October 13, 2006;
WORKING DOCUMENT

SMALL SCALE CDM PROJECTS AND NON-RENEWABLE BIOMASS

BACKGROUND TO THE ISSUE AND PROPOSALS FOR A NEW METHODOLOGY

Executive Summary

Clean Development Mechanism projects that reduce the consumption of non-renewably harvested biomass fuel (usually fuel wood) currently lack an appropriate methodology that project developers can use to benefit from the Mechanism. These projects often involve cooking stoves or other small scale applications. Non-renewable biomass projects have substantial climate change benefits, with several international studies placing the emissions reduction potential at around one tonne carbon dioxide equivalents per cooking stove per year. Furthermore, non-renewable biomass projects have significant side benefits to sustainable development, by alleviating the indoor air pollution, which, according to the World Health Organization, is responsible for some 1.5 million deaths per year. An additional side benefit is the likely productive use of time spent on fuel-wood gathering.

In November 2005, the Executive Board of the CDM decided to cancel a small-scale CDM methodology that allowed projects to receive credits from reducing the use of “non-renewable biomass”. This meant that projects that replace or improve inefficient use of biomass (typically fuel wood) would no longer be eligible under the CDM.

In response, Parties at the COP11/MOP1 requested the CDM Executive Board to produce new methodologies for these types of projects, emphasising their importance to the CDM. A subsequent call for inputs from the public attracted several submissions to the Board addressing many methodology-related issues To date, however, the Executive Board has not been able to reach an agreement on the approval of a suitable methodology to cover non-renewable biomass use.

Two methodologies were proposed by the Small Scale Working Group of the CDM, but there still remain concerns around these methodologies, most importantly related to the requirement in the methodologies to assume fossil fuels (kerosene) as the baseline, rather than the actual energy choice that the households have in practice. The methodology proposed by the Small Scale Working Group further requires the use of an emissions factor based on fossil fuels and considering the higher efficiency that fossil fuel-fired stoves generally have when calculating baseline emissions, although households have no scope to use such fossil fuels in the foreseeable future given constraints of fuel supply, poverty, and common practice.

Because of the real emission reductions created by these projects and their positive impacts on sustainable development, it is important to resolve any methodological concerns as soon as possible, and make approved methodologies available. This will

reduce institutional uncertainty and enable countries that have so far been marginalised in the CDM to participate in the Mechanism (less than 1% of all Certified Emission Reductions so far originate from Africa). This technical paper examines the issues surrounding non-renewable biomass projects in the CDM, and offers methodological solutions to the issues raised.

The proposed methodology recommends that fossil fuel form part of the baseline in proportion to realistic trends for fossil fuel adoption, and that leakage (increase in emissions outside the project boundary that is attributable to the project, for example if some of the non-renewable biomass saved by the project is used by someone else (outside the project) is estimated and accounted using a simplified approach.

The proposed methodology uses a conservative and rigorous approach for estimating emission reductions from projects that shift from non-renewable biomass to renewable energy sources such biogas, solar cookers etc. The methodology is applied to a solar cookers project in Indonesia (already registered as a CDM project) to show differences in the emission reduction estimates vis-à-vis previous methodologies proposed under this category of projects. The methodology can be considered conservative as it takes into account transitions to modern fuels, and is cost-effective and practical as it suggests simplified calculations for leakage.

Clear guidance from the COP/MOP, reinforcing and expanding on the previous decisions is needed, to allow the Executive Board to approve viable, yet rigorous methodologies for non renewable biomass replacement or usage reduction. It is important that the window of opportunity for these projects is not lost, as projects in the CDM currently need to generate credits by the Kyoto Protocol commitment period 2008-2012 in order to benefit from carbon finance.

Parties at the COP/MOP2 should re-emphasise the importance of incorporating non-renewable biomass projects in the CDM and provide specific direction to the Executive Board to approve a suitable methodology by mid 2007 so that project developers are able to undertake such projects at the earliest.

The aim of this paper is three fold: to highlight the need for regulatory guidance from the COP/MOP2 in Nairobi with the regard to the project types involving non-renewable biomass; to generate awareness among the conference participants and public on the need for resolving the issues associated with the project types in order to make these project types eligible under the CDM; and to put forward a viable methodological approach to facilitate the approval of a suitable methodology.

Introduction

This paper is designed to raise awareness of the pressing need to incorporate non-renewable biomass projects into the Clean Development Mechanism (CDM), highlighting the methodological issues faced by these projects and suggesting ways forward. Non-renewable biomass CDM projects could extend the benefits of carbon finance to least developed countries, which have otherwise limited opportunities to benefit from the Mechanism, and where some 2.4 billion people currently rely on traditional biomass energy[1]. Traditional biomass use poses tremendous health problems, mainly for women and children: traditional stoves vent smoke directly into the home, killing an estimated one and a half million people every year, according to the World Health Organization.

In November 2005, the Executive Board of the Clean Development Mechanism (CDM) decided to cancel a small-scale CDM methodology that allowed for projects to receive credits from reducing the use of "non-renewable biomass". This meant that projects that replace or improve inefficient uses of biomass (typically fuel wood) would no longer be eligible under the CDM. The typical types of projects and communities affected are poor households in rural areas of developing countries.

The subsequent COP/MOP1 decision in December 2005, in requesting the EB to develop a simplified methodology, acknowledged the significance of such projects in promoting sustainable development and recognized them as an important opportunity that would allow many developing countries to participate in the CDM. However, the Executive Board was not able to reach an agreement on the approval of a suitable methodology to cover non-renewable biomass use.

In this context, this note examines the issues at hand and presents proposals that form the basis for a new methodology that seeks to address the concerns that emerged from the Executive Board discussions.

This note is organized as follows.

- Background on non-renewable biomass CDM projects;
- Methodological issues for projects that replace or reduce the use of non-renewable biomass;
- The sustainable development benefits of these projects; and
- Proposals for a new methodology

[1] IEA (2002)

Background

In November 2005, the Executive Board of the Clean Development Mechanism (CDM) decided to constrain applicability of a small-scale CDM methodology[2] that allowed for projects to receive credits from substituting "non-renewable biomass". This meant that projects that replace or improve inefficient use of biomass (typically fuel wood) would no longer be considered eligible as the emission reductions were a result of saving fuel wood, interpreted by some as "avoided deforestation", a category that is currently ineligible under the CDM.

Request by the Conference of Parties

Acknowledging the significance of such projects in promoting sustainable development and the limited opportunities of their host countries to otherwise benefit from the CDM, Parties, on the occasion of the eleventh Conference of Parties to the United Nations Conference on Climate Change/Meeting of the Parties to the Kyoto Protocol (CoP/MoP1), requested the CDM Executive Board (CDM EB) to develop methodologies for such projects.

Paragraphs 29 and 30 of Decision 7 of MoP1 read as follows:

> [the MoP 1] "29. Welcomes the public call launched by the Executive Board for "alternative methods for calculating emission reductions for small-scale project activities that propose the switch from non-renewable to renewable biomass;.."
>
> "30. Requests the Board to develop, as a priority, a simplified methodology "for calculating emission reductions for small-scale project activities that propose the switch from non-renewable to renewable biomass";

Methodologies

The original methodology was:

- I.C: Thermal energy for the user

Under guidance from the EB and with inputs from the public, the Small Scale Working Group (SSWG), worked towards the development of the new methodologies for such project types. The new methodologies proposed by the SSWG are:

- I.E: Switch from Non-renewable Biomass to Thermal Applications by Users
- II.G: Energy Efficiency Measures in Thermal Applications of Non-renewable Biomass.

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[2] The original methodology was of Type I.C, "Small Scale methodologies for Thermal Energy for the User", version I.

The two recent methodologies indicated above are to be used for different types of project activities, but involve similar steps in determining the baseline.

Efforts by the Executive Board and the Small Scale Working Group (SSC WG) to develop these methodologies received wide recognition, though the Board was unable to reach an agreement on their status. There still remain concerns around these methodologies, most importantly of the requirement in the methodologies to assume fossil fuels (kerosene) as the baseline, rather than the actual energy choice that the households have in practice. In other words, the methodology as written pre-sets the baseline, rather than allows its systematic assessment by taking into account the national and project-specific circumstances. The methodology proposed by the Small Scale Working Group further requires an assumption on the use of fossil fuels and the corresponding emissions factor, including the consideration of the higher efficiency that fossil fuel-fired stoves generally have, when calculating baseline emissions, although households have no scope for such fossil fuel use in the foreseeable future. Use of the SSC WG proposed methodology results in a baseline emission factor that is approximately 75% lower than the baseline emission factor for firewood as per the AMS I.C (the methodology that was withdrawn by the Executive Board in 2005). The adoption of an unlikely baseline energy choice of fossil fuels leads to a significant reduction in the volume of emission reductions for the project types and their corresponding carbon revenues, and renders most such project activities commercially unsustainable. An illustration of the impacts of these methodologies on project types is given in **Annex IV**.

Furthermore, the suggested approaches for addressing leakage[3] would create a major barrier for these types of projects. For example, the requirement to assess what would happen to the biomass (fuel-wood) outside the project requires definition of the radius over which energy choice decisions of the project and others not involved in the project are made. As another example, the methodology requires a monitoring of carbon stocks and whether they decline because the land area is used for other purposes. Given that most other small scale methodologies leakage requirements are minimal, biomass projects should not be singled out and subject to tougher leakage standards than is required for other projects.

As the Executive Board has not been able reach an agreement on resolving the outstanding issues, there is currently no clear guidance to project developers in developing small scale non-renewable biomass projects.

Impacts on Sustainable Development

To date the CDM has seen projects developed in a selected group of countries, mostly India, China and Brazil, together accounting for approximately 80 % of the total certified emission reduction volumes transacted[4]. The CoP/MoP1 requested the Board to find ways to increase participation of the small and least developed countries in the CDM,

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[3] Leakage refers to the net change of anthropogenic emissions by sources of greenhouse gases (GHG) which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity.

4 State and Trends of the Carbon Market 2006, World Bank and IETA, May 2006.

and more explicitly on developing a methodology for projects that switch from non-renewable to renewable biomass.

Energy use in the residential sector dominates the total energy use in most developing countries, with some 2.4 billion people around the world relying on biomass as their primary source of energy, predominantly to meet basic cooking and heating needs. The vast majority of these people rely on inefficient cooking stoves or open fires. In the absence of economic diversification, energy shares in the industry and service sectors are relatively low. Energy use in the residential sector offers the only few opportunities for such countries to participate in the CDM. **Annex I** presents sector-based and source-wise energy shares within the residential sector in a sample of developing countries representing Africa, Asia, and Latin America and Caribbean.

Most projects that replace or reduce the use of non-renewable biomass are small, typically at the level of households and located in poor communities of rural and urban areas where cooking is carried out using solid fuels, notably biomass, which is often the only source of energy available and affordable to such communities. Globally, more than 2 billion rely on biomass as the primary source of cooking energy[5]. Most of the biomass used is derived from non-renewable sources, the burning of which for energy purposes results in net greenhouse gas emissions.

Studies conducted by the World Health Organization continue to highlight the adverse impacts of smoke from biomass fuels on human health, particularly that of women and children[6,7]

Biomass usage in traditional stoves is reported to be a major source of indoor air pollution, responsible for the deaths of over 1.5 million children every year. The same households also spend productive time collecting biomass, consequently affecting other productive human development activities such as education and skilled employment and severely constraining the growth of household incomes and human capital.

Several research and academic studies have been carried out on greenhouse gas emissions from stoves in different geographic regions of the world, including Smith et al, 1992[8;] Smith et al, 1999[9,] Smith et al, 2000[10]; Zhang et al, 200011; Bhattacharya & Salam, 20026;

5 International Energy Agency (2002)

6 Smith, K et al (2000) 'Greenhouse Implications of Household Stoves: An Analysis for India' Annual Review of Energy and the Environment 25:741–63

7 Edwards, R et al (2004) 'Implications of changes in household stoves and fuel use in China' Energy Policy 32:395–411

8 Smith, KR, RA Rasmussen, F Manegdeg, M Apte, Greenhouse Gases from Small- Scale Combustion in Developing Countries: A Pilot Study in Manila, EPA-600-R-92-005, Global Emissions and Control Division, USEPA, Research Triangle Park, NC, 1992

9 Smith, KR, DM Pennise, P Khummongkol, V Chaiwong, K Ritgeen, J Zhang, W Panyathanya, RA Rasmussen, MAK Khalil, Greenhouse Gases from Small-Scale Combustion in Developing Countries: Charcoal-Making Kilns In Thailand, EPA-600/R-99-109, USEPA, Research Tri. Park NC, Dec. 1999

10 Smith, KR, R Uma, VVN Kishore, K Lata, V Joshi, J Zhang, RA Rasmussen, MAK Khalil, Greenhouse Gases from Small-Scale Combustion in Developing Countries: Household Stoves in India, EPA-600/R-00-052, USEPA, Research Tri. Park NC, June 2000

Bailis et al, 200312; Edwards et al, 2003[13], Edwards et al, 2004[14], and Bond et al, 2004[15]. These studies show that switching to improved stoves can save up to 2 tonnes of CO_2 per stove per year, depending on the level of improvements in the stove design, and these conclusions have been substantiated in India[14], China[15] and Thailand[7].

Provision of cost effective energy alternatives to communities that would reduce the dependence on biomass is key to the conservation of natural resources and to enhance the qualities of life. Most of the energy alternatives promoted to date have been exclusively financed by international donor agents. Competing demands on Official Development Assistance limit its usage to a small number of countries and project initiatives. As aid declines, a trend evidenced by historical data, countries have to increasingly look alternative means to sustain economic development. Although the CDM is by no means expected to address this problem alone, it is nevertheless a means by which additional resources can be leveraged for such projects, while reducing greenhouse gas emissions.

Proposal for a new methodology

Given the lack of progress towards an approved methodology so far, it is important to consider alternative proposals for developing a methodology that will have wider consensus. Several alternatives have already been proposed and have been made available (see box below).

This paper considers a variant of those methodologies, which rests on the following **four** components, which are discussed below. The full text of this methodology is attached as Annex III:

(i) Prevailing location specific data from the surveys on energy use disaggregated as the shares of fossil and biomass fuels in rural and urban contexts are considered. Where such data are not available, national or regional data based on household surveys that delineate solid/biomass and modern/fossil fuels could be used as proxy.

(ii) The basic principle behind the "combined margin" approach (of assuming fuel sources of the current generation mix, and combining the same with fuel sources expected in the medium to long-term) to determine baseline emissions are applied to energy shares here – shares of current solid/biomass fuels combined

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11 Zhang J, Smith KR, Ma Y, Ye S, Weng X, Jiang F, Qi W, Khalil MAK, Rasmussen RA, and Thorneloe SA (2000) Greenhouse gases and other pollutants from household stoves in China: A database for emission factors. Atmospheric Environ 34 (26):4537-49.

12 Bailis, R, Ezzati, M, and Kammen, D M (2003) Greenhouse Gas Implications of Household Energy Technology in Kenya. Environmental Science and Technology 37 (10) p. 2051-2059

13 Edwards, R, Smith, K, Zhang, J and Ma, Y (2003) 'Models to predict emissions of health-damaging pollutants and global warming contributions of residential fuel/stove combinations in China' Chemosphere 50 (2003) 201–215

14 See below

15 Bond, T, Venkataraman, C, Masera, O (2004) 'Global Atmospheric Impacts of Residential Fuels' Energy for Sustainable Development 8 (2004) 20-32

with those of future modern/fossil fuels. To integrate the transition to modern fuels in the baseline scenario, the rate of adoption of modern fuels is used as the indicator.

(iii) Economic feasibility and investment barriers with regard to biomass energy alternatives are taken into account;

(iv) A simplified leakage assessment based on objective measures is used to cost-effectively account for leakage.

Each of the above components is discussed in detail below.

Component (i)

In conforming to the modalities and procedures of the CDM, the baseline should reflect prevailing energy use and its expected evolution in the absence of the CDM project. The prevailing energy – represented by the shares of fossil and biomass fuels - should be assessed from local/national household survey data.

- If local surveys are not available, data on energy use patterns and energy shares can be assessed from large-scale national household surveys conducted in countries (For example, Living Standard Measurement Surveys conducted with the support of the World Bank, Demographic and Health Surveys conducted by Macro International with the support from USAID, the World Bank and other development agencies). Shares of modern fuels (kerosene, LPG, etc.) and solid fuels (mostly biomass-based fuels such as fuelwood and charcoal) in household cooking energy for countries derived from the survey data are presented in **Annex II, Table 1**. It must be noted that an overwhelming proportion of the biomass is from non-renewable sources, although a certain proportion of renewable biomass that is collected from agricultural lands and community lands is used as energy for household cooking, depending on the agro-ecological region.

- As the energy use profiles of rural and urban areas of countries differ significantly, projects in rural and urban areas will need to consider the respective rural and urban baselines, as the energy use of households and by inversion, the dependence on non-renewable biomass is expected to be different in rural and urban areas. Based on the available national level household survey, solid and modern energy shares in the rural and urban areas of countries are presented in **Annex II, Table 2**.

- Assessment of prevailing energy use patterns and the shares of modern/fossil fuels and biomass fuels in a geographic region allow the aggregation of localities in a country or countries in a geographic region into groups that reflect similar energy use patterns and energy choices. This allows for the adoption of regional rural/urban energy baselines for the areas covered under the project that do not have disaggregated data on energy shares or classification into rural and urban consumption categories.

Component (ii)

Average shares of household energy in a region forms the basis for the baseline. Using the energy shares approach is similar to the principle of combined margin approach of the power sector methodologies, where a percentage of the current energy use type is represented by biomass or solid fuels, and a percentage is represented by modern or fossil fuels. The transition from solid to modern fuels is integrated by using the rate of adoption of modern fuels. The energy shares approach facilitates the analysis in the following ways.

- Separation of household survey data into modern fuel and biomass fuel shares enables the estimation of the **rate of adoption of modern fuels**. Based on the household survey data of two or more periods, it is possible to estimate the rate of energy transition to modern fossil fuels in the absence of the project.

- Separation of data into energy shares facilitates the dis-aggregation of biomass share into renewable and non-renewable fractions based on the sources and magnitudes of biomass production feasibility from agriculture, forestry, communal lands etc. and enables the estimation of the **share of non-renewable biomass in the total biomass**.

Component (iii)

Economic feasibility and investment barriers with regard to energy alternatives to biomass should be taken into account.

- As modern fossils fuel or renewable energy alternatives to biomass require additional investments, issues around economic feasibility and barriers to investment become relevant for initiating projects and therefore, in the demonstration of project additionality.

- In order to increase the rate of transition to low GHG emitting modern fuels or renewable energy alternatives of individual households spread over a large region, high upfront investment under program-based activities or interventions become relevant. For example, the cost recovery of a renewable energy alternative in the Indonesia Solar cookers project highlights that such projects require significant upfront investment, which may require program-based initiatives on solar cookers as it is not feasible to recover the costs from sale of emission reductions alone.

Component (iv)

The assessment of leakage can be simplified by either of the two options:

- Project developers can assume a 15% default deduction to the emission reductions to account for possible leakage associated with non-renewable biomass outside the project boundary, or

- Project developers can assess actual leakage estimations by defining reasonable limits to an assessment by monitoring a sample of households with similar energy profiles to those in the project in a 3 km radius of the project over a 5 year period. The radius defined for the assessment of leakage assumes that 3 km is a reasonable distance that users in biomass-using households are likely to travel to collect the biomass. The shift of modern fuel using households to biomass in the 3 km radius is considered significant leakage if the total emissions from leakage exceed 2% of the project emissions.

The above components have been incorporated into a new methodology proposed in **Annex III** of this paper. An application of the same methodology to the solar cookers project in Indonesia is in **Annex IV.**

Alternate Proposals for Methodologies

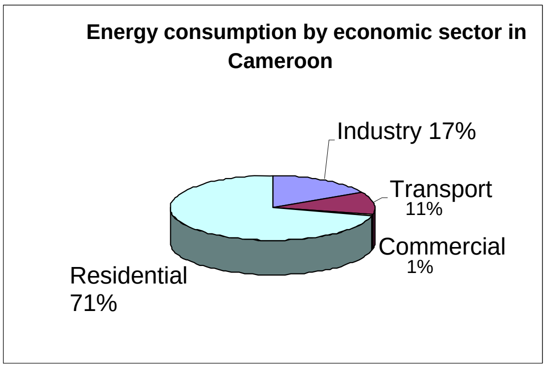
There are a number of alternate proposals submitted so far, each with slight variations but similar in overall approaches. These are available at:

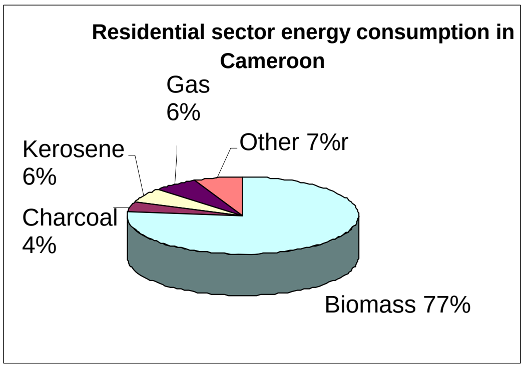
http://cdm.unfccc.int/UserManagement/FileStorage/RX9G3AESH7GO0QVR07CI0DV0AJ02VY
http://cdm.unfccc.int/UserManagement/FileStorage/8NI830VTBWI3399LCYYYW1P4ZVTQ7F
http://cdm.unfccc.int/UserManagement/FileStorage/0JG16VNJIR4GUJI4AYS6J5O5L4D9PE

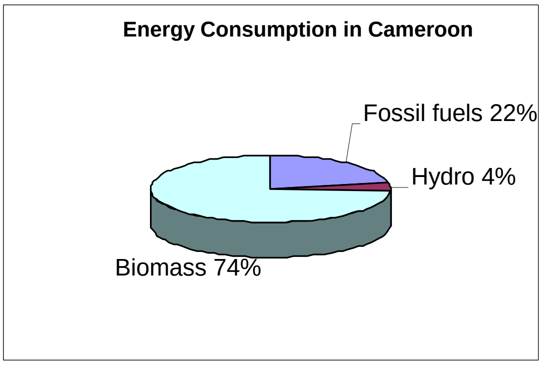
These proposed new methodologies are derived from the two methodologies proposed by the SSC Working Group recently (I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User; II.G. Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass). The proposed methodologies assume a mix of non-renewable biomass (including charcoal) and fossil fuel in the baseline. At the start of the project, per definition and per project design, the entire population of equipment in the project uses non-renewable biomass. In the baseline scenario this changes to a mix of non-renewable biomass and fossil fuels, corresponding to past and present regional trends. The proposed methodologies also address concerns raised earlier by EB members. Finally, these methodologies conservatively prescribe a 15% leakage deduction, unless project proponents can verifiably demonstrate that no leakage (less than 2%) occurs in the specific project context.

Annex 1: Energy use by fuel type and sector or select countries

CAMEROON

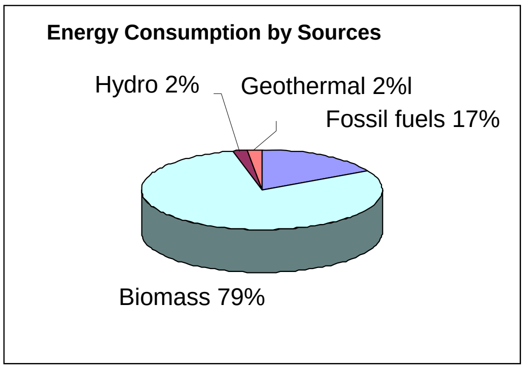


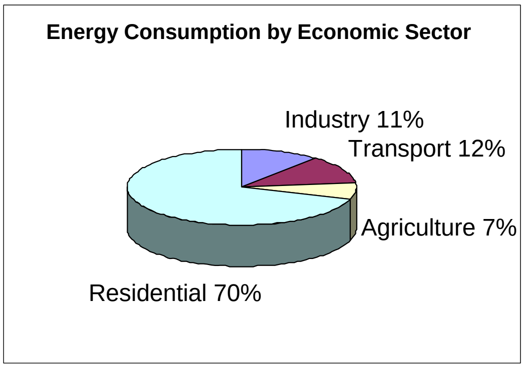


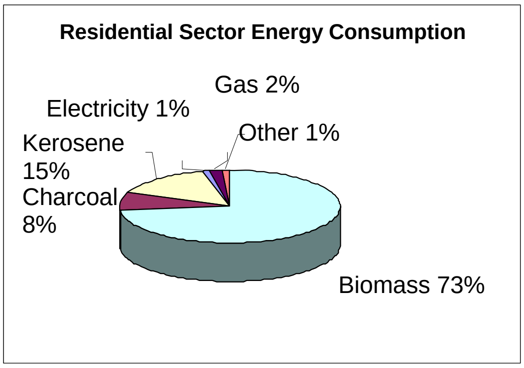


- Total CO_2 emissions in 2000: 1.4 Mt, 0.03% of world total
- Total emissions from energy sector: 1.2 Mt CO_2
- Emissions per capita: 0.5 tCO_2 per year
- No CDM projects in UNFCCC pipeline to date

KENYA

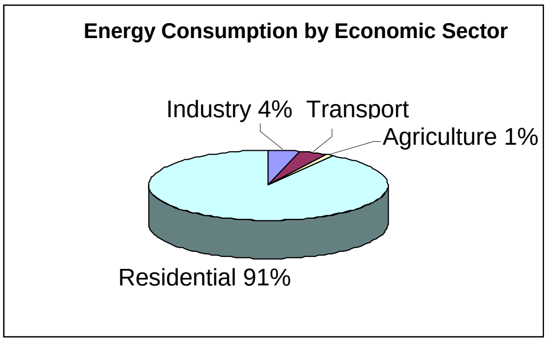


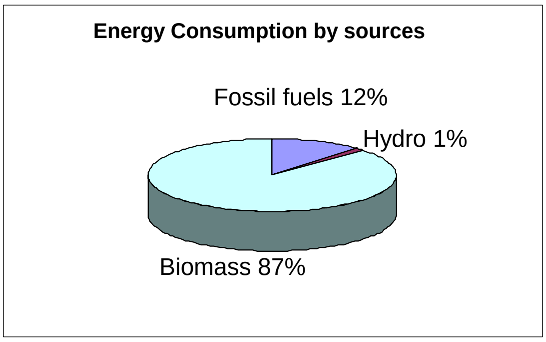


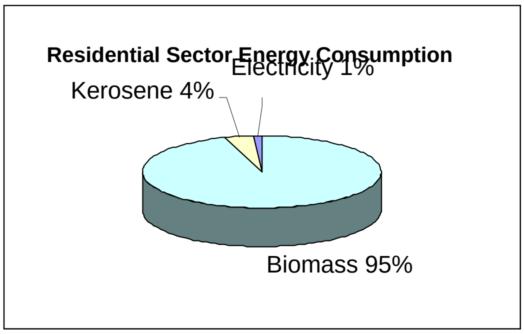


- Total CO_2 emissions in 2000: 10.2 Mt, 0.04 of world total
- Total emissions from energy sector: 9.1 Mt CO_2
- Emissions per capita: 0.3t CO_2 per year
- No CDM projects in UNFCCC pipeline to date

NEPAL

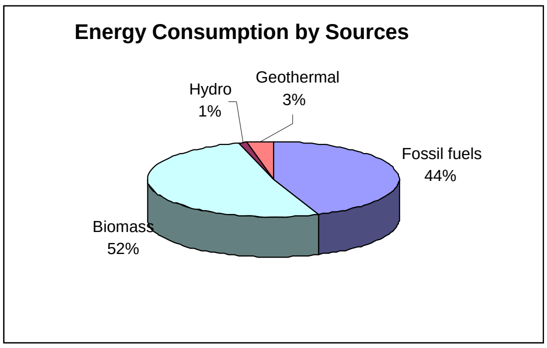


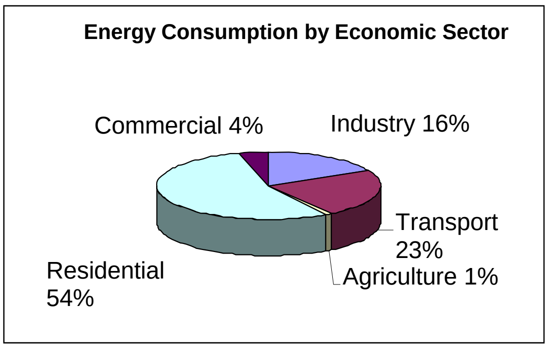




- Total CO_2 emissions in 2000: 3.2 Mt, 0.01 of world total
- Total emissions from energy sector: 3.1 Mt CO_2
- Emissions per capita: 0.1 tCO_2 per year
- 2 registered CDM projects

NICARAGUA





- Total CO_2 emissions in 2000: 3.6 Mt, 0.02 of world total
- Total emissions from energy sector: 3.5 Mt CO_2
- Emissions per capita: 0.7 tCO_2 per year
- 2 registered CDM projects

Source: Energy consumption by sector: WRI Earth Trends
Energy consumption by sources: African Indicators 2005, WRI Earth Trends
Residential Sector Energy Consumption: African Indicators 2003

Annex II: Solid and modern energy shares in the rural and urban areas of countries

Table 1: Percent share of solid and modern fuels by country and region

Region/country	Share of fossil fuels (%)	Share of Solid fuels (%)	Region/country	Share of fossil fuels (%)	Share of Solid fuels (%)	Region/country	Share of fossil fuels (%)	Share of Solid fuels (%)
Africa	23	77	Colombia	85	15	Hungary	> 95	<5
Algeria	> 95	<5	Costa Rica	77	23	Kazakhstan	95	5
Angola	<5	> 95	Cuba	> 95	< 5	Kyrgyzstan	24	76
Benin	5	95	Dominican Republic	86	14	Latvia	90	10
Botswana	35	65	Ecuador	> 95	< 5	Lithuania	> 95	<5
Burkina Faso	<5	> 95	El Salvador	67	33	Poland	> 95	<5
Burundi	<5	> 95	Grenada	52	48	Republic of Moldova	37	63
Cameroon	17	83	Guatemala	38	62	Romania	77	23
Cape Verde	64	36	Guyana	41	59	Serbia & Montenegro	NA	NA
Central African Republic	<5	> 95	Haiti	<5	> 95	Slovakia	> 95	<5
Chad	<5	> 95	Honduras	43	57	Tajikistan	25	75
Comoros	24	76	Jamaica	55	45	TFYR of Macedonia	70	30
Congo	16	84	Mexico	88	12	Turkey	89	11
Cote d'Ivoire	26	74	Nicaragua	42	58	Turkmenistan	>95	<5
Democratic Rep. of Congo	<5	> 95	Panama	67	33	Ukraine	94	6
Equatorial Guinea	NA	NA	Paraguay	42	58	Uzbekistan	28	72
Eritrea	20	80	Peru	67	33	Russian Federation	93	7
Ethiopia	<5	> 95	Saint Kitts and Nevis	> 95	<5	Southeast Asia	26	74
Gabon	72	28	Saint Lucia	37	63	Indonesia	28	72
Gambia	<5	> 95	St Vincent and Grenadines	69	31	Sri Lanka	33	67
Ghana	12	88	Suriname	NA	NA	Thailand	28	72
Guinea	<5	> 95	Trinidad and Tobago	92	8	Bangladesh	12	88
Guinea-Bissau	5	95	Uruguay	> 95	<5	Bhutan	NA	ND
Kenya	19	81	Venezuela	95	5	India	26	74
Lesotho	17	83	Eastern Mediterranean	64	36	Korea, Dem. People's	NA	ND
Liberia	NA	NA	Afghanistan	<5	> 95	Maldives	NA	ND
Madagascar	<5	>95	Bahrain	> 95	<5	Myanmar	5	95
Malawi	<5	>95	Cyprus	> 95	<5	Nepal	20	80
Mali	<5	>95	Djibouti	94	6	Timor-Leste	NA	ND
Mauritania	35	65	Egypt	> 95	< 5			
Mauritius	> 95	<5	Iran, Islamic Republic of	> 95	<5	Western Pacific	26	74
Mozambique	20	80	Iraq	> 95	< 5	Cambodia	<5	> 95
Namibia	37	63	Jordan	> 95	< 5	China	20	80
Niger	<5	>95	Kuwait	> 95	<5	Cook Islands	NA	NA
Nigeria	33	67	Lebanon	> 95	<5	Fiji	60	40
Rwanda	<5	>95	Libyan Arab Jamahiriya	> 95	<5	Kiribati	NA	NA
Sao Tome and Principe	NA	NA	Morocco	95	5	Korea, Republic of	> 95	<5
Senegal	59	41	Oman	> 95	<5	Lao People's Dem	<5	> 95
Seychelles	> 95	<5	Pakistan	28	72	Malaysia	> 95	<5
Sierra Leone	8	92	Qatar	> 95	<5	Marshall Islands	NA	NA
South Africa	82	18	Saudi Arabia	> 95	<5	Micronesia, Federated	NA	NA
Swaziland	32	68	Somalia	NA	NA	Mongolia	49	51
Togo	24	76	Sudan	<5	>95	Nauru	NA	NA
United Republic of Tanzania	<5	>95	Syrian Arab Republic	68	32	Niue	NA	NA
Uganda	<5	>95	Tunisia	95	5	Palau	NA	NA
Zambia	15	85	United Arab Emirates	>95	<5	Papua New Guinea	10	90
Zimbabwe	27	73	Yemen	58	42	Philippines	53	47
Latin America and the	84	16	Central & Eastern Europe	84	16	Samoa	30	70
Antigua and Barbuda	54	46	Albania	50	50	Singapore	>95	<5
Argentina	> 95	<5	Armenia	74	26	Solomon Islands	5	95
Bahamas	> 95	<5	Azerbaijan	51	49	Tonga	44	56
Barbados	> 95	<5	Belarus	89	19	Tuvalu	NA	NA
Belize	57	43	Bosnia and Herzegovina	49	51	Vanuatu	21	79
Bolivia	75	25	Bulgaria	83	17	Viet Nam	30	70
Brazil	88	12	Estonia	85	15	World	48	52
Chile	> 95	<5	Georgia	58	42			

Note: Biomass fuels overwhelmingly represent the solid fuels category
Fossil fuels such as kerosene and LPG overwhelmingly represent the modern fuels category

Source: Eva Rehfuess, Sumi Mehta, and Annette Prüss-Üstün (2004): Assessing Household Solid Fuel Use: Multiple Implications for the Millennium Development Goals, Environmental Health Perspectives, 114 (3), 373-78

Table 2: Share of solid and modern fuels by rural and urban areas of countries

Regio	Countries	Modern Fuels (%)			Solid Fuels (%)			Data Source	Year	Number of HouseHolds	Population
		Rural	Urban	National	Rural	Urban	National				
AFR	Benin	1.3	12.5	5.4	98.7	87.5	94.6	DHS	2001	1,380,416	6,436,660
	Burundi	0.2	1.9	0.2	99.9	98.1	99.8	EP	1998	2,986,426	6,548,190
	Cameroon	1.8	37.8	17.3	98.2	62.2	82.8	ECAM	2001	3,120,936	15,466,880
	Eritrea	2.6	69.6	20.3	97.4	30.4	79.7	DHS	1995	948,860	3,574,000
	Ethiopia	0.1	27.1	4.6	99.9	72.9	95.4	DHS	2000	14,087,172	64,298,000
	Ghana	0.6	12.0	4.2	99.4	88.0	95.8	CWIQ	1997	3,021,711	12,400,000
	Kenya	5.156	66.16	18.16	94.7	33.8	81.8	CWIQ	1997	5,543,416	28,043,000
	Madagascar	1.12	3.76	1.74	98.88	96.24	98.26	EP	1999	2,863,020	14,600,000
	Malawi	0.4	17.0	2.6	99.6	83.0	97.4	DHS	2000	2,576,029	10,311,000
	Mali	0.2	1.6	0.4	99.8	98.4	97.9	DHS	2001	2,373,512	11,094,340
	Niger	1.6	5.2	2.2	98.4	94.8	97.8	EPCES	1995	1,893,103	10,125,740
	Nigeria 8 States	5.9	42.6	14.0	94.2	57.4	85.7	CWIQ	2002	26,077,135	123,896,520
	Rwanda	0.1	1.9	0.2	99.9	98.1	99.8	DHS	2000	1,800,990	7,709,000
	Uganda	1.3	15.0	3.2	98.7	85.0	96.8	DHS	2001	5,345,742	22,210,000
	Zambia	1.9	37.6	14.1	98.1	62.4	85.9	DHS	2001	2,285,984	10,282,500
	Zimbabwe	6.4	95.3	40.3	93.6	4.7	59.7	DHS	1999	3,311,526	12,388,320
LAC	Bolivia	19.6	92.9	65.6	80.4	7.1	34.4	DHS	1998	2,032,657	7,950,000
	Brazil	61.7	97.3	90.7	38.3	2.7	9.3	PNAD	1999	42,924,843	
	Colombia	51.8	96.6	80.5	48.2	3.4	19.5	ENH	2000	9,566,040	
	Costa Rica	76.1	96.4	88.2	23.9	3.6	11.8	EHPM	2000	928,835	
	El Salvador	28.3	82.4	62.1	71.7	17.6	37.9	EHPM	2000	1,438,186	
	Mexico			81.1			18.9	ENIGH	2000	23,484,752	
	Paraguay	28.7	78.0	56.7	71.3	22.0	43.3	EPH	2000	1,243,870	
	Uruguay	98.2	99.6	98.9	1.8	0.4	1.1	ECH	2000	832,779	
	Haiti	0.4	9.0	3.6	99.6	91.0	96.4	DHS	2000	1,755,449	7,959,000
	Nicaragua	6.8	53.9	35.6	93.3	46.1	64.4	LSMS	2001	976,647	5,205,023
MENA	Djibouti	50.3	97.9	94.7	49.7	2.2	5.3	EDAM	1996		
	Yemen, Rep.	46.9	97.0	58.4	53.1	3.0	41.6	HBS	1998		8,837,545
	India	8.5	66.3	24.3	90.2	29.2	73.7	NSS	2000	196,597,842	982,182,464
	Nepal	4.4	60.1	10.3	95.6	39.9	89.7	DHS	2001	4,742,000	23,584,710
	Pakistan	5	72	24	95	28	76	HHS	2001	13,100,000	141,450,144
EAP	Cambodia	1.3	18.0	3.7	98.7	82.0	96.3	DHS	2000	2,395,778	12,021,230
	Indonesia	16.8	79.6	27.8	83.2	20.4	72.2	Ag. Cen	2003	50,200,000	208,000,000
	Papua New Guin	1.748	65.58	10.3217	98.25	34.417	89.6783	HHS	1996	838,060	4,870,000
	Vietnam	2.4	46.4	13.0	97.6	53.6	87.0	LSMS	1997	16,128,313	75,800,000
	Armenia	30.6	78.5	73.4	69.5	21.3	26.4	DHS	2000	833,023	3,112,000
	Romania	58.2	97.5	77.1	41.8	2.5	22.9	FBS	2002	7,779,163	22,391,651
	Tajikistan	9.849	67.34	25.48	90.15	32.66	74.52	LSMS	1999	854,745	6,043,900
	Countries with HH survey dat			**14**				**DHS**		**22**	**Other HH surv**

Notes

Regions	
AFR	Africa
LAC	Latin America & Caribbean
MENA	Middle East & North Africa
SA	South Asia
EAP	East Asia & Pacific
ECA	Eastern Europe & Central Asia

Definitions

Modern Fuels: kerosene, LPG, natural gas, butane, propane

Solid Fuels: wood,charcoal, dung, straw, grass, and others.

Survey Abbreviations

Ag. Cens	Agricultural Census
CWIQ	Core Welfare Indicators Questionnaire
DHS	Demographic and Health Survey
ECH	Encuesta Continua de Hogares
ECAM	Enquete Camerounaise Aupres Des Menages
EDAM	Enquête Djiboutienne auprès des ménages
EHPM	Encuesta de Hogares de Propositos Multiples
ENH	Encuesta Nacional de Hogares
ENIGH	Encuesta Nacional de IngresoGasto de los Hog
EP	Enquete Prioritaire
EPCES	Enquête Permanente De Conjoncture Économi
EPH	Encuesta Permanente de Hogares
FBS	Family Budget Survey
HBS	Household Budget Survey
HHS	Household Survey
LSMS	Living Standard Measurement Survey
NSS	National Sample Survey
PNAD	Presquisa Nacional por Amostra de Domicilios

Annex III
Type I: Renewable Energy Projects
Switch from Non-Renewable Biomass to Renewable Energy for Thermal Applications by the User

Technology/ Measure

1. This category comprises small appliances involving the switch from non-renewable biomass such as fuelwood or charcoal to renewable energy technologies. These technologies include biogas stoves, use of solar cookers and measures that involve the switch to renewable biomass.

Boundary

2. The project boundary is the physical, geographical area of the use of non-renewable biomass or a mixture of non-renewable biomass and modern fuels.

Baseline

3. It is assumed that in the absence of the project activity, the baseline scenario would be the mix of non-renewable biomass and modern (fossil) fuels use expected to be used in the baseline, by the local consumers, for meeting similar thermal energy needs. Project proponents must demonstrate that the biomass use claimed to be non-renewable is indeed non-renewable, following the EB 23 Annex 18 definition of renewable biomass. This can be done by factoring out the renewable biomass in the rural and urban biomass use assessing the proportion of non-renewable biomass from the household surveys.

4. Emission reductions would be calculated as:

$$BE_y = B_y \bullet NCV_{biomass} \bullet EF_{baseline,CO2} \bullet 10^{-3}$$

where:

BE_y Baseline emissions during the year y in t CO_2

B_y Quantity of non-renewable biomass used in tonnes, calculated as:

> The product of the number of appliances/households multiplied by the estimate of average annual consumption of non-renewable biomass per appliance/household (tonnes/year). This can be derived from historical data or a survey of local usage based on household surveys (living standard measurement surveys (the World Bank) or Demographic Health Survey (Macro International) or other similar local or national level household surveys

In the case of charcoal the quantity of non-renewable biomass going into the charcoal making process should be used (IPCC default: 6 kg wood per kg charcoal, reference manual of 1996 Guidelines page 1.45)

$NCV_{biomass}$ Net calorific value of the non-renewable biomass that is substituted (IPCC default for wood fuel, 15 MJ/Kg).

$EF_{non\text{-}renewable\ biomass,CO2}$ Emission factor for the substitution of non-renewable biomass by similar consumers locally, in t CO_2 / TJ biomass.

Evolution of energy use in the baseline considering the rate of adoption of modern fossils fuels in the absence of the project

$$X' = X + R(X) * n$$

Emission factor for modern fossil fuels

$$EF_{fossil\_fuels} = (EF_{kerosene} + EF_{LPG})/2 = (71.5+63.0)/2 = 67.25\ tCO2/TJ$$

Emission factor of non-renewable biomass

$$EF_{baseline,CO2} = X' \bullet (EF_{CO2,fossil\_fuels}) + PNR \bullet (1 - X') \bullet (EF_{CO2,biomass})$$

where:

$EFCO_2$, fossil	CO_2 emission factor for the fossil fuel; 71.5 tCO_2/TJ for Kerosene, 63.0 tCO_2/TJ for LPG or the IPCC default value of the fossil fuel commonly observed with local consumers
$EFCO_2$, biomass	CO_2 emission factor for the biomass fuel; 109.6 tCO_2/TJ (default for biomass from IPCC 1996 GL).
X	Share of modern fossil fuels (kerosene and LPG) in the baseline as per the historical and/or current trends. The modern fossil fuels (X) include kerosene and LPG and can be determined from the household survey data.
1-X’	Share of biomass fuels in the baseline. The biomass fuels are assumed to include both non-sustainable and sustainable sources of biomass.
PNR	Share of non-renewable biomass is assumed to be the range of 0 to 1.0. The proportion of non-renewable biomass could be estimated from the household surveys conducted in the project area or from the literature and studies on energy use patterns that are relevant to the region or the regional level verifiable data such as from the satellite imagery on the biomass resources in the region that corresponds to the project area.
R	Average annual rate of adoption of modern fossil fuels in percent (kerosene/LPG) under the baseline (in the absence of the project) default regional adoption rates based on the multi-period household survey data can be used. In the absence of the location specific data national or regional data shall be used. For example, the adoption rate could be 1% percent annum.
n	Number of years corresponding to the completion of project period

Project Emissions

Renewable energy (Solar energy and Biogas)

The emission factor for renewable energy technologies is zero. Therefore, project emissions are expected to be zero.

$$PE_y = RE_y * NCV_{renewable} * EF_{renewable, CO2} * 10^{-3}$$

where:

REy	Amount of renewable energy used, calculated as the number of appliances times the estimated average annual consumption of renewable energy per appliance.
$NCV_{renewable}$	Net calorific value of the renewable energy source (IPCC default)
$EF_{renewable, CO2}$	CO_2 emission factor for the renewable energy; (it is zero for renewable energy technologies such as solar energy

Emission Reductions:

$$\mathbf{ER_y = BE_y - PE_y}$$

where:

ERy	Emission reductions during the year y in t CO_2

Leakage

5. The project participants shall demonstrate the leakage is not likely to be significant (less than 2% as per the guidance under the small scale A/R methodology) by demonstrating that leakage is not likely to occur in the 3 km radius of the project boundary. The radius defined takes into account the likely distance that the households travel to harvest non-sustainable biomass. This can done undertaken through surveys of households that have similar profiles to those of the pre-project households.

6. In the event household surveys demonstrate a possibility that the savings of non-renewable biomass due to the project activity lead to greater use of non-renewable biomass outside the project boundary, then a leakage deduction of 15% shall be applied (on lines of leakage allowance in the EB approved small scale afforestation and reforestation methodology

Monitoring

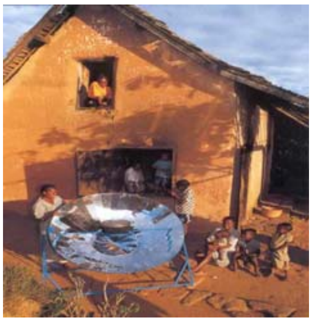
6. Monitoring shall consist of an annual check of all appliances or a representative sample thereof to ensure that they are still operating or replaced by an equivalent in service appliance.

7. Monitoring should confirm the complete displacement or substitution of the non-renewable biomass at each location.

8. Leakage monitoring annually for 5 year period shall demonstrate if the leakage deduction of 15% is to be applied, monitoring shall demonstrate that greater use of non-renewable biomass outside the project boundary does not occur.

Annex IV: Examples

Application of the Proposed New Methodology to the Solar Cooker Project in Aceh, Indonesia



The solar cooker project in Aceh, Indonesia provides access to solar cookers and appropriate heat retention containers for cooking, heating and sterilizing of water and for preserving of food for 1000 households. It was approved by the CDM Executive Board in December 2005 under the old methodology AMS I.c and the project was registered on 6 February 2006.

Total project costs according to PDD: **402,850 USD, using an exchange rate of 1.27 USD per Euro.**

<u>I. Emission reductions according to PDD as registered, following AMS I.c</u>

Yearly emission reductions: 3500 tCO2

- ⇨ Total emission reductions (7 years): 24.500 tCO2
- ⇨ CER revenue assuming a price of 6.5 USD/tCO2: 159,250 US$
- ⇨ Carbon finance covers **39.5 %** of total project cost

<u>II. Emission reductions/ CER revenues according to AMS I.e as proposed by the SSC WG</u>

Yearly emission reductions: 926 tons CO2e (SSC WG calculation)

=> Total emission reductions: 926 tons CO2e * 7 = 6,482 t CO_2

CER revenue assuming a price of 6.5 USD/t CO_2: 6,482t * 6.5 USD/tCO_2 = **42,133 EUR => 10.5% of total project cost**

<u>III. Assuming energy shares baseline for East Asia</u>

On average, 16.8 % of rural households in Indonesia have access to modern fuels (i.e. LPG, kerosene, etc.):

Share of rural household using modern (fossil) fuels (X) = 0.168
Rate of adoption of modern (fossil) fuels under the baseline scenario = 1% per annum (assumption). This value can be estimated either from local studies or household surveys.
Share of rural households using solid (biomass) fuels (1-X) = 0.832
Proportion of non-renewable biomass in the total biomass (PNR) = 75% (assumption). This value can be estimated from the local studies or household surveys.

X' = $X' = X + R(X) * n$

= 0.168 + [0.01(0.168)*7]

= 0.1697

EF_{fossil_fuels} = $(EF_{kerosene} + EF_{LPG})/3$

= (71.5+83.0)/2 = 67.25 tCO2/TJ

$EF_{Baseline}$ = $X' * EF_{fossil\_fuels} + PNR*(1-X') * EF_{biomass}$

= 0.1697 * 67.25 tCO2/TJ + 0.75*0.9401 * 109.6 = 88.68

ER_y = $B_y * NCV_{biomass} * EF_{baseline}$

= 2160kg * 15 MJ/kg * 88.68 tCO2/TJ = 2,873.23 tCO2

ER_{total} = 2873.23 tCO2 * 7 years = 20,112.62 tCO2

CER revenue assuming a price of 6.5 USD: 20,112.62 * 6.5 USD/tCO_2 = $ 130,732.01
=> 32.8% of total project cost

ERs and Economic Viability of the Project as per AMS I.C (biomass baseline)	ERs and Economic Viability of the Project as per AMS 1.E (kerosene baseline)	ERs and Economic Viability of the project as per the proposed methodology (mixed baseline - fossil fuels and biomass)
24.500 tCO_2e	6,482 tCO_2e	20,112.62 tCO_2e
159,250 USD *	42,133 USD *	130,732.01 USD *
40 % of project costs	10.5 % of project costs	32.8% of project costs

* carbon finance revenue assuming a CER price of USD 6.50