3c	Reporting on **sustainable development indicators** (A2a-e).	Will have to be realized in the project monitoring plan.

(B) Environmental aspects

Indicator group	Key	**Indicator**	**Assessment**
Precondition	B0a	No conversion of, or negative impact (e.g. desertification) to **native ecosystems.**	Reforestation of degraded grazing areas of savannah-type *cerrado* lands.
	B0b	No e**nvironmentally harmful forest practices** and written guidelines: no soil erosion, no reduction in quality and quantity of water, no alteration of natural disturbance regimes (e.g. fire)	Anthropogenic fires are reduced, leading to natural succession processes towards the original ecosystems. Reforestation involves the use of a proportion of exotic species, plantation consume some ground water but also prevent erosion. No environmentally harmful forest practices occur.
	B0c	**Environmental impact assessment** if negative impacts are considered significant by project participants of host party.	FSC certification covers the subject.
	B0d	No persistent or unnecessary **pesticides** are used.	FSC certification controls the use of pesticides.
	B0e	Project design complies with **environmental legislation** of host country.	Fulfilled according to FSC certification.
Forest Practices Indicators	B1a	Assessment and safeguards to protect **rare species**.	Fulfilled according to FSC certification.
	B1b	For LS-projects: establishment of **protection areas**.	Legal reserves are established.
	B1c	Control of **inappropriate hunting**, fishing & trapping.	The area is supervised.
	B1d	Design & diversity of plantations should promote the protection or restoration of natural forest (more than two tree species, uneven age, irregular spacing, no genetically modified species, only controlled use of non-invasive exotic species, native species preferred).	Fulfilled according to FSC certification.
	B1e	Careful **site preparation** techniques.	Site preparation techniques are not specified. However, FSC certification makes sure that no harmful techniques are used.
	B1f	**Management plan** with explicitly stated objectives and strategies regarding plantation and natural forest conservation (if relevant).	Such management plan exists.
Environmental impact Indicators	B2a	Study of **environmental impacts** (biodiversity, habitat, natural ecosystems, landscape, incl. impacts outside project boundaries) if negative impacts are	No significant negative impacts expected. Fulfilled according to FSC certification.

Indicator group	Key	**Indicator**	**Assessment**
		considered significant by project participants of host country.	
	B2b	Existence of plans and strategies for impact mitigation. Implementation of credible mitigation measures.	No significant negative impacts expected. Fulfilled according to FSC certification.
	B2c	Assessment/ calculation of compensation needs. Implementation of credible compensation measures (e.g. in case of loss of habitats).	No significant negative impacts expected. Fulfilled according to FSC certification.
Monitoring indicators	B3a	Collection, archiving and analysing of relevant data concerning environmental impacts.	This is part of the CDM project and FSC requirements.
	B3b	Description of planned monitoring and remedial measures to address significant impacts.	No significant negative impacts expected.
		Make all information necessary to assess environmental impacts available to all stakeholders.	This is part of the CDM project and FSC requirements.

The V&M do Brasil S.A.) Fuel Switch Project is very likely to fulfill the essential social and environmental criteria and can thus be recommended as a beneficial Combined Biomass-Energy & Forest Carbon Sink Projects for sustainable development. However, due to the pre-existence of the forest plantations, the A/R component is not (and cannot be) included as CDM project.

B. Reference key standards

B.1. Social criteria derived from leading standard setting organizations including a recommendation by the study authors.

Criteria	**CDM PDD**	**WWF GS**	**FSC**	**CCBA**	**IETA/ WB**	**Recom-mended**
Regarding Project Design						
Prohibitions						
Not involving displacement of local communities or indigenous people						
Not involving displacement of local communities or indigenous people, except on a voluntary base						**x**
No inclusion of areas where land tenure is in dispute						**x**
Process oriented conditions						
Clear evidence of long-term tenure and forest use rights to the land (e.g. land title, customary rights, or lease agreements) shall be demonstrated			**x**			**x**
Local communities with legal or customary tenure or use rights shall maintain control, to the extent necessary to protect their rights or resources, over forest operations unless they delegate control with free and informed consent to other agencies			**x**			**x**
Appropriate mechanisms shall be employed to resolve disputes over tenure claims and use rights. The circumstances and status of any outstanding disputes will be explicitly considered in the certification evaluation. Disputes of substantial magnitude involving a significant number of interests will normally disqualify an operation from being certified			**x**			**x**
Forest management shall not threaten or diminish, either directly or indirectly, the resources or tenure rights of indigenous peoples			**x**			**x**
Sites of special cultural, ecological, economic or religious significance to indigenous peoples shall be clearly identified in cooperation with such peoples, and recognized and protected by forest managers			**x**			**x**
Indigenous peoples shall be compensated for the application of their traditional knowledge regarding the use of forest species or management systems in forest operations. This compensation shall be formally agreed upon with their free and informed consent before forest operations commence			**x**			**x**
Comments by local stakeholders have been invited and compiled	**x**				**x**	**x**

Criteria	**CDM PDD**	**WWF GS**	**FSC**	**CCBA**	**IETA/ WB**	**Recom- mended**
Summary of comments and report on how due account was taken of any comments received	**x**				**x**	**x**
Parties, stakeholders and UNFCCC accredited NGOs shall have been invited to comment on the validation requirements for minimum 30 days, and the project design document and comments have been made publicly available					**x**	**x**
Management planning and operations shall incorporate the results of evaluations of social impact. Consultations shall be maintained with people and groups directly affected by management operations			**x**			**x**
Require a social impact assessment						
Require a social impact assessment if impacts are considered significant by project participants or host country	**x**					**x**
Make all information necessary to assess social impacts available to all stakeholders						**x**
Ensure meaningful and transparent stakeholder participation						
Appropriate and unbiased training offered to the community to understand and evaluate issues of hosting the project				**x**		**x**
Existence of a process for hearing and responding to community grievances within 30 days and to document these grievances and the responses and to make them publicly available				**x**		**x**
Appropriate mechanisms shall be employed for resolving grievances and for providing fair compensation in the case of loss or damage affecting the legal or customary rights, property, resources, or livelihoods of local peoples. Measures shall be taken to avoid such loss or damage			**x**			**x**

Criteria	**CDM PDD**	**WW F GS**	**FSC**	**CCB A**	**IETA/ WB**	**Recom- mended**
Community members, leaders and groups in the project’s area of influence have been adequately consulted and given an opportunity to provide input on the design from the beginning				**x**		**x**
Project developers must provide community members adequate information about the scope and impacts from the project, including the baseline scenario				**x**		**x**
The monitoring plan must provide the collection and archiving of relevant data					**x**	**x**

Criteria	**CDM PDD**	**WW F GS**	**FSC**	**CCB A**	**IETA/ WB**	**Recom-mended**
concerning social and economic impacts						
The choice of indicators for sustainability development (social, economic) must be reasonable					**x**	**x**
At least two direct public consultations		**x**				**x**
Respect and build upon the rights and needs of indigenous people and local communities						**x**
Ensuring that the project meets the needs of local stakeholders		**x**				
Ensuring that the project creates other social benefits than GHG emission reductions					**x**	**x**
Contribution to poverty alleviation		**x**				**x**
Contribution to improve the livelihoods of the poor: equal distribution of wealth and opportunity for disadvantaged sectors, in particular marginal or excluded social groups		**x**				**x**
Improving access to essential services (water, health, education, access to facilities, etc.)		**x**				
Improving access to reliable and affordable clean energy services, especially to the poor and in rural areas		**x**				**x**
Raising the human and institutional capacity of local people and/or communities to participate actively in social and economic development (including empowerment, education, involvement, gender)		**x**				**x**

Criteria	**CDM PDD**	**WWF GS**	**FSC**	**CCBA**	**IETA/ WB**	**Recom-mended**
Regarding Project Execution						
Exclusion of project types						
Guarantee that approval or disapproval of a project is based on the results of the						**x**

Criteria	**CDM PDD**	**WWF GS**	**FSC**	**CCBA**	**IETA/ WB**	**Recom-mended**
mandatory social impact assessment						
Project *characteristics*						
Demonstrate ancillary social benefits (generation of local income, promotion of secure land tenure, capacity building)						
The project must assess and address situations or occupations that pose a substantial risk to worker safety				**x**		**x**
Forest management should meet or exceed all applicable laws and/or regulations covering health and safety of employees and their families			**x**			**x**
The project employs techniques of adaptive management and includes the community in establishing and monitoring pertinent indicators of project community impacts				**x**		
Creating employment (including job quality, ulfillment of labour standards)		**x**		**x**		**x**
The communities within, or adjacent to, the forest management area should be given opportunities for employment, training, and other services			**x**			**x**
The rights of workers to organize and voluntarily negotiate with their employers shall be guaranteed as outlined in Conventions 87 and 98 of the International Labour Organisation (ILO)			**x**			**x**
A great proportion of the total project costs is spent in communities impacted by the project (local salaries, infrastructure, training, capacity building, supplies, food, equipment)				**x**		**x**
Appropriate to the scale and diversity of the operation, monitoring of plantations shall include regular assessment of potential on-site and off-site social impacts, (e.g. impacts on local welfare and social well-being). Special attention will be paid to social issues of land acquisition for plantations, especially the protection of local rights of ownership, use or access			**x**			**x**

B.2. Environmental criteria derived from leading standard setting organizations including a recommendation by the study authors

Criteria	CDM PDD	WWF GS	FSC	CCBA	IETA/ WB	Recom-mended
Regarding Project Design						
Prohibitions						
No conversion of, or negative impact to, native ecosystems						
Not contribute to the risk of desertification or soil erosion (…) or reduce the quantity or quality of freshwater resources						
No use of genetically modified trees or other organisms, no introduction of exotic species						
No use of pesticides that are prohibited under multilateral environment agreements or local laws						
No alteration of natural or traditional indigenous fire regimes						
Exclusion of the use of harmful forestry practices						
Climate forestry projects (carbon sequestration) and co-firing of biomass in fossil fuel plants are excluded		**x**				
Process oriented conditions						
Require an environmental impact assessment						
Assessment of environmental impacts shall be completed – appropriate to the scale, intensity of forest management and the uniqueness of the affected resources – and adequately integrated into management systems. Assessments shall include landscape level considerations as well as the impacts of on-site processing facilities. Environmental impacts shall be assessed prior to commencement of site-disturbing operations			**x**			**x**
Documentation on the analysis of the environmental impacts, including impacts on biodiversity and natural ecosystems, and impacts outside the project boundary of the proposed A/R CDM project activity	**x**					**x**
If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken an environmental impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to support documentation	**x**					**x**

Criteria	**CDM PDD**	**WWF GS**	**FSC**	**CCBA**	**IETA/ WB**	**Recom- mended**
Documentation on the analysis of the environmental impacts of the project activity, including transboundary impacts, shall be submitted, and, if those impacts are considered significant by the project participants or the Host Party, an environmental impact assessment in accordance with procedures as required by the Host Party shall be carried out					**x**	**x**
The project proponent needs to perform an EIA, if: the host country legislation or the EB requires an EIA to be performed; additional guidance from the Gold Standard requires an EIA to be performed.		**x**				**x**
Make all information necessary to assess environmental impacts available to all stakeholders						**x**
Contain plans / strategies to mitigate any environmental impacts						
Safeguards shall exist which protect rare, threatened and endangered species and their habitats (e.g., nesting and feeding areas). Conservation zones and protection areas shall be established, appropriate to the scale and intensity of forest management and the uniqueness of the affected resources. Inappropriate hunting, fishing, trapping and collecting shall be controlled			**x**			**x**
Ecological functions and values shall be maintained intact, enhanced, or restored, including: a) Forest regeneration and succession, b) Genetic, species, and ecosystem diversity, c) Natural cycles that affect the productivity of the forest ecosystem			**x**			**x**
Representative samples of existing ecosystems within the landscape shall be protected in their natural state and recorded on maps, appropriate to the scale and intensity of operations and the uniqueness of the affected resources			**x**			**x**
Written guidelines shall be prepared and implemented to: control erosion; minimize forest damage during harvesting, road construction, and all other mechanical disturbances; and protect water resources			**x**			**x**
Management systems shall promote the development and adoption of environmentally friendly non-chemical methods of pest management and strive to avoid the use of chemical pesticides. World Health Organization Type 1A and 1B and chlorinated hydrocarbon pesticides; pesticides that are persistent, toxic or whose derivatives remain biologically active and accumulate in the food chain beyond their intended use; as well as any pesticides banned by international agreement, shall be prohibited. If chemicals are used, proper equipment and training shall be provided to minimize health and environmental risks			**x**			**x**

Criteria	**CDM PDD**	**WWF GS**	**FSC**	**CCBA**	**IETA/ WB**	**Recom-mended**
Chemicals, containers, liquid and solid non-organic wastes including fuel and oil shall be disposed of in an environmentally appropriate manner at off-site locations			**x**			**x**
The use of exotic species shall be carefully controlled and actively monitored to avoid adverse ecological impacts			**x**			**x**
The design and layout of plantations should promote the protection, restoration and conservation of natural forests, and not increase pressures on natural forests. Wildlife corridors, streamside zones and a mosaic of stands of different ages and rotation periods shall be used in the layout of the plantation, consistent with the scale of the operation. The scale and layout of plantation blocks shall be consistent with the patterns of forest stands found within the natural landscape			**x**			**x**
Diversity in the composition of plantations is preferred, to enhance economic, ecological and social stability. Such diversity may include the size and spatial distribution of management units within the landscape, number and genetic composition of species, age classes and structures			**x**			**x**
The selection of species for planting shall be based on their overall suitability for the site and their appropriateness to the management objectives. In order to enhance the conservation of biological diversity, native species are preferred over exotic species in the establishment of plantations and the restoration of degraded ecosystems. Exotic species, which shall be used only when their performance is greater than that of native species, shall be carefully monitored to detect unusual mortality, disease, or insect outbreaks and adverse ecological impacts			**x**			**x**
A proportion of the overall forest management area, appropriate to the scale of the plantation and to be determined in regional standards, shall be managed so as to restore the site to a natural forest cover			**x**			**x**
Measures shall be taken to maintain or improve soil structure, fertility, and biological activity. The techniques and rate of harvesting, road and trail construction and maintenance, and the choice of species shall not result in long term soil degradation or adverse impacts on water quality, quantity or substantial deviation from stream course drainage patterns			**x**			**x**

Criteria	CDM PDD	WWF GS	FSC	CCBA	IETA/ WB	Recom-mended
Measures shall be taken to prevent and minimize outbreaks of pests, diseases, fire and invasive plant introductions. Integrated pest management shall form an essential part of the management plan, with primary reliance on prevention and biological control methods rather than chemical pesticides and fertilizers. Plantation management should make every effort to move away from chemical pesticides and fertilizers, including their use in nurseries			x			x
Appropriate to the scale and diversity of the operation, monitoring of plantations shall include regular assessment of potential on-site and off-site ecological impacts, (e.g. natural regeneration, effects on water resources and soil fertility). No species should be planted on a full-scale until local trials and/or experience have shown that they are ecologically well-adapted to the site, are not invasive, and do not have significant negative ecological impacts on other ecosystems			x			x
The monitoring plan should provide the collection and archiving of relevant data concerning environmental impacts					x	x
Description of planned monitoring and remedial measures to address significant impacts	x					x
The choice of indicators for environmental sustainability development should be reasonable					x	x
It should be possible to monitor the specified sustainable development indicators					x	x
The sustainable development indicators should be in line with stated national priorities in the host country					x	x
Identified environmental impacts should be addressed in the project design					x	x
The project should comply with environmental legislation in the host country					x	x
Where the EIA indicates that there will or may be significant adverse impacts, the project developer must design and implement credible mitigation and, where necessary, compensation measures. These should be reviewed during the second stakeholder consultation and checked for the viability by the validator. Implementation should also be monitored throughout the project lifetime		x				x
The project proponents have a credible process for selecting biodiversity indicators. The project proponent must plan to select at least one floral, one faunal, and one ecosystem function indicator to evaluate the biodiversity impacts of the project during the implementation phase. The project developer must also describe the uncertainties in estimating the status of each indicator (e.g., population size)				x		x

Criteria	**CDM PDD**	**WWF GS**	**FSC**	**CCBA**	**IETA/ WB**	**Recom-mended**
There is no evidence that the project will harm or deteriorate water quality or water quantity				**x**		
The project proponents provide a credible description of the project's biodiversity conservation goals (e.g., enhanced/restored ecological systems) and how it will meet these goals				**x**		**x**
If the project uses non-native species, project proponents must thoroughly evaluate and describe any potential adverse impacts on the area's environment. This evaluation and description must address the following issues: 1) impacts on native species, 2) invasiveness, 3) fire proneness, 4) disease introduction or facilitation, 5) hydrological impacts, and 6) hybridisation. If these impacts have a substantial bearing on the biodiversity or environmental outcomes of the project, the project proponents justify the necessity of using non-native species over native species and demonstrate how these impacts will be mitigated				**x**		**x**
If the project involves significant site preparation, chemical applications, soil disturbance or the use of fire, the project proponents should thoroughly defend the methods, and evaluate and describe potential adverse impacts. If significant adverse impacts are expected, the project proponents should justify the necessity of these practices and demonstrate how these impacts will be mitigated				**x**		**x**
Project developers should provide a credible, spatially explicit, habitat-based assessment demonstrating that project activities will likely result in the maintenance or restoration of a viable population of a selected species-of-concern				**x**		**x**
The project proposal should give a well-documented and thorough discussion of natural disturbance regimes in the project area ecosystem(s). As applicable, the project proposal should include a credible plan to maintain or reestablish natural disturbance regimes through proposed activities, and/or adequately justifies any temporary disruption of natural disturbance regimes				**x**		**x**
The project proposal should demonstrate that water quality is a significant issue in the project area, and project goals include significant improvements to water quality, with the credible baseline information, mechanisms, indicators, and monitoring necessary to achieve the specific objectives of meeting such goal				**x**		**x**
If hunting is a dominant threat to biodiversity in the project area, the project proponents should develop a credible plan to reduce hunting of key species to a sustainable level				**x**		**x**

Criteria	CDM PDD	WWF GS	FSC	CCBA	IETA/ WB	Recom-mended
A general assessment of presence and status of rare, unique, endemic, threatened, and endangered species should be provided				x		x
Regarding Project Execution				x		x
Exclusion of project types						
Reject a project if mitigation proposals concerning negative impacts are inadequate to ensure the conservation of biodiversity and the sustainable use of natural resources						x
Guarantee that approval or disapproval of a project is based on the results of the mandatory environmental impact assessment						
Exclusion of plantations defined as "forest stands established by planting and/or seeding in the process of afforestation / reforestation, which are either: of introduced species or intensively managed stands of indigenous species which meet all the following criteria: one or two species at plantation, even age class, regular spacing"						
The management objectives of the plantation, including natural forest conservation and restoration objectives, shall be explicitly stated in the management plan, and clearly demonstrated in the implementation of the plan			x			x
Project *characteristics*						
Promote ecosystem restoration with native species to maximize environmental benefits (e.g. watershed enhancement, biodiversity)						
Demonstrate ancillary environmental benefits (e.g. protection of biodiversity, soil and freshwater conservation, combating desertification, improvement of air and water quality)						
In order for the project to be eligible the project activity must be assessed against the following environmental sustainable development indicators: Water quality and quantity, air quality, other pollutants, soil condition, biodiversity (species and habitat conservation)		x				x

C. Evaluation scheme for A&R-Projects (Choudhury et al. 2004, UBA Berlin)