THE GOLD STANDARD:
Project Design Document for Gold Standard Voluntary Offset projects

(GS-VER-PDD)

For more information, please contact The Gold Standard:

http://www.cdmgoldstandard.org
info@cdmgoldstandard.org

phone +41 61 283 09 16
fax +41 61 271 10 10

ADES
Solar and efficient stoves in Southwest Madagascar

VOLUNTARY OFFSET PROJECTS

PROJECT DESIGN DOCUMENT FORM (GS-VER-PDD)
Version 01 - in effect as of: January 2006)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity

Title: Solar and efficient stoves in Southwest Madagascar
Version: 5
Date: 21.12.09

A.2. Description of the project activity

Purpose of the project activity

The objective of the project is to provide solar cookers and efficient wood stoves for cooking to people in Southwest Madagascar. Wood fuel and charcoal consumption can be substantially reduced. In order to convince the people to this new way of cooking, training programs, cooking demonstrations, workshops and publicity programs are planned. The project will be developed by a Swiss NGO called ADES – Association pour le Développement de l'Energie Solaire.

For centuries the population of Madagascar has been cooking their food with wood, which requires vast amounts of firewood in the form of charcoal. Madagascar has, especially in the South and Southwest of the country, close to ideal conditions for the use of solar energy. The solar cookers are an important contribution towards halting the deforestation process and thereby preserve the environment. There is no CO2 emission, which is the main agent responsible for climate change. The population will become less dependent on wood and charcoal. Besides environmental reasons there are also economical and practical reasons to favor the solar cooker. Families spend a lot less money on wood and charcoal. Furthermore cooking with the solar cooker is hygienic, there is no smoke to affect health and therefore reduces life expectancy.

Solar cookers have to be subsidized so that the people can afford them. Up to now, fundraising by ADES in Switzerland made this possible in a small way. Two local workshops have been built in Tuléar and Ejeda, where first solar cookers have been assembled and successfully distributed to surrounding villages. The current project is a wide extension of this situation. A successful expansion is only possible through carbon crediting.

ADES has the vision that within 20-40 years a large part of the population in Southwest Madagascar is predominantly using solar cookers to prepare their food. Due to the favorable conditions of 330 sunny days per year this region is ideal for using solar energy. During the first seven years of the project phase it is planned to build five more workshops in Morondava, Ambouvombe, Majanga, Ihosy and Antisrabe. Every year an increasing number of built stoves is foreseen. In fact, until 2014, ADES plans to distribute 38,190 solar box stoves, 6,610 parabolic stoves and 8,610 efficient stoves. For each regional centre, the construction of 2-3 local centers is planned in order to reduce the level of transportation on the poor roads. The solar cookers will be introduced to the surrounding villages via the regional and local centers. Each centre consists of a carpentry workshop for the production of the solar cookers and a sales and demonstration office.

Furthermore wider activities are planned in contribution with this project, like cooking demonstrations in the town and the surrounding villages, training of women who disseminate the cookers themselves, training of school teachers in environmental questions and usage of solar cookers so they can integrate them in their lessons.

Additionality

Financial barrier: The market prices for the new solar and efficient stoves is a high investment in urban and rural Madagascar, where the average monthly income of employed people is around 40-50 Euros (The World Bank gives figures for per capita yearly income in Madagascar of 280 USD in 2006 - equaling around 204 Euros per year or 17 Euros per month[1]; The Economic Development Board of Madagascar indicates average salary for non-qualified workers to be around 44 USD or 33 Euros[2]). ADES sells the solar box stoves at a subsidized and affordable price of 16 Euros to the population. The total costs for a parabolic solar stove is at around 120 Euros and it is sold at a subsidized price of 36 Euros. The efficient stove costs ADES around 24 Euros and it is sold also at a reduced price of 12 Euros. The reduced prices are based on the experiences ADES made concerning the local population's willingness and ability to pay. ADES is reliant on additional funds, since the financial means from fundraising is by no means sufficient to offer the stoves at reduced prices to the local population. Therefore, revenues from carbon credits are essential to conduct the projet activity.
All in all, ADES funds are expected to cover at best 44% of the total project budget (2008 – 2014). Revenues from carbon credits are therefore of crucial importance to fill this financial gap. From 2009 on revenues from carbon credits will start contributing to the project budget and will be able to cover at the beginning 10-30% of the yearly budget increasing to 90% towards the end of the crediting period.

Technological barrier: Traditionally, no solar and efficient stoves are produced in Madagascar. The local producers have to be trained on how to manufacture the stoves.

Barrier due to prevailing practice: Most families are used to cook with charcoal or wood fired stoves or even the 3-stone-technology. The introduction of solar and efficient cookers has to be accompanied with a change in the habits regarding cooking time and periods as well as cooking methods. Therefore, demonstration and training courses are needed.

Avoidance of double counting / securing ownership;
The stove buyers are informed that they are not allowed to make further money by marketing the stove as the added value is already included in the Sales price. Moreover, the stove owners sign a form, where it is mentioned that the rights on emissions reductions from the use of the stove are transferred to ADES. There is no risk of double counting as ADES is the only organization producing and selling the solar and Yoyo efficient stoves in Madagascar. An ERPA between ADES and myclimate will guarantee the transfer of ER ownership.

ADES also sold solar and efficient stoves to a partner organization called Blue Venture (http://blueventures.org), a marine conservation organization conducting volunteer community projects in Andavoaka, a fishermen settlement about 120 km north of Tuléar, in Madagascar. Blue Venture distributed the stoves to the local population in the area as a way to offset emissions resulting from the international volunteers' flight travel to Madagascar. Since October 2008, Blue Venture does no more buy stoves from ADES, nor does Blue Venture distribute stoves to the local population. The stoves that were sold to Blue Venture in 2008 are listed in the Sales Record and labeled accordingly. These stoves are not used to generate carbon credits for this project.

The view of the project participants of the contribution of the project activity to Sustainable Development

In general the interest of people for solar cooking is big, but it needs a lot of work to convince the people to apply this new way of cooking like a daily routine. Since solar cooking means a completely new cooking method and therefore a change in cooking habits and attitudes. Due to the constantly rising energy prices including wood and charcoal the conditions for a more economical cooking method are very favorable.

---

[1] http://devdata.worldbank.org/ict/mdg_ict.pdf

[2] http://www.edbm.gov.mg/page-living-madagascar-3-2

However, the project does not only transfer renewable energy technology to the region but it also contributes to Sustainable Development in a wider sense, like:

- Avoidance of deforestation. Thereby, there is reduced erosion and loss of fertile soil.
- Reduction of airborne emissions due to combustion of wood and charcoal.
- Transfer of the solar cooker technology to different regions of Madagascar.
- New jobs for production and dissemination of the stoves.
- Avoidance of time-intensive search for fuelwood.

Sustainable development matrix

Component Indicator	Score (-2 to 2)	Rational
Local/regional/global environment		
Water quality and quantity	1	Reducing the demand for wood fuel and charcoal decreases deforestation. This has positive effects on the water cycle (availability and quality): An intact vegetation cover preserves water resources in the ground and prevents soil erosion, which would lead to silting of water courses and bodies.[3]
Air quality (emissions other than GHGs)	1	The reduction of wood fuel and charcoal burning will also substantially reduce the emission of airborne particles, which is a major cause for many deseases.[4]
Other pollutants (including, where relevant, toxicity, radioactivity, POPs, stratospheric ozone layer depleting gases)	0	No other relevant pollutants are emitted in the project or in the baseline case. Operating solar cook stoves is free of emissions.[5]
Soil condition (quality and quantity)	1	By the reduction of deforestation soil erosion and leaching is prevented.[6]
Biodiversity (species and habitat conservation)	1	As deforestation is reduced by lowering the demand on charcoal for cooking, the highly valuable and biodiverse forests of Southwest Madagascar are protected. E.g. the Madagascar spiny thickets (also known as the Madagascar spiny forests) is protected, which is an ecoregion containing an outstanding proportion of endemic plant species[7,8]
Sub total	***4***	
Social sustainability and development		
Employment (including job quality, fulfillment of labour standards)	1	The ADES workers receive average or above average wages, which is fixed with an agreement with local trade unions. ADES trains its workers on the job. More than 25 carpenters and nutrition consultants have already been trained and many more will be trained in the future.[9]
Livelihood of the poor (including poverty alleviation, distributional equity, and access to essential services)	2*	The expenses for charcoal buying as well as the time needed for wood collecting will both be reduced by the project. This means, poor households have more time and money available. Especially children and women benefit from reduced transport effort for wood. [10]

---

[3] http://rainforests.mongabay.com/0902.htm

[4] See Report "Smoke – the Killer in the Kitchen": http://practicalaction.org/?id=smoke_report_home, 24/09/2008

[5] http://en.wikipedia.org/wiki/Solar_cooker

[6] Thorkil Casse, Anders Milhøj , Socrate Ranaivoson , Jean Romuald Randriamanarivo. 2004. Causes of deforestation in southwestern Madagascar: what do we know? Forest Policy and Economics 6, 33–48. doi:10.1016/S1389-9341(02)00084-9

[7] http://en.wikipedia.org/wiki/Madagascar_spiny_thickets, accessed 03/07/2008

[8] http://www.cipec.org/research/madagascar.html , 24/09/2008

[9] ADES Annual report 2007, page 27, http://www.adesolaire.org/de/vorstand.html

[10] See results from Kitchen Tests on page 25 of this PDD for fuel savings.

Access to energy services	1	The project gives access to solar energy (solar cook stoves) as a new energy source. [11]
Human and institutional capacity (including empowerment, education, involvement, gender)	2*	The stove project is accompanied by cooking demonstrations and training of cook stove manufacturing and appliance. Especially women and children (schools) are targeted as they are considered to be crucial for further social developments.[12]
Sub total	***6***	
Economic and technological development		
Employment (numbers)	2*	ADES employs 34 persons at the moment. The extension of the project will give additional jobs to 50 or more workers.[13]
Balance of payments (sustainability)	1	For the moment, hardly any of the locals is using fossil fuels for cooking. As deforestation will diminish the access to fuel wood, the pressure to switch to fossil fuels will rise. Considering the rising oil prices, the avoidance of need for fossil fuels could become a major benefit from the project in some years.[14]
Technological self reliance (including project replicability, hard currency liability, skills development, institutional capacity, technology transfer)	1	The stoves can be locally produced, assembled, repaired and distributed by trained local ADES staff. This builds up knowledge and capacity for this new technology in Madagascar. [15]
Sub total	***4***	
TOTAL	**14**	

* The indicators marked with an asterisk are monitored (see monitoring) as they have a value of +2. No other indicators are monitored, as there are no indicators mentioned by the stakeholders, nor are there any indicators sensitive to boundary conditions nor have any other a significant negative impact or need mitigation measures.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	**Private and/or public entity(ies) project participants (*) (as applicable)**	**Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Madagascar (Host)	Private Entity - ADES – Association pour le Développement de l'Energie Solaire	No
Switzerland (Annex 1)	Private Entity - Foundation myclimate - the Climate Protection Partnership	No

[11] http://www.adesolaire.org/de/situation.html

[12] http://www.adesolaire.org/de/worumEsGeht.html

[13] ADES – Association pour le Développement de l'Energie Solaire Suisse - Madagascar

[14] Results from the Kitchen Survey (see Kitchen Survey Report V3) show that only about 1.5% use fossil fuel (LPG).

[15] http://www.adesolaire.org/de/worumEsGeht.html

A.4. Technical description of the project activity:

Baseline stoves

	
Baseline Wood stove	**Baseline Wood Charcoal stove**
Energy efficiency 10%[16] [17]	Energy efficiency 10%[1] [2]

Project stoves

		
Solar box stove	**Solar parabol stove**	**Rocket stove Yoyo**
Energy output: 0.2 kW	Energy output: 0.6 kW[18] [19]	Energy output: 1.5 kW [20]
		Energy efficiency: 30 % [21]

---

16 Carbones nouveaux de la région Sud-Ouest de Madagascar Dr. Daniel Kotonirina RAMAMPIHERIKA
17 UNDP, Kingdom of Morocco, GEF: "Clean Energy for Development and Economic Growth: Biomass and Other Renewable Energy Options to Meet Energy and Development Needs in Poor Nations Growth", http://www.energyandenvironment.undp.org/undp/index.cfm?module=Library&page=Document&DocumentID=5047 [accessed November 2008]
18 FAO: "Wood Fuel Surveys", Annex III - (a) Measuring cooking fuel economy, 1. Introduction http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/Q1085e/q1085e09.htm
19 GTZ: Moving Ahead with Solar Cookers - Acceptance and Introduction to the Market". Eschborn (1999): http://www2.gtz.de/dokumente/bib/00-0160.pdf
20 G T Z Mass dissemination of Rocket Lorena stoves in Uganda http://www.betuco.be/stoves/Rocket%20Lorena%20stoves%20uganda.pdf

Solar box stove:
The box type solar stove is an easily built, insulated box. Due to incident solar radiation temperatures up to 150° C can be generated in the box which is sufficient to cook almost all meals: rice, manioc, mais, potatoes, vegetables, meat and fish. Also, bread and cakes can be baked and medical tools or water can be sterilised. The box solar stove is produced in the ADES workshops in Madagascar. The solar box stove has a lifetime of 7 years for which ADES gives warranty and provides free repair service during the warranty period.

Parabolic solar stove:
The parabolic solar stove is using a parabolic mirror. In the focus point of the mirror there is a device where the cooking pot can be put. The parabolic mirror gathers the sun rays and this process leads to high temperatures at the focal point. These temperatures are high enough to cook, bake, grill and even fry. The cooker can also be used to sterilize medical tools. The parabolic mirror is made of weatherproof shining aluminium and the base frame is made of zinc coated steel (galvanised). The material for the mirror of parabolic solar cooker comes from Europe. The mirror parts and the frame of the stove are fabricated in Madagascar. ADES then assembles the parabolic solar stove in its workshops. The temperatures in the focus point of a parabolic-solar cooker are higher than the temperatures in the interior of the solar cooking box, which leads to a faster cooking process. The parabolic-solar cooker and the solar cooker box can be used in a complimentary manner. The parabolic solar stove has a lifetime of 7 years for which ADES gives warranty and provides free repair service during the warranty period.

Efficient wood-fired / charcoal-fired stove:
The efficient wood or charcoal fired stove is a simple steel construction with insulating material inside (sand or ash). This improves the energy efficiency of the cooking process by 50-60% compared to the traditional cooking on the open fire. The stoves can be fabricated locally at a low price. ADES introduced the stoves in April 2007 in combination with the solar cookers. ADES produces the stove locally at a private workshop and sells them in combination with the solar stoves. The efficient stove has a lifetime of 7 years for which ADES gives warranty and provides free repair service during the warranty period.
In order to motivate stove users of the efficient Yoyo stove to surrender the old baseline stove, the project offers a price reduction of 20% for the Yoyo stove if the households hands in the old baseline stove in exchange for it. The collected baseline stoves will be destroyed and the materials recycled if ever possible.

[21] Rocket Stove Efficiency, http://www.repp.org/discussiongroups/resources/stoves/Ogle/nordicarocket.pdf

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Republic of Madagascar

A.4.1.2. Region/State/Province etc.:

Southwest Madagascar consisting of the 6 regions of Menabe, Atsimo-Andrefana, Androy, Anosy, Melaky and Boeny.

Map 1: The six regions in Souhwest Madagascar

A.4.1.3. City/Town/Community etc:

The production and distribution centers for the solar and efficient stoves are located in:

- Tuléar (already operating)
- Ejeda (already operating)
- Morondava (already operating)
- Ambovomb (to be opened in summer 2009)

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

The exact geographical positions of the centers are:

- Toliara: 23°21'S 43°40'E
- Ejeda: 24°21'S 44°31'E
- Morondava: 20°17'5"S, 44°19'3"E
- Ambovombe: 21°30'13"S, 45°12'34"E

Potential centers in other regions:
- Mahajanga: 15°43'S, 46°19'E
- Ihosy: 22°24'S 46°07'E
- Antisrabe: 19°52'S, 47°02'E

A.4.2. Size of the project:

In accordance with the Voluntary Gold Standard thresholds, the project is specified as large-scale project (over 60,000 tCO2eq reduced per year). Emission reductions are increasing every year, rising from an estimated total of 5,676 tCO2eq in the first year up to 93,945 tCO2eq in the seventh year. This leads to an average reduction of 44,662 tCO2eq per year (see Section A.4.4.1 and E.6).

The following sales of stoves are expected,

	Accumulated sales of stoves				
Year	**Box**	**Parabolic**	**E stove**	**Total**	**Total** (only 1 stove within households with more than 1 stove type[22])
2008	1'700	320	470	2'490	2241
2009	4'400	820	1'150	6'370	5733
2010	8'500	1'590	2'140	12'230	11007
2011	13'990	2'590	3'400	19'980	17982
2012	20'840	3'780	4'920	29'540	26586
2013	28'890	5'110	6'640	40'640	36576
2014	38'190	6'610	8'610	53'410	48069

[22] In households with two different stove types only the reduction of 1 stove type is counted. The reason for this is described in the Kitchen Survey report The measurement in the Kitchen Surveys led to the conclusion that in case of several stoves of the same type the savings per stove are about the same no matter how many stoves of this type are used by a household. However, the savings per stove are lower in a household using different types of stove than in a household using only one type of stove. Therefore, stoves from a household with one stove type can be included in the same clusters, while stoves from households using different types of stoves cannot. By treating a household with several stove types as a household with 1 stove, the emissio reductions accounted for a lower than the actual reductions. This supports a conservative approach for estimating emission reductions.

The following numbers of charcoal and wood using stoves are expected to be sold (only stoves for which ERs are claimed, this means only 1 stove within households with more than 1 stove type);

	Accumulated sold stoves (only stoves for which ERs are claimed)		
Year	**Total**	**Charcoal users**	**Wood users**
2008	2241	1614	627
2009	5733	4128	1605
2010	11007	7925	3082
2011	17982	12947	5035
2012	26586	19142	7444
2013	36576	26335	10241
2014	48069	34610	13459

According to ADES' experience on average 72% of stove buyers use charcoal and 28% wood fuel

Assuming there is a yearly drop off-rate of 10% (This means only 90% of stoves having been in operation in the previous year are also in operation in a specific year), then the following numbers of stoves in operation apply;

	Accumulated stoves in operation (only stoves for which ERs are claimed) *Drop-of rate of 10% is assumed*		
Year	**Total**	**Charcoal users**	**Wood users**
2008	2241	1614	627
2009	5509	3966	1542
2010	10232	7367	2865
2011	16184	11652	4531
2012	23169	16682	6487
2013	30842	22207	8636
2014	39251	28261	10990

A.4.3. Category(ies) of project activity:

This project belongs to the category "End-use Energy Efficiency Improvement". In accordance with the thresholds, the project is specified as large-scale project. Estimated emission reductions are between 5,676 and 93,945 tCO2eq per year (see Section A.4.4.1 and E.6).

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

Without this project activity the thermal energy need for cooking applications in the south- southwest of Madagascar would be filled by the use of wood-fuel or charcoal, most of which is non-renewable biomass from primary forests. To calculate emission reduction of the whole project different customer groups have to be built, depending on the fuel they currently use and on the type of new stove they purchase. Since solar cookers do not emit any GHGs, the reduction for these buyers is equal to the emissions generated by the combustion of unsustainable biomass in absence of the project. For the group using efficient stoves the emission reductions are calculated from the reduced amount of unsustainable biomass needed through the new technology.

The project meets all basic requirements for Voluntary Gold Standard projects to be judged as additional;

- The emission reductions of the project are measurable by appliance of the “Gold Standard Methodology for Improved Cook-stoves and Kitchen Regimes V.01”, approved by the GS TAC
- The project entails an introduction of technological innovation in the host country by the dissemination of solar and efficient stoves not used before. The technology is transferred from its original center in Tuléar to new regions of Madagascar
- The project as described here has not previously been publicly announced to be implemented without carbon credit funding.
- The additionality can be clearly proved by the UNFCCC’s “Tool for the demonstration and assessment of additionality”, version 5 as is used in B.3.
- No ODA funds are used for purchasing VER credits. All VERs are bought by myclimate, a private actor funded by mainly private and small public (but non-ODA) funds. Myclimate’s annual report shows that no ODA governmental agency is a client of myclimate[23].

A.4.4.1. Estimated amount of emission reductions over the crediting period:

Years	**Annual estimation of emission reductions in tonnes of CO_2 e**
2008	5,676
2009	13,953
2010	25,917
2011	40,602
2012	57,377
2013	75,164
2014	93,945
Total emission reductions (tonnes of CO_2 e)	312,634
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	44,662

[23] See http://www.myclimate.org/download/JB_07_e_web.pdf and http://www.myclimate.org/download/myclimate_jb_2006_en.pdf, 25/09/08

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

Gold Standard Methodology for Improved Cook-stoves and Kitchen Regimes V.01

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

The project addresses the switch form cook-stoves having significant green-house gas emissions to those having considerably less or zero emissions.

The following conditions apply:
- Low-emission cook-stoves replace relatively high-emission baseline scenarios: As described in section A.4. solar box stoves, parabolic solar stoves and efficicent cook stoves replace inefficient baseline stove technologies (three-stone-stove and inefficient charcoal/wood stove).
- The project boundary can be clearly identified, and the stoves counted in the project are not included in another voluntary market or CDM project: The project boundary includes the place of the kitchens where the project stoves are applied and the place of fuel collection, production, and transport in Southwest Madagascar.
- The project is located in a single country: The project is located in Madagascar.
- The improved cook-stoves do not number more than ten per kitchen and each have continuous useful energy outputs of less than 50kW: The only important kitchen regime so far is the domestic use for cooking. The solar box stove has an energy output of 0.2 kW, the parabolic solar stove of 0.6 kW and the efficient stove of 1.5 kW.

B.2. Description of how the methodology is applied in the context of the project activity:

As the most plausible baseline scenario for this project a fixed baseline is chosen. The baseline situation is not expected to change significantly during the next years considering the current situation in Madagascar and its economic development of the last years: Madagascar had a negative annual growth rate of the Gross Domestic Product during the last 30 years (-1.6% from 1975 – 2005[24]). Moreover, Madagascar is ranked 143rd out of 177 countries classified according to the Human Development Index and with almost 70% of the population living below the poverty line. This is especially true for rural areas, where around 80% of the population live and where living conditions have been steadily declining in recent years (in terms of transport, health, education and market access)[25]. Severe droughts in 2009 hit the already arid South of Madagascar hard. Staple food production in Toliara is forecasted to significantly decline this year with consequenes on the food prices and health. Prices of cereals in the south have already risen by up to 400 percent.[26] Around 80% of children under the age of five suffer from malnutrition in the South of Madagascar. [27] Rising prices for staple food and high prices for fuels as well as the economic downturn initiated by global economic crisis and the political turmoil in early 2009 make it impossible for rural Madagassians to change from biomass to fossil fuels for cooking in the near future. Fuels such as petrol, diesel and gas are not subsidized and international markets define the prices for these commodities. Moreover, power supply is very unreliable with frequent blackouts. A main obstacle for electrification of households located in the vicinity of the power grid is the purchase of electric meters. These are not deliverable at the moment due to supply shortage.

---

[24] Human Development Report 2007/2008, 14 Economic Performance, GDP per capita, annual growth rate (%). http://hdrstats.undp.org/indicators/134.html

[25] Rural Poverty Portal: http://www.ruralpovertyportal.org/english/regions/africa/mdg/index.htm

[26] IRIN news referring to FAO and WFP: http://www.irinnews.org/Report.aspx?ReportId=85626

[27] UNICEF, July 2009: http://www.unicef.org/infobycountry/madagascar_50348.html

Outlook: The international community will only regonize Madagascar's government after fresh polls, which are forecasted to be held in late 2010. The country has been suspended from regional bodies like the AU and SADC, and donors were quick to cease all non-humanitarian aid when the crisis erupted in early 2009.[28] In addition to drought and cyclones, also the cessation of donor and aid money hit the economy and the population very hard. Considering the effects of the poitcal unrest starting in early 2009 and the expected political stabilization after fresh polls in late 2010, the economy first has to recover before a further economic development and increase in standard of living can be expected. This makes it very unlikely that in the next years, rural population in Madagascar will be enabled to switch to fossil fuels or electricity for cooking. Therefore, a fixed baseline is the most plausible scenario for the project.

Baseline emissions

The methodology asks for a multi-step determination of the baseline emissions;

1. Determine customer groups or "clusters" Step 1.1: Establish a pilot Sales Record Step 1.2: Provisionally assess fuel types, fuel mix, and kitchen regimes Step 1.3: Analyze renewability status of wood-fuels Step 1.4: Divide pilot Sales Record into customer groups or clusters Step 1.5: Carry out a qualitative survey (Kitchen Survey) Step 1.6: Refine demarcation of clusters and populate Project Database **2. Calculate baseline emissions** Step 2.1: Estimate expected variation and improvement in emission reductions Step 2.2: Specify the Units of emission reduction or fuel consumption Step 2.3: Make quantitative measurements (Kitchen Tests) Step 2.4: Calculate baseline

1. Determine customer groups or "clusters"
Step 1.1: Establish a pilot Sales Record

The pilot Sales Record consists of all stoves sold until end of May 2008 (for which required data was available) and contained the following data;

- Date of Sale
- Location of sale
- Mode of use: resale/onward retailing, institutional, other (assumed domestic)
- Model/type of stoves purchased
- Number of stoves purchased
- Name and telephone number:
  - Required for all bulk purchasers, ie retailers and institutional users
  - Domestic end users: as many as possible
- Address
  - Required for all bulk purchasers and institutional users
  - Domestic end users: as many as possible

Step 1.2: Provisionally assess fuel types, fuel mix, and kitchen regimes
The following Fuel Types were assessed;

[28] IRIN news: http://www.irinnews.org/Report.aspx?ReportId=85659

Used: a) Renewable and Non-Renewable Woody Biomass, which includes all wood-fuels.
Not Used b) Renewable energy fuels, e.g. agricultural residues
Not Used c) Alternative fuels (AF)

The following fuel mixes are assessed as important:

- 100% wood
- 100% charcoal

The only important kitchen regime is the domestic use for cooking, while institutional use (restaurant, school,...) accounting for around 2% of the stove users is negligible.

Step 1.3: Analyze renewability status of wood-fuels

The analysis showed that there is more wood used in the region than what can sustainably regrow (see Annex 5).

Step 1.4: Divide pilot Sales Record into customer groups or clusters

The Sales Record is divided into the following clusters;

- 1 new stove (solar box, parabol or efficient stove) in a household using only charcoal
- 1 new stove (solar box, parabol or efficient stove) in a household using only wood

Justification;

- Households with one new stove are expected to reduce about the same amount of fuel (non-dependent on the technology applied) because the solar stoves replace 100% of the fuel when utilised while efficient stoves only reduce fuel consumption. However, solar stoves can only be used during sunshine hours whereas efficient stoves can be applied during the whole day. Assuming that solar stoves can be applied for two of three meals per day and that efficient stoves have an efficiency of 30% compared to the 3-stone-stove with 10% efficiency, solar and efficient stoves reduce about the same amount of fuel (around 66%). Therefore, they can be included in the same cluster.

- Households with more than one stove of the same type (e.g. two solar stoves): fuel savings per stove are assumed to be equal for each stove, since it is assumed that people will use a second (or third) stove for the same purpose and not in a complementary way.

- Households with more than one type of stove technology (e.g. solar stove and efficient stove): fuel savings per stove are assumed to be equal for each stove, since it is assumed that people will use the other stove type for the same purposes and in the same way.

Step 1.5: Carry out a qualitative survey (Kitchen Survey)

First, the number of needed kitchen surveys had to be determined. The following group sizes are recommended by the methodology;

- Group size < 300: Minimum sample size 30
- Group size 300 to 1000: Minimum sample size 10% of group size
- Group size > 1000 Minimum sample size 100

This means for the assessed clusters;

Cluster	*Cluster size (stoves sold until end of May 2008)*	*Kitchen Survey Sample Size*

1 new stove (solar box, parabol or Yoyo) in a household using only charcoal	Around 1250*	≥100
1 new stove (solar box, parabol or Yoyo) in a household using only wood	Around 500*	At least 50

* Exact numbers are not known as the stoves can be used for both types of fuel

The Kitchen Survey was conducted by ADES staff visiting the households. All households were visited, no telephone interviews were conducted. For this purpose a „Questionnaire for Kitchen Survey“ was applied (see Annex 2). The selected kitchens for Kitchen Surveys were chosen randomly applying the snowball sampling method. For this, several representatives of ADES (from all three centres) randomly chose a part of the project area and identified a first stove user. If the stove user was at home and the respective person available the questionnaire was filled out. The selected stove user then referred to a next stove user. If the selected stove user was not present people were asked to indicate another stove user in the neighbourhood, which was interviewed for the Kitchen Survey. This procedure was repeated until the necessary amount of Kitchen Survey questionnaires was achieved for all of the three project centers (Tuléar, Ejeda, Morondava).

As result of the kitchen surveys a „Report on Kitchen Surveys“ is compiled which resulted in the following recommendations for delineation of the clusters;

- regional variation: The places were found to correlate very well with the clusters (charcoal users in Tuléar, wood users in Ejeda) by the kitchen surveys.

- domestic/insitutional appliances: The large majority of the kitchens use the stoves for domestic purpose, a very small minority use it for institutional purpose (see Kitchen Survey Report). So far, no big differences in fuel use between domestic and institutional application could be detected. More Kitchen Surveys are needed in the future to decide if a new cluster has to be made for institutional use.

- seasonal variations / variations during the week : It was found that two variations are significant: the more use of fuel in winter (dry season) and the lower use during the weekends. It is proposed to subtract from fuel use values measured in winter and on week-days 9.1% for charcoal users and 7.7% for wood fuel users (see Kitchen Survey Report). As the variations correlate well with the existing clusters no further cluster delineation is needed. The seasonal data can only be regarded as a first estimation because households are hardly able to estimate the seasonal differences (especially with the new technology). Therefore, it is recommendable to carry out kitchen surveys in all seasons during monitoring to get more stable results and to distinguish between project and baseline case. Even if the adjustment factors are just first estimations, it is recommended to include them in the PDD calculation to receive conservative assumptions.

- Only 2% of the households use both wood and charcoal. No new cluster is built. In order to be conservative the mixed households are looked at as „wood households“ reducing less CO_2 than „charcoal households“.

- The reduction per stove is about the same no matter if efficient stove (Yoyo), parabol or solar box is applied.

- Even if more than 1 stove of the same type (e.g. two solar box stoves) is applied in one household, the reduction per stove is about the same..

- The reduction is smaller per stove if more than one type of stove is applied. However, the reduction is (significantly) higher in a household with more than one type of stove than in a household with one stove.

Step 1.6: Refine demarcation of clusters and populate Project Database

The original clusters as described in 1.4 were not changed as results from the kitchen survey. Only the cookers from households with different types of new stove showed a remarkably different amount of reduction per stove. In order to remain conservative, only 1 stove per household with different stove type is included in the clusters, the other ones are excluded and listed in a separate list. The project database was divided into the different clusters. A separate sheet was created for users not being part of any of the clusters meaning that no emission reductions can be claimed from their stove use (stoves distributed via BlueVentures until October 2008 and LPG users).

ADES also sold solar stoves to a partner organization called Blue Venture (http://blueventures.org), a marine conservation organization conducting volunteer community projects in Andavoaka, a fishermen settlement around 120 km north of Tuléar in Madagascar. Blue Venture distributed the solar and efficient stoves to local households in their project area as a means to offset the emissions generated by the flights of the volunteers joining their projects from all over the world. Stoves that were sold to Blue Venture in 2008 are listed in the Sales Record and labeled accordingly and are not eligible to generate carbon credits for this project. Since October 2008 Blue Venture does no more buy stoves from ADES, nor does Blue Venture distribute stoves to the local population.

2. Calculate baseline emissions

Step 2.1: Estimate expected variation and improvement in emission reductions
From the results of the kitchen surveys the expected variation of the emission reductions was calculated for each cluster. An expert statistician from the Swiss Federal Institute of Technology in Zurich was asked to define the needed sample for „Kitchen Tests“, which shall give a confidence interval for the reduced fuel use of approximately +/- 15% from the sample mean with 90% confidence (as given as example value in the methodology). As pre- and post-installation fuel use is measured in the same households (paired sampling), the sample of minimum Kitchen Tests was determined to be 40 for each cluster.

Cluster	*Expected variation (Standard deviation of fuel reduction in tonnes per year)*	*Kitchen Test Sample Size (minimum)*	*Expected lower bound of 90% confidence level (in % of mean)*
Charcoal users with a new solar box stove	0.31 t	40	87.12%
Wood users with a new solar box stove	0.82* t	40	80.48%

* The rather high standard deviation for the wood users compared to the standard deviation for the charcoal users can be explained as follows: It is much more difficult for the households to estimate the actual amount of wood used since there is no common unit as for charcoal that is purchased per kg or other pre-defined unit.

Step 2.2: Specify the Units of emission reduction or fuel consumption
As unit of emission reduction the tCO2 per stove and year is determined. The unit of emission reduction for both clusters and all stove types is tCO2e per stove-year. The unit of fuel consumption is tons of charcoal or tons of wood, respectively, per stove-year.

Step 2.3: Make quantitative measurements (Kitchen Tests)
Kitchen tests were conducted for the number okf kitchens as determined in 2.1. The following procedures were applied to conduct the kitchen tests.

- The selected kitchens for Kitchen Tests were selected randomly by the snowball sampling method.
- The kitchen tests were mainly conducted in the Tuléar and surroundings. To account for regional variation, spot check tests in Morondava and Ejeda were conducted. The variations remain within the cluster, no significant variations between the regions can be found.
- The seasonal variation will be accounted for during the monitoring (done in all seasons).

- The charcoal and wood fuel use was measured 3 days with the old and 3 days with the new methodology. This was possible as the people have no main cooking variation between different days.
- The test was done with households having bought the stove some months ago to account for the time needed to accostume to the new technology
- The households were asked to cook the same meals throughout the Kitchen Tests to make the measurements more valuable
- Alternative fuel was also measured during the kitchen tests.
- Measurements were made by weighing the amount of fuel used.
- The originally planned number of kitchen tests (40) was unchanged for the wood fuel cluster but enhanced to 57 for the charcoal cluster in order to get a better level of confidence.

Step 2.4: Calculate baseline

For calculation of the baseline emissions the approach 1 in the methodology (direct measurement of primary and secondary fuel consumption) was chosen as this reflects the measurements made in the kitchen tests.

The Baseline Emissions per applied stove are, therefore, calculated as follows (for each cluster separately);

(1)

$$BE_y = X_{nrb,bl,y} * B_{bl,y} * EF_{bl.bio,CO2} + \sum(AF_{bl,i,y} * EF_{af,CO2,i}) + \sum(\text{Non-CO2 emissions during cooking}) \rightarrow \text{equation 2} + \sum(\text{GHG emissions during production of the fuels}) \rightarrow \text{equation 3}$$

Where

BE_y = baseline emissions per applied stove in year y (in tonnes CO2e per year) specific to cluster
$X_{nrb,bl,y}$ = the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the baseline scenario
$B_{bl,y}$ = the mass of woody biomass consumed during cooking in the baseline in year y (tonnes/year).
$EF_{bl.bio,co2}$ = the CO2 emission factor for use of the biomass fuel in the baseline scenario in tonnes CO2 per tonne fuel
$AF_{bl,i,y}$ = The mass of alternative fuel i in the baseline in year y in accordance with trends projected throughout the project period, in tonnes. This mass can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels (approach 3).
$EF_{af,co2,i}$ = The CO2 emission factor for use of the alternative fuel i in the baseline in tonnes of CO2 per tonne fuel

(2)

$$\text{Non-CO2 emissions during cooking} = \sum (B_{bl,y} * EF_{bl.bio,non-co2,i}) + \sum(AF_{bl,i,y} * EF_{af,i,non-co2\ gas\ i})$$

(3)

$$\text{GHG emissions during production of the fuels} = X_{nrb} * B_{bl,y} * EF_{bio,prod,co2} + \sum(AF_{bl,i,y} * EF_{af,prod,co2,i}) + \sum(B_{bl,y} * EF_{bio,prod,non-co2\ gas\ i}) + \sum(AF_{bl,i,y} * EF_{af,i,prod,non-co2\ gas\ i})$$

Where;

$EF_{bl.bio,non-co2,i}$ = Emission factor for GHG gas i in the baseline scenario in units of tonnes gas per tonne wood-fuel
$EF_{af,i,non-co2\ gas\ i}$ = Non-CO2 Emission factor during cooking for alternative fuel i for GHG gas i in tonnes gas per tonnes fuel

EFbio,prod,co2 = CO2 Emission factor for wood-fuel during production in tonnes gas per tonnes fuel
EFaf,prod,co2,i = CO2 Emission factor for fuel i during production in tonnes gas per tonnes fuel
EFbio,prod,non-co2 gas i= Non-CO2 Emission factor for wood-fuel during production in tonnes gas per tonne fuel
EFaf,i,prod,non-co2 gas i= Non-CO2 Emission factor alternative fuel i for GHG gas i during production in tonnes gas per tonnes fuel

Using the data as set out in Annex 2 and distinguishing the clusters, the following equations evolve;

(3a)
GHG emissions during production of charcoal
= Xnrb * Bbl,y * EFbio,prod,co2 + ∑ (AFbl,i,y * EFaf,prod,co2,i) + ∑ (Bbl,y * EFbio,prod,non-co2 gas i) + ∑(AFbl,i,y * EFaf,i,prod,non-co2 gas i)
= Xnrb * Bbl,y * 3.04 + ∑(AFbl,i,y * 0) + ∑ (Bbl,y * 0.6195) + ∑(AFbl,i,y * 0)

(3b)
GHG emissions during production of wood
= Xnrb * Bbl,y * EFbio,prod,co2 + ∑(AFbl,i,y * EFaf,prod,co2,i) + ∑(Bbl,y * EFbio,prod,non-co2 gas i) + ∑(AFbl,i,y * EFaf,i,prod,non-co2 gas i)
= Xnrb * Bbl,y * 0 + ∑(AFbl,i,y * 0) + ∑(Bbl,y * 0) + ∑(AFbl,i,y * 0)

(2a)
Non-CO2 emissions during cooking with charcoal = ∑(Bbl,y * EFbl.bio,non-co2,i) + ∑(AFbl,i,y * EFaf,i,non-co2 gas i)
=∑ (Bbl,y * 0.133045 tCO2eq/t charcoal) + ∑(AFbl,i,y * 0.006433 tCO2eq/t LPG)

(2b)
Non-CO2 emissions during cooking with wood = ∑ (Bbl,y * EFbl.bio,non-co2,i) + ∑(AFbl,i,y * EFaf,i,non-co2 gas i)

(1a)
BEy (charcoal) = Xnrb,bl,y * Bbl,y * EFbl.bio,CO2 + ∑(AFbl,i,y* EFaf,CO2,i) + ∑(Non-CO2 emissions during cooking) + ∑(GHG emissions during production of the fuels)
= Xnrb,bl,y * Bbl,y * 3.304 tCO2/t charcoal + ∑(AFbl,i,y* 0.81356 tCO2/t LPG) + ∑(Non-CO2 emissions during cooking) + ∑(GHG emissions during production of the fuels)
= Xnrb,bl,y * Bbl,y * 3.304 tCO2/t charcoal + ∑(AFbl,i,y* 0.81356 tCO2/t LPG) + ∑(Bbj,y * 0.133045 tCO2eq/t charcoal) + ∑(AFbj,i,y * 0.006433 tCO2eq/t LPG) + ∑(Xnrb * Bbj,y * 3.04 tCO2eq/t charcoal + ∑ (Bbj,y * 0.6195)
= Xnrb,bj,y * Bbj,y * 6.344 tCO2/t charcoal + Bbj,y * 0.752545 tCO2eq/t charcoal + AFbj,i,y * 0.819993 tCO2eq/t LPG

(1b)
BEy (wood) = Xnrb,bl,y * Bbl,y * EFbl.bio,CO2 + ∑(AFbl,i,y* EFaf,CO2,i) + ∑(Non-CO2 emissions during cooking) + ∑(GHG emissions during production of the fuels)
= Xnrb,bl,y * Bbl,y * 1.7474 tCO2/t wood + ∑(AFbl,i,y* 0.81356 tCO2/t LPG) + ∑(Non-CO2 emissions during cooking) + ∑(GHG emissions during production of the fuels)
= Xnrb,pj,y * Bbj,y * 1.7474 tCO2/t wood + ∑(AFbj,i,y * 0.81356 tCO2/t LPG) + ∑(Bbj,y * 0.117624 tCO2eq/t wood) + ∑(AFbj,i,y * 0.006433 tCO2eq/t LPG) + 0

$= X_{nrb,pj,y} * B_{bj,y} * 1.7474\ tCO_2/t\ wood + \sum(B_{bj,y} * 0.117624\ tCO_2eq/t\ wood) + AF_{bj,i,y} * 0.819993\ tCO_2eq/t\ LPG$

$BE_{i,y} = N_{i,y} * BE_y$

$BE_{i,y}\ (charcoal) = N_{i,y} * (X_{nrb,bj,y} * B_{bj,y} * 6.344\ tCO_2/t\ charcoal + B_{bj,y} * 0.752545\ tCO_2eq/t\ charcoal + AF_{bj,i,y} * 0.819993\ tCO_2eq/t\ LPG)$

$BE_{i,y}\ (wood) = N_{i,y} * (X_{nrb,pj,y} * B_{bj,y} * 1.7474\ tCO_2/t\ wood + \sum(B_{bj,y} * 0.117624\ tCO_2eq/t\ wood) + AF_{bj,i,y} * 0.819993\ tCO_2eq/t\ LPG)$

Project emissions

The project emissions are considered to be dependent on the year of stove installation. According to first experiences by ADES[29], the project emissions for stoves sold within 2 years before the verification are the lowest while a multiplier has to be used for the project emissions of older stoves. The following multipliers for stove-age dependent project emissions are used for the PDD calculations;

Stove installation	Project emission multiplier (Age,z)
Year of verification	1
Year of verification – 1 year	1
Year of verification – 2 year	1
Year of verification – 3 year	1.1
Year of verification – 4 year	1.2
Year of verification – 5 year	1.3
Year of verification – 6 year	1.4

Source: Estimation based on experiences made by ADES from solar stoves being operational already 5-6 years.

The real aging of stove is accounted for by monitoring every two years the average fuel use per sold stove for the first year of stove installation (2008). For more information see monitoring plan.

Generally, the project emissions are calculated with Approach 1 (measurement of all fuels). Therefore, the project emissions per stove are calculated for each cluster applying the following equations;

(1)

PEy = Xnrb,pj,y * Bpj,y * EFpj.bio,CO2 + ∑(AFpj,i,y. EFaf,CO2,i)
+ ∑(Non-CO2 emissions during cooking) -> equation 2
+ ∑(GHG emissions during production of the fuels) -> equation 3

Where (noting that parameters common to baseline equations are not repeated):
Xnrb,pj,y = the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the project scenario
PEy = project emissions in year y (in tonnes CO2e per year) specific to cluster and Unit chosen
Bpj,y = the mass of woody biomass consumed during cooking in the project each year (in tonnes/year).
AFpj,i,y = The mass of alternative fuel i in the project in year y in accordance with trends projected throughout the project period, in tonnes. This mass can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels.

(2)
Non-CO2 emissions during cooking = ∑ (Bpj,y * EFpj.bio,non-co2,i) + ∑(AFpj,i,y * EFaf,i,non-co2 gas i)

(3)
GHG emissions during production of the fuels = Xnrb . Bpj,y * EFbio,prod,co2
+ ∑(AFpj,i,y * EFaf,prod,co2,i)
+ ∑ (Bpj,y * EFbio,prod,non-co2 gas i)

[29] In difference to many other stove projects the solar stove requires some experience by the users to acquire the skills for using the stove perfectly. Therefore, the slightly reduced use of the stove is counterbalanced by the improvement of usage skills. Only from 2 years after installation on the stoves are on average used a bit less every year.

+ ∑(AFpj,i,y * EFaf,i,prod,non-co2 gas i)

Using the data as set out in Annex 2 and distinguishing the clusters, the following equations evolve;

(3a)
GHG emissions during production of charcoal
= Xnrb * Bpj,y * EFbio,prod,co2 + ∑(AFpj,i,y * EFaf,prod,co2,i) + ∑ (Bpj,y * EFbio,prod,non-co2 gas i) + ∑(AFpj,i,y * EFaf,i,prod,non-co2 gas i)
= Xnrb * Bpj,y * 3.04 tCO2eq/t charcoal + ∑(AFpj,i,y * 0) + ∑ (Bpj,y * 0.6195) + ∑(AFpj,i,y * 0)
= Xnrb * Bpj,y * 3.04 tCO2eq/t charcoal + ∑ (Bpj,y * 0.6195)

(3b)
GHG emissions during production of wood
= Xnrb * Bpj,y * EFbio,prod,co2 + ∑(AFpj,i,y * EFaf,prod,co2,i) + ∑ (Bpj,y * EFbio,prod,non-co2 gas i) + ∑(AFpj,i,y * EFaf,i,prod,non-co2 gas i)
= Xnrb * Bpj,y * 0 + ∑(AFpj,i,y * 0) + ∑ (Bpj,y * 0) + ∑(AFpj,i,y * 0)
= 0

(2a)
Non-CO2 emissions during cooking with charcoal = (Bpj,y * EFpj.bio,non-co2,i) + (AFpj,i,y * EFaf,i,non-co2 gas i)
= (Bpj,y * 0.133045 tCO2eq/t charcoal) + (AFpj,i,y * 0.006433 tCO2eq/t LPG)

(2b)
Non-CO2 emissions during cooking with wood = (Bpj,y * EFpj.bio,non-co2,i) + (AFpj,i,y * EFaf,i,non-co2 gas i)

(1)
PEy = Xnrb,pj,y * Bpj,y * EFpj.bio,CO2 + ∑(AFpj,i,y * EFaf,CO2,i) + ∑(Non-CO2 emissions during cooking) + ∑(GHG emissions during production of the fuels)

(1a)
PEy (charcoal) = Xnrb,pj,y * Bpj,y * EFpj.bio,CO2 + ∑(AFpj,i,y * EFaf,CO2,i) + (Non-CO2 emissions during cooking) + (GHG emissions during production of the fuels)
= Xnrb,pj,y * Bpj,y * 3.304 tCO2/t charcoal + (AFpj,i,y * 0.81356 tCO2/t LPG) + (Non-CO2 emissions during cooking) + (GHG emissions during production of the fuels)
= Xnrb,pj,y * Bpj,y * 3.304 tCO2/t charcoal + (AFpj,i,y * 0.81356 tCO2/t LPG) + (Bpj,y * 0.133045 tCO2eq/t charcoal) + (AFpj,i,y * 0.006433 tCO2eq/t LPG) + (Xnrb * Bpj,y * 3.04 tCO2eq/t charcoal + (Bpj,y * 0.6195)
= Xnrb,pj,y * Bpj,y * 6.344 tCO2/t charcoal + Bpj,y * 0.752545 tCO2eq/t charcoal + AFpj,i,y * 0.819993 tCO2eq/t LPG

(1b)
PEy (wood) = Xnrb,pj,y * Bpj,y * EFpj.bio,CO2 + (AFpj,i,y * EFaf,CO2,i) + (Non-CO2 emissions during cooking) + ∑(GHG emissions during production of the fuels)
= Xnrb,pj,y * Bpj,y * 1.7474 tCO2/t wood + (AFpj,i,y * 0.81356 tCO2/t LPG) + (Non-CO2 emissions during cooking) + (GHG emissions during production of the fuels)

= Xnrb,pj,y * Bpj,y * 1.7474 tCO2/t wood + (AFpj,i,y * 0.81356 tCO2/t LPG) + (Bpj,y * 0.117624 tCO2eq/t wood) + (AFpj,i,y * 0.006433 tCO2eq/t LPG) + 0

= Xnrb,pj,y * Bpj,y * 1.7474 tCO2/t wood + (Bpj,y * 0.117624 tCO2eq/t wood) + AFpj,i,y * 0.819993 tCO2eq/t LPG

PEi,y = Ni,y * PEy * Age

PEy (charcoal)= Ni,y * (Xnrb,pj,y * Bpj,y * 6.344 tCO2/t charcoal + Bpj,y * 0.752545 tCO2eq/t charcoal + AFpj,i,y * 0.819993 tCO2eq/t LPG) * Age,z

PEy (wood) = Ni,y * (Xnrb,pj,y * Bpj,y * 1.7474 tCO2/t wood + (Bpj,y * 0.117624 tCO2eq/t wood) + AFpj,i,y * 0.819993 tCO2eq/t LPG) * Age.z

Leakage

The potential leakages as set out in the methodology are assessed as risks for each cluster;

Leakage form	*Risk for Charcoal Cluster*	*Risk for Wood Cluster*	*Justification*
a) rebound effect inside the project boundary	Not applicable	Not applicable	Potential rebound effects are already assessed as part of the Kitchen Test (measuring the amount of emission reduction). Fuel use for heating purposes can be excluded because of the climate zone[30]. Space heating is not known in the project area.
b) higher consumption outside the project boundary	No risk	No risk	The amount of saved biomass is really small compared to the total use of fuel wood (In 2011 years the project will save less than 2%[31] of the fuel wood used in the area, if the optimistic projections of stove sales are accurate). Furthermore, bad road conditions[32], difficult transport situation[33] and high fuel costs make it very unlikely that reduction of fuel consumption (wood and charcoal) due to the project activity will have an effect on market prices and thus result in higher consumptions. Therefore, there is no risk of higher consumption outside the project boundary. However, to be absolutely sure that

[30] See climate chart in Annex 2 or the literature, e.g. O. Rakoto-Joseph, F. Garde, M. David, L. Adelardb and Z.A. Randriamanantanya, 2009. Development of climatic zones and passive solar design in Madagascar. In: Energy Conversion and Management 50(4), pp. 1004-1010. They state that “no conventional *heating* is required except in the highlands of *Madagascar”.*

[31] Calculated assuming annual population growth equal to the UN projections for Madagascar (2.9% from 2009 to 2015) & average household size of 6.17 (taken from kitchen surveys), see “0910_assessment of leakage.xls”

[32] E.g. only 11.6% of roads were paved in Madagascar in 2009, which makes it No. 155 of 181 in the world. (source: World Development Indicators of the World Bank, as cited in nationmaster.com)

[33] In Madagascar there is only about 1 vehicle per 1000 inhabitants, one of the lowest rates worldwide see http://www.nationmaster.com/graph/tra_mot_veh-transportation-motor-vehicles

			no leakage exists fuel market prices are included in the monitoring.
c) substitution of low-emissions by high-emission stoves	No risk	No risk	This is not the case as there is no other efficient technology available than the Yoyo stove (see step 4 “common practice analysis” of the additionality assessment in section B4). The Kitchen Surveys[34] have shown that no low emission stoves such as biogas are replaced. There is also no incentive for the few LPG users to switch back to charcoal or wood as the project will not distort the fuel market prices (see b) above).”
d) Loss of space heating effect	No risk	No risk	This leakage is not occuring in the project region as the temperatures never fall below 15 degrees (see Annex 2 for Tuléar Climate chart). Also scholars agree that heating is not required in the project region[35].
e) Reuse of traditional stoves	No risk	No risk	This is not the case as is shown by the results of the kitchen surveys[36]. The traditional stoves (3 stone fireplace) stay in the households and are still used after installation of the solar stove in all households.
f) Emissions from transportation or construction of the stoves	Emissions negligible	Emissions negligible	Those emissions are much lower than the avoided emissions for transporting wood and charcoal.[37]” In order to reduce transportation costs and emissions, ADES established so far three manufacturing centers located in Tuléar, Ejeda, and Morondava.

Therefore, the only potential leakage could be a minimal impact on the market prices and therefore higher consumption outside the project boundary. This minimal leakage is assessed for both clusters;

$\sum LE_{i,y} = LE_y(\text{charcoal}) + LE_y(\text{wood})$

Emission reduction calculation

---

[34] See ADES - Solar and efficient stoves in Southwest Madagascar. Report on Kitchen Surveys Version 3.2, December 2008, p.3

[35] See climate chart in Annex 2 or the literature, e.g. O. Rakoto-Joseph, F. Garde, M. David, L. Adelardb and Z.A. Randriamanantanya, 2009. Development of climatic zones and passive solar design in Madagascar. In: Energy Conversion and Management 50(4), pp. 1004-1010. They state that “no conventional *heating* is required except in the highlands of *Madagascar”.*

[36] See ADES - Solar and efficient stoves in Southwest Madagascar. Report on Kitchen Surveys Version 3.2, December 2008, p.3

[37] It is estimated that the production and transportation causes around 0.8 kg CO2 per stove (assuming only 1 MWh of non-solar power consumed per year), while it is estimated that 2-4 kg CO2 of transport related emissions can be saved over the lifetime of a project, see “0910_assessment of leakage.xls”

The overall reductions of GHG induced by the project are calculated as follows:

ERy = ∑ BEi,y – ∑ PEi,y – ∑ LEi,y

Where:
ERy = Emission reduction in total project population in year y (tCO2e/yr)
BEi,y = Baseline emissions of cluster i in year y (tCO2e/yr)
PEi,y = Project emissions of cluster i in year y (tCO2e/yr), depending on the year of installation z
LEi,y = Leakage of cluster i in year y (tCO2e/yr)

Therefore;
ERy = ∑ BEi,y – ∑ PEi,y – ∑ LEi,y
= BEy (charcoal) + BEy (wood) - PEy (charcoal) - PEy (wood) – LEy (charcoal) - LEy (wood)
= Ni,y * (Xnrb,bj,y * Bbj,y * 6.344 tCO2/t charcoal + Bbj,y * 0.752545 tCO2eq/t charcoal
+ AFbj,i,y * 0.819993 tCO2eq/t LPG) + Ni,y * (Xnrb,pj,y * Bpj,y * 6.344 tCO2/t charcoal
- Bpj,y * 0.752545 tCO2eq/t charcoal + AFpj,i,y * 0.819993 tCO2eq/t LPG) * Age,z
- Ni,y * (Xnrb,pj,y * Bpj,y * 1.7474 tCO2/t wood + ∑(Bpj,y * 0.117624 tCO2eq/t wood) + AFpj,i,y * 0.819993 tCO2eq/t LPG) * Age,z
– ∑ LEy (charcoal)
– ∑ LEy (wood)

Where;
Ni,y = the number of Units in cluster I (100% working)
Ni,y = sold stoves,x * Usage,x,z

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered VER project activity:

Generally spoken the project reduces greenhouse gas emissions emitted during production and combustion of fuel wood and charcoal[38]. This is because the new stoves introduced emit no emissions while in use (in case of the solar stoves) or fewer emissions than the traditional technology (in case of the efficient stoves). Both kitchen surveys and tests show that really wood and charcoal is used.

The following data showing reduction of fuel use resulted from the kitchen tests (see B.2);

CHARCOAL (Morondava and Toliara)		Sample size: 57	
	*t/(year*stove)*		
Mean before	1.91		
Mean after	0.93		
Mean change	0.98		
Standard deviation change	0.35		
Upper 90%-confidence limit for the mean	1.06	108.0%	of mean

[38] Part of the CO2 emissions are not net emissions as they come from renewable biomass. Only the reduction of CO2 emitted due to use of non-renewable emissions is accounted for as emission reduction. See Annex 4 for the determination of the share of non-renewable biomass of total biomass use.

change			
Lower 90%-confidence limit for the mean change	0.90	92.0%	of mean

WOOD (Ejeda)		Sample size:	39
	*t/(year*stove)*		
Mean before	6.64		
Mean after	3.19		
Mean change	3.45		
Standard deviation change	1.30		
Upper 90%-confidence limit for the mean change	3.80	110.1%	of mean
Lower 90%-confidence limit for the mean change	3.10	89.9%	of mean

Discussion of the results

The two groups polled in Morondava and Toliara (both charcoal) gave identical values (within 10% differences) in terms of average and standard deviation of fuel reduction. Therefore, they can be treated as one single population.

The two cluster both show a distribution, which is very close to normal distribution. Therefore, the appliance of a t-test for paired samples is appropriate. The lower 90%-confidence limit is a conservative assumption for the emission reductions.

The lower 90%-confidence limit for the change is closer to the mean change as it was expected from the kitchen surveys. This can be explained as the values from the kitchen surveys have not got the same quality as the values from the kitchen tests (estimation vs. measurement).

Additionality

Apart from showing the reduction of greenhouse gas emissions, it is showed below that the project is additional to the baseline scenario. This is done by using the UNFCCC's "Tool for the demonstration and assessment of additionality". Version 5 is used.

<u>Step 0 (required by Gold Standard): Previous Announcement Check</u>

The project as described here has never been publicly announced to be implemented without carbon credits. Funding the project by carbon credits has been disccussed within ADES since 2005. In June 2007, the carbon credit buyer myclimate visited the project on-site and shortly later successful discussions and negotiations on carbon credit financing started, which concluded in an agreement.

Timeline of the project history:

Date	Decision	Source
22.05.2005	ADES discusses the possibility of financing solar and efficient stove project in Southwest Madagascar with the help of carbon credits.	Minutes of board meeting
25.05.2007	ADES meets representative of myclimate and discusses the development of a carbon offset project.	
June 2007	Representative of myclimate visits ADES project site in	

	Toliara, Southwest Madagascar.	
12.07.2007	Myclimate decides to support the project	
09.08.2007	First PIN of the project activity is presented.	PIN
22.08.2007	ADES decides to purchase stove contruction machines and orders them on 27.08.2007 (point of no return)	Minutes Purchase contract

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

The output / service that the project activity is delivering is heat for cooking purposes. The same service with comparable quality, properties and application area can be met by the following alternatives in Madagascar;

- cooking with traditional, 3-stone or low-efficiency technology (current situation)
- cooking with fossil fuels (LPG, kerosene, coal)
- cooking with electricity
- project activity (solar stoves and efficient cook stoves) without carbon credit funding

Sub-step 1b. Consistency with mandatory laws and regulations:

All four alternatives comply with all mandatory applicable legislation and regulations.

Step 2. Investment analysis

Step 2. is left out as "Step 3. Barrier Analysis" is conducted.

Step 3. Barrier analysis

Sub-step 3a. Identify barriers that would prevent the implementation of the proposed project Activity :

Investment barrier:
The procurement/production costs for all ADES stoves is very high (see table below) compared to the per capita income in Madagascar of around 17 Euros per months (The World Bank gives figures for per capita yearly income in Madagascar of 280 USD in 2006 - equaling around 204 Euros per year or 17 Euros per month[39]; The Economic Development Board of Madagascar indicates average monthly salary for non-qualified workers to be around 44 USD or 33 Euros[40]; ADES reports average monthly income for employed people to be around 50 Euros). Moreover, Madagascar is ranked 143rd out of 177 countries classified according to the Human Development Index and with more than 70% of the population living below the national poverty line. This is especially true for rural areas, where around 80% of the population live and where living conditions have been steadily declining in recent years (in terms of transport, health, education and market access)[41]. To buy the new stoves for the price of the

[39] http://devdata.worldbank.org/ict/mdg_ict.pdf

[40] http://www.edbm.gov.mg/page-living-madagascar-3-2

[41] Rural Poverty Portal: http://www.ruralpovertyportal.org/english/regions/africa/mdg/index.htm

procurement/production costs equaling 2-3 monthly salaries in the case of the solar stoves is an unaffordable investment for families in urban and rural Madagascar. Moreover, it is not only a high and additional but also a rather risky investment as local people may perceive since they buy a completely new and to them unknown stove technology. Furthermore, also basic financing mechanisms to finance the stoves are not readily available to the people in the project area.

Therefore ADES sells the solar box stoves at a subsidized and affordable price of 16 Euros to the population compared to procurement/production costs of 140 Euros. The total costs for a parabolic solar stove is at around 120 Euros and it is sold at a subsidized price of 36 Euros. The efficient stove costs ADES around 24 Euros and it is sold also at a reduced price of 12 Euros. The reduced prices are based on the experiences ADES made concerning the local population's willingness and ability to pay.

The following table shows the procurement/production price of the stoves as well as the level at which the stoves would be bought (according to a multiyear experience by ADES).

	Procurement / production costs	Affordable price for average household
Solar Box stove	140 Euros	16 Euros
Parabolic stove	120 Euros*	36 Euros
Yoyo efficient stove	24 Euros	12 Euros

* The low cost for the parabolic solar stove is given by the fact that ADES is not producing the stove parts on its own but only assembles the stoves in its workshops. The stove parts are locally produced by another organization at subsidized conditions. If not so, the production costs for this stove type would be much higher of course.

ADES is reliant on additional funds, since the financial means from fundraising is by no means sufficient to offer the stoves at reduced prices to the local population. Therefore, revenues from carbon credits are essential to conduct the project activity. All in all, ADES funds are expected to cover at best 44% of the total project budget (2008 – 2014). Revenues from carbon credits are therefore of crucial importance to fill this financial gap. From 2009 on revenues from carbon credits will start contributing to the project budget and will be able to cover at the beginning 10-30% of the yearly budget increasing to 90% towards the end of the crediting period.

Technological barrier:
There exists a technological barrier in many ways;

- Traditionally, no solar stoves and efficient stoves are produced and disseminated in Madagascar. Therefore, no local engineers and producers of solar and efficient stoves are available. The workers have to be trained on how to manufacture the solar stoves.
- Given the low production volumes, the needed economies of scale cannot be achieved, especially not for the efficient stoves.
- There is a lack of infrastructure in the region (few roads, in very bad shape), which leads to high transport costs (e.g. use of expensive 4x4 off-road cars for transporting material and bringing the stoves to the users, large transporting distances, slowness of transport)
- Some of the needed constructing material (e.g. high-quality glass and wood) and most of the manufacturing equipment (machines) is not available locally and must be brought from other regions of the country or even from other countries. Given the high transport costs in the country, this is a major hurdle.
- No facilities for repairing the stoves exist. Damaged stoves have to be returned to the centers for being repaired.
- As the technology is new the quality of the product has to be permanently checked

Barrier due to prevailing practice:

Most families are used to cook with charcoal or wood fired stoves. The introduction of solar cookers has to be accompanied with a change in the habits regarding cooking time and periods as well as cooking methods. Therefore;

- cooking demonstration and training courses are needed to show that the technology works
- the technology has to be made known by the public through newspapers, the radio and well-known persons (marketing costs).
- The use of the stoves has to be checked from time to time and users have to be advised on how to handle the technology.

Sub-step 3 b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

The three barriers do not affect the alternative scenario of current situation continuation because;

- No investment barrier: the households already own inefficient stoves and the 3-stone-technology has not any costs
- No technological barrier: traditional stoves can easily be manufactured, the know-how is traditionally available. The 3-stone method does not even need any manufacturing.
- No barrier due to prevailing practice: almost 100% of the population cooks with charcoal and fuel wood. Traditional stoves therefore do not need to be made known and to be disseminated.

All barriers also prevent the use of electricity and fossil fuels for cooking purposes because those technologies are all very expensive, unknown, not easily available and not disseminated at all. Electricity or fossil fuels for cooking is only by very rich people and tourist facilities in Madagascar, which are both not the target population of the project activity. The rising oil prices will make it even more improbable that middle-income people switch to fossil fuel even if the fuel wood and charcoal prices rise. In the table below the current prices for cooking fuels in Madagascar (in Ariary per kWh) is given;

Fuel	Fuel costs per kWh (in Ariary)
Produced wood	2.7
Bought wood	11
Charcoal	36
Fuel oil	88
Gasoil	171
Gas	189/265
Ethanol	294
Electricity	300

Source: Cyrill Zebrowski: Les Bio-Energies à Madagascar. Présentation FIM, mai 2007

As all other Alternatives face one or more barriers, the baseline of the project activity is Alternative 1 (cooking with traditional, 3-stove or low-efficiency technology (current situation))

Overview of the barriers faced by the different alternatives:

	Alternative 1: cooking with traditional, 3-stone or low-efficiency	**Alternative 2:** cooking with fossil fuels (fuel oil, gasoil, gas)	**Alternative 3:** cooking with electricity	**Alternative 4:** project activity (solar stoves and efficient cook stoves) without

	technology (current situation)			carbon credit funding
Investment barrier	n/a	X	X	X
Technological barrier	n/a	X	X	X
Barrier of prevailing practice	n/a	X	X	X

4. Common practice analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity:

All solar stoves in use in Madagascar were disseminated by ADES on a subsidized base.
Few projects tried to implement efficient stoves in Madagascar. However, all of them were sold for a subsidized price. All of the projects failed to achieve a long term market position except a World Bank project distributing the type Kenyan Jiiko around the capital Antananarivo in the highlands (central Madagascar)[42]. In the project region (Southwest Madagascar) one project is known: the NGO Andrew Lee Trust (ALT) in Fort Dauphin (South east Madagascar) had a project from 1999-2005 that was quite successful in distributing efficient stoves but is not continued[43]. However, it is assumed that most stoves are not in operation any more[44] and the artisans have ceased to produce new stoves[45].

Sub-step 4b: Discuss any similar Options that are occurring:

Sub-step 4a showed that at the moment similar activities are not occurring in the whole country (solar stoves) or only in other regions (efficient stoves).

Conclusions

The barriers explained above prevent the implementation of the project activity without carbon funds as well as the alternative scenarios. Therefore the baseline scenario is the continuation of the current situation (continued use of charcoal and fuel wood in inefficient stoves in the next 7 years).

---

[42] Email communication by Dr. Marlis Kees, GTZ Household Energy Program (HERA), GTZ Household Energy Program (HERA), 25th August 2008.

[43] The project is listed as completed under http://www.andrewleestrust.org/fuel.htm . According to the homepage, the project distributed 36,000 stoves (of which 8,000 in the region Tuléar according to Marlis Kees). The project was also supported by carbon offset provider Climate Care until 2005 but the collaboration was not continued (Email communication by Tom Morton, Climate Care, 29. September 2008).

[44] The project owner assumes a large fall off of use after two years due to poor repair skills and availability of materials close to the village (Email communication by Yvonne Orengo, Andrew Lees Trust, 14th October 2009).

[45] At the time of the final evaluation (McCue, E., 2005. Final Evaluation Projet Energie. Andrew Lees Trust, London) two of originally 6 artisans were still part-time producing stoves. However, today the existing knowledge on the stoves is only communicated on a neighbourhood-help basis if at all, which has hardly any impact on the baseline (Telephone communication with Yvonne Orengo, Andrew Lees Trust, 15th October 2009).

Gold Standard registration will give the project activity the needed funding and will help the project to overcome barriers in the way such as:
- Revenues from carbon credits allow ADES to offer the locally produced stoves at subsized prices compatible with local population's ability and willingness to pay for such a device. Without the support from carbon credits the stoves would not be marketable. However, the prices are still at the upper end of the affordable price range, thus more stoves could be sold if it would be possible to further lower the prices.
- Revenues from carbon credits allow ADES to run their local stove workshops and carefully train stove users in the proper handling of the stoves. Moreover, ADES in this way can provide warranty and free repair service over the stoves' lifetime. This is only possible when having additional funds to run the local workshops and train new staff that is able to manufacture and repair the stoves.

For the reasons mentioned above, the project activity could not be implemented without carbon funds. The project is therefore additional.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

As defined by the applied methodology three parameters have to be delinated: Project Boundary, Target Area, Fuel Collection Area.

Project Boundary: The project boundary in this case is defined as including;
- The place of the kitchens where the project stoves (solar and efficient) are applied..
- The place of fuel collection, production and transport, located in the fuel collection area.

Target Area: The target area is defined as Southwest Madagascar consisting of the 6 regions of Menabe, Atsimo-Andrefana , Androy, Anosy, Melaky and Boeny.

Fuel Collection Area: This Area is defined as well as the former Province of Tuléar, today consisting of the 3 regions of Menabe, Sud-Ouest et Androy-Anosy. This definition is done to take account to the available forestry data, which normally refers to the former provinces. In fact, this definition means that the remote regions where deforestation is lower (because the fuel is mainly collected close to the cities) are also included in the Fuel Collection Area, which leads to a conservative estimation of emission reductions.

The following emission sources are included or excluded from the project boundary;

	Source	Gas	Included?	Justification / Explanation
Baseline	Cooking, production of fuel, and transport of fuel	CO_2	Yes	Important source of emissions
		CH_4	Yes	Important source of emissions
		N_2O	Yes	Can be significant in some fuels
Project Activity	Cooking, production of fuel, and transport of fuel	CO_2	Yes	Important source of emissions
		CH_4	Yes	Important source of emissions
		N_2O	Yes	Can be significant in some fuels

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

Detailed baseline information can be found in Annex 2.

Date of completing the final draft of this baseline section:
25/11/2008

Name of person/entity determining the baseline:
Martin Stadelmann
myclimate - The Climate Protection Partnership
Listed in annex 1

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

27/08/2007 (starting event of the project activity is the purchase of wood treatment machines for stove construction)

C.1.2. Expected operational lifetime of the project activity:

20y- 0m

C.2 Choice of the crediting period and related information:

The renewable crediting period is chosen.

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

01/01/2008

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applied

C.2.2.2. Length:

SECTION D. Application of a monitoring methodology and plan

Data monitored and required for verification and issuance are to be kept for two years after the end of the crediting period or the last issuance of VERs for this project activity, whatever occurs later.

D.1. Name and reference of approved monitoring methodology applied to the project activity:

Section III of the "Gold Standard Methodology for Improved Cook-stoves and Kitchen Regimes V.01"

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The monitoring methodology is applicable as;

- A Total Sales Record, a Detailed Customer Database, and a Project Database are maintained continuously
- Periodically Kitchen Surveys and Kitchen Test are conducted to measure or estimate parameter values and review and revise the cluster lists held in the Project Database

A detailled description of these procedures can be found in Annex 3

Total Sales Record,

The following data are recorded for all sold stoves;

- Date of Sale
- Location of sale
- Mode of use: resale/onward retailing, institutional, other (assumed domestic)
- Model/type of stoves purchased
- Number of stoves purchased
- ID number of stove
- Cluster inclusion (wood or charcoal user)
- Name and telephone number:
    - Required for all bulk purchasers, ie retailers and institutional users
    - Domestic end users: as many as possible
- Address
    - Required for all bulk purchasers and institutional users

- Domestic end users: as many as possible

Detailed Customer Database

The Detailed Customer Database is filled with the results from the Kitchen Surveys (both project and monitoring) and Monitoring Kitchen Tests. The data collected for the Detailleid Costumer Database are the one included in the Kitchen Survey Questionnaire (see Annex 2).

Project Database

The Project Database contains;

- Description of the outcome of the newest Kitchen Surveys and Kitchen Tests regarding clustering and emission reduction calculation the newest available definions of clusters
- list for each cluster containing all stove users from the Total Sales Recrod belonging to this cluster
- list of all stove users not being part of any cluster

Continuous repetition of Kitchen Surveys

- Each season (6 months), at least 25 kitchens of each cluster
- The same guidelines and questions for Kitchen Surveys are followed as described in the baseline section (B). In case new issues arise they can be included in the Kitchen Surveys
- Results of the Kitchen Surveys will be included in the Detailed Customer Database and in the Monitoring Reports

Other periodic monitoring tasks

- Reassessment of the NRB fraction of wood every second year
- Measurements for potential leakage effects, every second year
- Usage survey for stoves sold in the first year to assess the drop-of rate, same sample size as KS, conducted continously, reported every second year
- Aging-Stove KT for stoves sold in the first year, same sample size as in the baseline, conducted every second year
- New-Stove-KT: in case a new stove is introduced.
- Social and economic impact assessment, every 2nd year

D.2. 1. OPTION 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1) Non-renewability of woody biomass fuel in the project in year y	Xnrb,pj,y	Study	Fraction	*c/e*	Every two years	*100%*	electronic	Reassess the non-reweability of the fuelwood used in the project area and adjust the non-renewable biomass fraction used for the calculation of emission reductions
2) Mass of woody biomass combusted in the project in year y	$B_{pj,,y}$	*Kitchen Test*	t_biomass/stove and year	*m*	Every two years	Measurements of sample of cluster population	electronic	Repetition of the Kitchen Test in order to control fuel savings with the improved stoves and adjust figures used for emission reduction calculation if needed.
3) The mass of alternative fuel i combusted in the project in year y	$AF_{pj,i,y}$	*Kitchen Test*	t_fuel/unit-year	*m*	Every two years	Measurements of sample of cluster population	electronic	In case the Kitchen Surveys reveal the use of alternative fuels.
4) Percentage of stoves of age z remaining in use in year y	Usage,z,y	*Kitchen Survey*	Fraction	*m*	Every two years	Measurements of sample of cluster population	electronic	Kitchen Survey of stoves sold in the first year In order to establish the drop-off rate in stove usage over time.
5) Adjustment to values of $B_{pj,y}$ and $AF_{pj,i,y}$ for stoves of age x	Age, z	*Kitchen Test*	Fraction	*m*	Every two years	Measurement of sample of cluster population	electronic	Aging-stove kitchen test is undertaken for sales made in the first year to measure fuel reduction performance in successive years of stoves of Age x, Age y,…
6) Adjustment to values of Bpj,,y and AFpj,i,y for new stove models	New Stove	*New-Stove-Kitchen Test*	Fraction	*m*	When new models or designs are introduced and then every two years	Measurements of sample of cluster population	electronic	A "New-Stove KT" is to measure fuel consumption of new models and designs when they are launched and will be repeated every two years.
7) Similar new	New	*Different*	Numbe		annually		electronic	ADES will report and monitor any similar new project

project activity in the project area	project activity	*sources*	r of projects					activity in the project area in order to avoid double counting.

D.2.1.2. Data to be collected in order to monitor project performance on the most sensitive sustainable development indicators:

No sustainable development indicators were found critical during Stakeholder Consultation and Sustainable Development Assessment but the following are monitored for the need to assess bi-annually the social and environmental impact of the project.

Sustainable Development Indicator	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency
SD1) Jobs created by ADES	*Economic impact*	*Annual report ADES*	#	*measured*	Every two yearsl
SD2) Schools visited by ADES	*Social impact*	*Annual report ADES*	#	*measured*	Every two yearsl
SD3) Expenses for wood and charcoal	*Social impact*	*Kitchen Survey*	*Time/financial expenses*	*measured*	Every two yearsl

D.2.1.3. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

When applying the not monitored variables as set out in part B, then within each cluster the emissions are calculated thus:

$PE_{i,y,z} = N_{i,y} * PE_y * Age_{,z}$

$PE_{i,y}$ (charcoal)= $N_{i,y} * (X_{nrb,pj,y} * B_{pj,y} * 6.344\ tCO_2/t\ charcoal + B_{pj,y} * 0.752545\ tCO_2eq/t\ charcoal + AF_{pj,i,y} * 0.819993\ tCO_2eq/t\ LPG) * Age_{,z}$

$PE_{i,y}$ (wood) = $N_{i,y} * (X_{nrb,pj,y} * B_{pj,y} * 1.7474\ tCO_2/t\ wood + \sum(B_{pj,y} * 0.117624\ tCO_2eq/t\ wood) + AF_{pj,i,y} * 0.819993\ tCO_2eq/t\ LPG) * Age_{,z}$

Where;

$N_{i,y}$ = the number of Units in cluster I (100% working)

$N_{i,y}$ = sold stoves,x * Usage,x,z

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

N.A. since a fixed baseline is chosen.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)

Within each cluster the emissions are calculated thus:
BEi,y = Ni,y * BEy
BEi,y (charcoal)= Ni,y * (Xnrb,bj,y * Bbj,y * 6.344 tCO2/t charcoal + Bbj,y * 0.752545 tCO2eq/t charcoal + AFbj,i,y * 0.819993 tCO2eq/t LPG)
BEi,y (wood) = Ni,y * (Xnrb,pj,y * Bbj,y * 1.7474 tCO2/t wood + ∑(Bbj,y * 0.117624 tCO2eq/t wood) + AFbj,i,y * 0.819993 tCO2eq/t LPG)

Where;
Ni,y = the number of Units in cluster I (100% working)
Ni,y = sold stoves,x * Usage,x,z

D. 2.2. OPTION 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

[not applied]

D.2.2.1. Data to be collected in order to monitor emission reductions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate emission reductions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

D.2.3. Treatment of leakage in the monitoring plan

As explained in B.2. there is no leakage expected from any source except increased use of wood/charcoal outside the project boundary. For making sure that the dissemination of solar and efficient stove does not have a significant impact on the local charcoal and wood fuel market, every two year a survey with market participant is conducted to look if the saved wood and charcoal may be used for another purpose.

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
8) Leakage (wood cluster)	LEy (wood)	Survey	Fraction	e	Every two yearsl	n/a	electronic/ paper	Percentage of saved wood used for another purpose is estimated Retailers on the market are asked if the supply of wood has risen in the last months or years as consequence of stove appliance
9) Leakage (charcoal cluster)	LEy (charcoal)	Survey	Fraction	e	Every two yearsl	n/a	electronic/ paper	Percentage of saved charcoal used for another purpose is estimated Retailers on the market are asked if the supply of charcoal has risen in the last months or years as consequence of stove appliance

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Lei,y = Ley (charcoal) + Ley (wood)

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Ery = ∑ Bei,y – ∑ Pei,y – ∑ Lei,y
= Bey (charcoal) + Bey (wood) – Pey (charcoal) – Pey (wood) – Ley (charcoal) – Ley (wood)
= Ni,y * (Xnrb,bj,y * Bbj,y * 6.344 tCO2/t charcoal + Bbj,y * 0.752545 tCO2eq/t charcoal
+ Afbj,i,y * 0.819993 tCO2eq/t LPG) + Ni,y * (Xnrb,pj,y * Bpj,y * 6.344 tCO2/t charcoal
- Bpj,y * 0.752545 tCO2eq/t charcoal + Afpj,i,y * 0.819993 tCO2eq/t LPG) * Age,z
- Ni,y * (Xnrb,pj,y * Bpj,y * 1.7474 tCO2/t wood + ∑(Bpj,y * 0.117624 tCO2eq/t wood) + Afpj,i,y * 0.819993 tCO2eq/t LPG) * Age,z
– Ley (charcoal) + Ley (wood)

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1) Non-renewability of woody biomass fuel in the project in year y	Low	3rd party studies are used to calculate this data
2) Mass of woody biomass combusted in the project in year y	Medium	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
3) The mass of alternative fuel i combusted in the project in year y	Medium	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
4) Percentage of stoves of age z remaining in use in year y	Medium	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
5) Adjustment to values of Bpj,i,y and Afpj,i,y for stoves of age z	Medium	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
6) Adjustment to values of Bpj,,y and Afpj,i,y for new stove models	Low	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
7) Leakage (wood cluster)	Low	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
8) Leakage (charcoal cluster)	Low	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
SD1) Jobs created	Low	The project participant records used, no uncertainty applies
SD2) Schools visited	Low	The project participant records used, no uncertainty applies

SD3) Expenses for wood and charcoal	Low	This question is part of the Kitchen Survey, where households are directly interviewed and ask for their expenses for wood and charcoal.

D.4. Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

For the monitoring of the emission reductions a detailed monitoring plan exist. Quality controls will happen both internally by the ADES monitoring manager and the ADES head in Madagascar as well as external advidese by local experts (NGOs, government, university) is sought. Additionally, myclimate and ADES Switzerland will supervise the process from Europe.

Responsibilities: New staff is employed by ADES, only responsible for monitoring and not for sales. The staff is trained at the beginning and works with a monitoring manual. If needed, the manual is updated and the staff is re-trained.

All data will be kept electronically for a period of 2 years after the end of the crediting period

D.5 Name of person/entity determining the monitoring methodology:

Name of person/entity determining the monitoring plan;
Martin Stadelmann
myclimate - The Climate Protection Partnership
Listed as project participant in annex 1

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

If the following factors are applied;

Xnrb,pj,y = 49.3% (see annex 5)
Bp (wood),y = 2.604 t (see annex 2, kitchen tests)
Bp (charcoal),y = 0.788 t (see annex 2, kitchen tests)
AFp (wood),y = 0 t (see annex 2, kitchen tests)
AFp (charcoal),y = 0 t (see annex 2, kitchen tests)

Then;

PEi,y = PEy (charcoal) - PEy (wood)
= Ni,y * (Xnrb,pj,y * Bpj,y * 6.344 tCO2/t charcoal + Bpj,y * 0.752545 tCO2eq/t charcoal + AFpj,i,y * 0.819993 tCO2eq/t LPG) * Age,z + Ni,y * (Xnrb,pj,y * Bpj,y * 1.7474 tCO2/t wood + (Bpj,y * 0.117624 tCO2eq/t wood) + AFpj,i,y * 0.819993 tCO2eq/t LPG) * Age ,z
= Ni,y * (49.3% * 0.832 t * 6.344 tCO2/t charcoal + 0.832 t * 0.752545 tCO2eq/t charcoal + 0 t LPG *0.819993 tCO2eq/t LPG) * Age,z + Ni,y * (49.3% * 2.604 t * 1.7474 tCO2/t wood + (2.604 t * 0.117624 tCO2eq/t wood) + 0 t * 0.819993 tCO2eq/t LPG) * Age,z
<u>= Ny (charcoal) * 2.55 t CO2eq * Age,z + Ny (wood) * 1.95 tCO2eq * Age,z</u>

E.2. Estimated leakage:

Leakage is estimated to be negligible (see Section B), therefore;

∑ LEi,y = LEy (charcoal) + LEy (wood)
<u>= Ny (charcoal) * 0 t CO2eq * Age,z + Ny (wood) * 0 tCO2eq * Age,z</u>
= 0

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Project activity emissions = PEy (charcoal) + PEy (wood) + LEy (charcoal) + LEy (wood)
= Ny (charcoal) * 2.55 t CO2eq * Age,z + Ny (wood) * 1.95 tCO2eq * Age,z + Ny (charcoal) * 0 * Age,z + Ny (wood) * 0 tCO2eq * Age,z
<u>= Ny (charcoal) * 2.55 t CO2eq * Age,z + Ny (wood) * 1.95 tCO2eq * Age,z</u>

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

If the following factors are applied;

Xnrb,bj,y = 49.3% (see annex 5)
Bb (wood),y = 5.426 t (see annex 2, kitchen tests)
Bb (charcoal),y = 1.621 t (see annex 2, kitchen tests)
AFb (wood),y = 0 t (see annex 2, kitchen surveys & tests)

AFb (charcoal),y = 0 t (see annex 2, kitchen surveys & tests)

∑ BEi,y = BEy (charcoal) + BEy (wood)
= Ni,y * (Xnrb,pj,y * Bbj,y * 6.344 tCO2/t charcoal + Bbj,y * 0.752545 tCO2eq/t charcoal + AFbj,i,y * 0.819993 tCO2eq/t LPG) + Ni,y * (Xnrb,pj,y * Bbj,y * 1.7474 tCO2/t wood + ∑(Bbj,y * 0.117624 tCO2eq/t wood) + AFbj,i,y * 0.819993 tCO2eq/t LPG)
= Ni,y * (49.3% * 1.621 t * 6.344 tCO2/t charcoal + 1.621 t * 0.752545 tCO2eq/t charcoal + 0 t * 0.819993 tCO2eq/t LPG) + Ni,y * (49.3% * 5.426 t * 1.7474 tCO2/t wood + 5.426 t * 0.117624 tCO2eq/t wood + 0 t * 0.819993 tCO2eq/t LPG)
= Ny (charcoal) * 5.24 t CO2eq + Ny (wood) * 4.07 tCO2eq

Where;
BEy (total) = total baseline emissions in year y (in tonnes CO2e per year) per stove
BEy (charcoal) = baseline emissions in year y (in tonnes CO2e per year) specific to cluster and Unit chosen
BEy (wood) = baseline emissions in year y (in tonnes CO2e per year) specific to cluster and Unit chosen

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

ERy = ∑ BEi,y – ∑ PEi,y – ∑ LEi,y
= ∑ BEi,y – Project Activity Emissions
= Ny (charcoal) * 5.24 t CO2eq + Ny (wood) * 4.07 tCO2eq - Ny (charcoal) * 2.55 t CO2eq * Age,z - Ny (wood) * 1.95 tCO2eq * Age,z

E.6. Table providing values obtained when applying formulae above:

Assuming the stove aging factor (Age,z) as set out in B.2. and the projected stoves in use (see section A.4.2) then the following emission values are projected;

Year	Estimation of baseline emissions (tonnes CO_2 e)	Estimation of project emissions (tonnes CO_2 e)	Estimation of leakage (tonnes CO_2 e)	Estimation of emission reductions (tonnes CO_2 e)
2008	11'020	5'344	0	5'676
2009	27'091	13'137	0	13'953
2010	50'317	24'400	0	25'917
2011	79'586	38'983	0	40'602
2012	113'938	56'561	0	57'377
2013	151'671	76'507	0	75'164
2014	193'022	99'077	0	93'945
Total	**626'645**	**314'009**	**0**	**312'634**

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

According to the Gold Standard VER Manual an Environmental Impact Assessment (EIA) is necessary if required by appropriate host country law or if required by the Gold Standard. In order to decide if an EIA must be performed the results of the Sustainable Development Assessment Matrix and the stakeholder consultation are considered.

The Gold Standard EIA prescreeen checklist (see Annex 4) did not reveal any negative or critical impacts of the project. The sustainability matrix in Section A.2 does not contain any negative scores, every sub-total and total score is positive. As well there are no crucial indicators for an overall positive impact. Furthermore, the Stakeholder Consultation outlined in Section G shows that the stakeholders are very positive about the harmlessness of the project. No significant negative impacts have been identified. Therefore, the EIA has not to be performed as a result of GS requirements.

As well, there is no EIA required by the host country. In the respective legal decree "DECRET N° 99 -954 relatif à la mise en compatibilité des investissements avec l'environnement" from the 15 December 1999 the projects with mandatory EIA are stated in Annex I. For the energy sector, only large power plants and fossil fuel facilities need an EIA. Regarding, the production site, an EIA would only be required if the production site of the solar and efficient stoves would be classified as industrial plant, which is not the case. Since, the beginnings of ADES five years ago, there were many contacts with several governmental departments. Never any government representative mentioned that a EIA is required. As well the project site is not located in any of the ecologically sensible zones mentioned in the „Arrêté interministériel n°4355 /97" where the ecologically sensible zones are listed.

Even if no EIA is required, the Gold Standard requires a description of environmental impacts, which is given here;

The project is a renewable energy & energy efficiency project, which improves the environment resulting in less deforestation and less air pollution;

- Avoidance of deforestation. Thereby, reduced erosion, reduced loss of fertile soil and conservation of the biodiversity in the region.
- Reduction of airborne emissions due to indoor combustion of wood and charcoal.
- Reduction of water pollution caused by charcoal production.
- Reduction of CO2, airborne emissions and noise through reduced transportation of wood and charcoal

No essential negative aspects for the environment generated by this project could have been found. The material and energy use for the stove production is negligible compared to the energy and wood savings generated by the stoves in operation.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

An Environmental Impact Assessment (EIA) is not needed (see F.1.) because it is neither required by the Gold Standard procedures nor by the host country (see F.1.).

SECTION G. Stakeholders' comments

G.1. Brief description how comments by local stakeholders have been invited and compiled:

Stakeholders were addressed in two phases;

1. Previous consultation activities
(prior to retroactive registration request to the Gold Standard)
2. Second round stakeholder consultation
(after feedback from the Gold Standard to the retroactive registration request)

1. Previous consultation activities

Since it beginnings in 2000 ADES has constantly been in contact with local stakeholders such as the government and NGOs. This helped to improve the technology and get a better understanding of the local Situation. From mid 2008 on, the stakeholders were consulted in a more formal way as follows;

Consultation meeting for local stakeholders
(part of the „Conference du 17 juin 2008 sur le CO_2")

Date: 17th June 2008
Place: ADES Conference room, Tuléar

Way of making the local meeting public:
The most important organizations and governmental institutions were invited per emails and letters. Additionally, leaflets on the meeting were placed at seeral locations of the city.

Independent person leading through the consultation: Mark Fenn, WWF Madagascar

Participants :

Name	Type of stakeholder	Organization / Company	Function
REJORAHARIMALALA Odette	Local government	Municipality of Tuléar	Deputy Mayor, Exponent of the community
Ranoandro Joëline	Local NGO	COS-DRV Toliara	Exponent of a woman's organization
Berthin-Poreaka	Local affected people	Exponent of the wood and charcoal business	Charcoal producer
Mark Fenn	Local representative of international NGO	WWF Madagascar	Technical assistant
Ralaimahandry Jean Bosco	Local NGO	ANGAP (Association National pour la Gestion des Aires Protégées)	General Secretary
Ramampiherika Daniel	Local university	University of Tuléar	Professor for Renewable energy
Rakotondrasoa Ananias	Local NGO	SAGE (Service d'Appui à la Gestion de l'Environnement)	Technical Coordinator
Hery Rosette	National Government	Ministry of population	Coordinator PC/EPT
Ramiandrisoa Richard	Local representative of	Regional Directorate of	Chef of service of

	national government	National Education (DREN) Antsimo Andrefana	alphabetisation
Jean Aimé Randrianandrasana	Local press	Radio le buffet Sakaraha	Reporter
Mananama	National Government	Ministry of mines	S/G Mines/DPMEM
Ismael Moussa Benali	Local university	University of Tuléar	Student
Retovo Latimer	Local press	Midi Madagascar	Reporter
Maherizo T. Geoline	Local NGO	SEESO	Chef of project "volet A"
Mananandro Julienne	Local representative of international NGO	Red cross	President of district CRM
Marcelin Jean	Local representative of governmental orgnanisation	Project FAP/RSO	
Francia	Local press	Radio of the university	Reporter
Otto Frei	Project proponent	ADES	Coordinator
Allain Chantal	Project proponent	ADES	Director of ADES Toliara
Rafelasoaritendry Jeanne Elise	Project proponent	ADES	Assistent of Coordinator of ADES

Personally invited but not participating persons:

- Chef de region (= Prime minister/president of the region of Tuléar)
- GTZ (Deutsche Gesellschaft für technische Zusammenarbeit) Tuléar

Language: Invitation for the meeting and meeting itself was conducted in French. A translation to the local language Malagasy was not made as all participants speak French.

Meeting procedure:

- Opening (5 min)
- Purpose of the consultation (5 min)
- Description of the project (15 min)
- Answering of questions (15 min)
- Answering to the checklists (15 min)
- General feedback (30 min)

Email consultation

In addition to the meeting for local stakeholders, Gold Standard supporting NGOs in Madagascar, international GS supporters as well as the Gold Standard itself were consulted through email.

NGOs consulted:

Contacts	Organisation	e-mail	Email sent	Feed-back
Meinrad Buerer	The Gold Standard	meinrad@ cdmgoldstandard.org	30/06/08	02/07/08
Voahirana Randriambola	WWF Madagascar	vrandriambola@wwf.mg	30/06/08	01/07/08
Fenosoa Andriamahenina	Tany Meva (Fondation malgache en environnement)	fenosoa.tanymeva@ wanadoo.mg	30/06/08	01/07/08
Amanda Luxande	REEEP, Regional Secretariat Southern African	amanda.luxande@ reeep.org	24/07/08	
Dorothy McIntosh	Mercy Corps UK	dmcIntosh@ uk.mercycorps.org	24/07/08	
Steve Sawyer	Greeenpeace international	Steve.Sawyer@ diala.greenpeace.org	24/07/08	

None of the consulted NGOs made any critical comments on the project.

Information to the DNA

On the 16th of January 2008 the Designated National Authority (DNA) of Madagascar (Monsieur Randriasandratana Germain, Ministére de l'Environnement, des Eaux et Forets, BP.571 Ampandrianomby, Antananarivo 101, Madagascar) was informed on the project. The DNA confirmed the receipt of the email on 19th January 2008.

Results announcement

The results of both the local meeting and the email consultation were made public from the 17th of July 2008 on the myclimate website (www.myclimate.org/index.php?lang=en&m=project&um=overview&uum=tulear).

Translation in French

The checklist for social and environmental impacts as well as a non-technical summary of the project were translated into French for purpose of the Stakeholder Consultation.

2. Second round stakeholder consultation

The second round of stakeholder consultation was initiated from the 25th of September 2008 and included;
- Making the PDD publicly available for at least 60 days on myclimate.org
- Inviting all GS supporter organizations and their local representatives to comment on the project
- Actively requesting a feedback from all stakeholders consulted in the previous periods (including several local NGOs) on the adapted version of the project.

After the 60 days have passed a stakeholder consultation report will be provided.

G.2.	Summary of the comments received:

As part of the previous consultation activities (1) the following comments were received;

All stakeholders generally support the use of solar and energy efficient stoves in the region and also approve the ADES project. In specific, all stakeholders agree on the following positive impacts of the project;
- it is as an important contribution in the fight against deforestation in the South of Madagascar.
- CO_2 emissions are reduced.
- The local population benefits by the lower need for buying charcoal and wood fuel. This can help the people to escape poverty.

The stakeholders think that ADES needs further help and funds to maintain and enlarge the activities in order to reach the final goals of poverty alleviation and the end of deforestation.

Mr. Mananama from the Ministry of Energy and Mines stated that the protection of the environnement must not be neglected and acknowledged that the ADES project contributes substantially to environmtal projection.

Several stakeholders mentioned that not only the production but also the promotion of the ADES cookers has to be expanded. Andrew, a student doing research at the University of Tuléar, asked ADES to train new people for cooking demonstration and the dissemination of the stoves. RAKOTONDRASOA Ananias, technical responsable at SAGE, thinks that the dissemination of the stoves is not over after the sale and that the stove users have to be trained in order to enhance the utilisation rate and to evaluate the products of ADES.

The national and international stakeholders did not provide any comments.

As part of the second round of stakeholder consultation (2) .the following comments were received:
During the second round four comments on the project activity were received from the contacted stakeholders.
Mr. MARCELLI, a local representative of governmental organization, points out the importance of combating global climate change und reducing CO2 emissions not only in the industrialized, but also in the developing countries. Therefore, he encourages ADES to continue the promotion of solar and efficient stoves in Madagascar as an important contribution to protect the environment. Further, Mr. MARCELLI recommends that ADES should enforce its marketing efforts for the promotion of solar stoves.
Narcisse ZAFIFAMENOSOA from SAGE (Servie d'Appui à la Gestion de l'Environnement) is convinced that the project activity will benefit the development of the region and kindly offers their support to the project if needed.
Solonarivo RAZAFIMANDIMBY, representative of a local commune, expresses its thanks to ADES for their efforts and emphasizes the importance of the project activity for the development of their commune.
Mr. MANANAMA from the Ministry of Energy and Mines supports the project activity as a contribution to the development of the region.
In general, all stakeholders support the project activity and emphasize its contribution to the development of the region. One stakeholder recommends intensifying the promotion of solar and efficient stoves in the region. No negative issues were mentioned.

G.3. Report on how due account was taken of any comments received:

Generally, the project design does not have to be amended as no negative comments were received.

Regarding the call from several stakeholders for more promotion, training and dissemination measures ADES is aware that more can be done. However, the sources of ADES are at the moment limited. However, the income from carbon credits will not only help to enlarge the activities but also to do more for promotion of the technology and the training of resellers and cooking consultants.

As reaction to the call for more evaluation measures it is to be said that the monitoring for the carbon crediting gives the project the possibility to evaluate the usage rate and the aging of the stoves.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Association pour le Développement de l'Energie Solaire Suisse - Madagascar (ADES)
Street/P.O.Box:	BP 637 - Route de Betanimena
City:	Toliara
Postfix/ZIP:	601
Country:	MADAGASCAR
Telephone:	-
FAX:	-
E-Mail:	info@adesolaire.org
URL:	www.adesolaire.org
Represented by:	
Title:	-
Salutation:	Mr
Last Name:	Frei
Middle Name:	-
First Name:	Hanspeter
Mobile:	+41 79 / 402 47 56 (Switzerland)
Direct FAX:	+41 44 / 877 62 32 (Switzerland)
Direct tel:	+41 55 / 210 99 74 (Switzerland)
Personal E-Mail:	hanspeter.frei@bluemail.ch

Organization:	Foundation myclimate – The Climate Protection Partnership.
Street/P.O.Box:	Sternenstrasse 12
City:	Zürich
Postfix/ZIP:	8002
Country:	SWITZERLAND
Telephone:	+41 44 500 43 50
FAX:	+41 44 500 43 51
E-Mail:	projects@myclimate.org
URL:	www.myclimate.org
Represented by:	
Title:	-
Salutation:	Mr
Last Name:	Tobias
Middle Name:	-
First Name:	Hoeck
Mobile:	-
Direct FAX:	(see above)
Direct tel:	+41 44 500 43 74
Personal E-Mail:	tobias.hoeck@myclimate.org

Annex 2

BASELINE INFORMATION

Data used to determine the baseline and project emissions:

Data / Parameter:	EFbl.bio,co2
Data unit:	tCO2/t_biomass
Description:	CO2 emission factor arising from use of wood-fuel in baseline scenario
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4
Value applied:	1.7472 tCO2/t wood (=112.0 tCO2/TJ * 0.0156 TJ/ t) 3.304 tCO2/t charcoal(=112.0 tCO2/TJ * 0.0295 TJ/ t)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default IPCC values for wood / wood waste are applied Default IPCC values for charcoal are applied
Any comment:	

Data / Parameter:	EFpj.bio,co2
Data unit:	tCO2/t_biomass
Description:	CO2 emission factor arising from use of wood-fuel in project scenario
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4
Value applied:	1.7473 tCO2/t wood (=112.0 tCO2/TJ * 0.0156 TJ/ t) 3.304 tCO2/t charcoal(=112.0 tCO2/TJ * 0.0295 TJ/ t)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default IPCC values for wood / wood waste are applied Default IPCC values for charcoal are applied
Any comment:	

Data / Parameter:	EFaf,co2
Data unit:	tCO2/t_fuel
Description:	CO2 emission factor arising from use of alternative fuel
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4
Value applied:	0.81356 tCO2/t LPG(=17.2 tCO2/TJ * 0.0473 TJ/ t), LPG
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default IPCC values for Liquefied Petroleum Gases are applied
Any comment:	

Data / Parameter:	EFbl.bio,non-co2
Data unit:	Data unit: tCO2/t_biomass
Description:	Description: Non-CO2 emission factor arising from use of wood-fuel in baseline scenario
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 2.5
Value applied:	0.117624 tCO2eq/t wood

	0.133045 tCO2eq/t charcoal
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default IPCC values for CH4 and N20 emissions for wood / wood waste are applied Default IPCC values for CH4 and N20 emissions for charcoal are applied The following GWP100 are applied: 21 for CH4, 310 for N20

Data / Parameter:	EFpj.bio,non-co2
Data unit:	Data unit: tCO2/t_biomass
Description:	Description: Non-CO2 emission factor arising from use of wood-fuel in project scenario
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 2.5
Value applied:	0.117624 tCO2eq/t wood 0.133045 tCO2eq/t charcoal
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default IPCC values for CH4 and N20 emissions for wood / wood waste are applied Default IPCC values for CH4 and N20 emissions for charcoal are applied The following GWP100 are applied: 21 for CH4, 310 for N20

Data / Parameter:	EFaf, non-co2
Data unit:	Data unit: tCO2/t_fuel
Description:	Description: Non-CO2 emission factor arising from use of alternative fuel
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 2.5
Value applied:	0.006433 tCO2eq/t LPG
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default IPCC values for CH4 and N20 emissions for Liquefied Petroleum Gases are applied The following GWP100 are applied: 21 for CH4, 310 for N20

Data / Parameter:	EFbio,prod,co2
Data unit:	Data unit: tCO2/t_fuel
Description:	Description: CO2 emission factor arising from production of wood-fuel
Source of data used:	Girard, P., Rousset, P, Vergnet, A., Rasamindisa, A., 1998. Comparing forestry wood species for the charcoal supply of Antananarivo city, Madagascar, Boiling Point, Issue 40, Household energy and health. (www.hedon.info/ComparingForestryWoodSpeciesForTheCharcoalSupplyOfAntananarivoCityMadagascar) -> Mean of mentioned emission factors
Value applied:	3.04 tCO2eq/t charcoal 0 tCO2eq/t wood
Justification of the choice of data or description of measurement methods and procedures actually applied :	There are no IPCC default values available. Therefore, country-specific values are applied
Any comment:	

Data / Parameter:	EFaf,prod,co2

Data unit:	Data unit: tCO2/t_fuel
Description:	Description: Non-CO2 emission factor arising from production of alternative fuel
Source of data used:	-
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Conservative estimation
Any comment:	

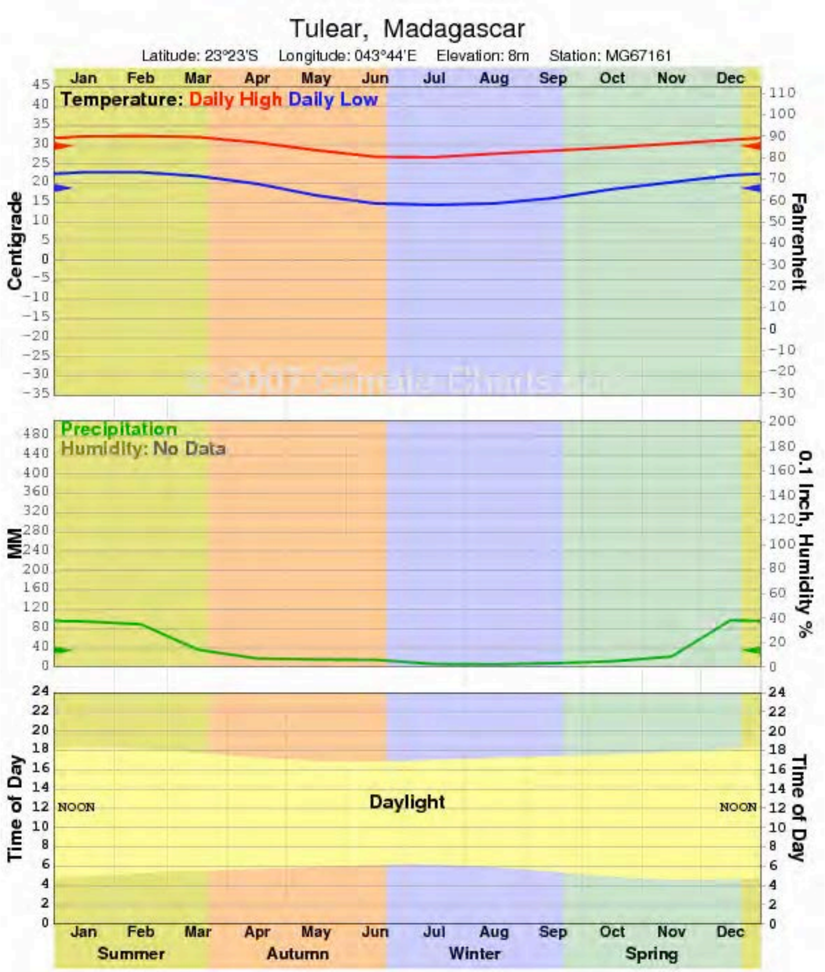
Data / Parameter:	EFbio,prod,non-co2
Data unit:	Data unit: tCO2/t_biomass
Description:	Description: Non-CO2 emission factor arising from production of wood-fuel
Source of data used:	Calculation with factor from “Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-14 on Page 1.46of the Reference Manual)”
Value applied:	0.6195 tCO2eq/t charcoal 0 tCO2eq/t wood
Justification of the choice of data or description of measurement methods and procedures actually applied :	- only methane emissions during charcoal production are reflected (no N_20) - wood is not produced but collected
Any comment:	

Data / Parameter:	EFaf,prod,non-co2
Data unit:	Data unit: tCO2/t_fuel
Description:	Description: Non-CO2 emission factor arising from production of alternative fuel
Source of data used:	-
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Conservatively left out
Any comment:	

		UNIT	Charcoal BE	Charcoal PE	Charcoal LE	Charcoal ER	Wood BE	Wood PE	Wood LE	Wood ER
	Total Emissions per stove (lower bound confidence interval) + seasonal/weekend variation	t CO2e	5.245	2.551	0.000	2.694	4.075	1.956	0.000	2.119
	Total Emissions per stove	t CO2e	6.179	3.005	0.000	3.173	4.988	2.394	0.000	2.594
	CO2 emissions during cooking	t CO2e	2.640	1.284	0.000	1.356	4.673	2.243	0.000	2.430
	Non-CO2 emissions during cooking	t CO2e	0.106	0.052	0.000	0.055	0.315	0.151	0.000	0.164
	emissions during production of the fuels	t CO2e	3.433	1.670	0.000	1.763	0.000	0.000	0.000	0.000
Xnrb	NRB		49.3%	49.3%	49.3%	49.3%	49.3%	49.3%	49.3%	49.3%
By	Biomass combusted (adapted to lower bound of confidence interval & seasonal/weekly variations)	t biomass	1.621	0.788	0.832	0.832	5.426	2.604	2.821	2.821
	Biomass combusted (measured values from kitchen tests)	t biomass	1.909	0.929	0.980	0.980	6.642	3.188	3.453	3.453
AFy	Alternative Fuel comb.	t LPG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LEy	Leakage				0%				0%	
LCI	Lower Bound of 90% Confidence Interval		92.0%	92.0%	92.0%	92.0%	89.9%	89.9%	89.9%	89.9%
	Adaptation for seasonal / weekend variation		92.3%	92.3%	92.3%	92.3%	90.9%	90.9%	90.9%	90.9%
EF.bio,co2	CO2 emission factor arising from use of biomass	tCO2/t_biomass	3.304	3.304	3.304	3.304	1.747	1.747	1.747	1.747
EFaf,co2	CO2 emission factor arising from use of alternative fuel	tCO2/t_fuel	0.814	0.814	0.814	0.814	0.814	0.814	0.814	0.814
EFbio,non-co2	Non-CO2 emission factor arising from use of biomass	tCO2/t_biomass	0.133	0.133	0.133	0.133	0.118	0.118	0.118	0.118
EFaf, non-co2	Non-CO2 emission factor arising from use of alternative fuel	tCO2/t_fuel	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
EFbio,prod,co2	CO2 emission factor arising from production of wood-fuel	tCO2/t_biomass	3.040	3.040	3.040	3.040	0.000	0.000	0.000	0.000
EFaf,prod,co2	CO2 emission factor arising from production of alternative fuel	tCO2/t_fuel	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EFbio,prod,non-co2	Non-CO2 emission factor arising from production of wood-fuel	tCO2/t_biomass	0.620	0.620	0.620	0.620	0.000	0.000	0.000	0.000
EFaf,prod,non-co2	Non-CO2 emission factor arising from production of alternative fuel	tCO2/t_fuel	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Non-CO2 emission factor arising from use and production of wood-fuel	tCO2/t_biomass	0.753	0.753	0.753	0.753	0.118	0.118	0.118	0.118

Other baseline information:

Climate Chart for Tuléar



Source: http://www.climate-charts.com/Locations/m/MG67161.php, acceded on 05/07/07

Questionnaire for Kitchen Survey and Kitchen Tests

Date of the survey	Day:___ Month:____ Year:_______
Name of the user	
Location of the user's home	Village/Quartier: Region/City:
Number of people in the household	
Numbers of stove bought	___ Solar Box ___ Parabol ___ Efficient Cooker (Yoyo)
Date of stove purchase	Day: Month: Year:
Identification number of the stove	#
Condition of the stove	▢ good / ▢ average / ▢ bad / ▢ very bad
Usage of the stove	▢ stove is in use ▢ stove is no more in use
Application of the stove	▢ domestic: at home for preparing meals ▢ restaurant / ▢ school / ▢ community
Kind & amount of fuel used **before** installation of the stove	___ kg fuel wood per month ___ kg charcoal per month ___ kg of LPG per month ___ kg of ________ (other fuel type) per month
Kind & amount of fuel used **after** installation of the stove	___ kg fuel wood per month ___ kg charcoal per month ___ kg of LPG per month ___ kg of ________ (other fuel type) per month
Money or time spent for the procurement of wood and charcoal	___ hours per month for collecting fuel wood ___ Ariary per month for buying charcoal and/or fuel wood
Price for charcoal	___ Ariary per bag (50 Kg) ___Ariary per Arielle (local purchase unit)
Variation in fuel use?	Dry season (March – Nov.): 100% Rainy season (Dec. – Feb.): ______% Monday to Friday: 100% Weekend (Saturday and Sunday): ______%
Improvement of the livelihood	▢ equal / ▢ minor / ▢ average / ▢ large
What has happened to the old stove?	▢ Sold or given away to other people ▢ At home: ▢ in use / ▢ not in use ▢ there was only a 3-stove-technology before

Annex 3

MONITORING PLAN

The monitoring plan is available in a separate document called "0910_ADES_monitoring_plan.doc".

Annex 4

ENVIRONMENTAL ASESSMENT

EIA Pre-screen

1. Will there be a large change in environmental conditions?

No, the project is to small to have a large impact. However, the deforestation and the air pollution can be reduced

2. Will new features be out-of-scale with the existing environment?

No, the stoves can hardly be seen. The production facility is done in a existing building.

3. Will the effect be unusual in the area or particularly complex?

n/a

4. Will the effect extend over a large area?

n/a

5. Will there be any potential for transfrontier impact?

No, Madagascar is an island.

6. Will many people be affected?

Several thousands households benefit from affordable, ecologically sound cooking technology

7. Will many receptors of other types (fauna and flora, businesses, facilities) be affected?

No

8. Will valuable or scarce features or resources be affected?

No

9. Is there a risk that environmental standards will be breached?

No

10. Is there a risk that protected sites, areas, features will be affected?

No

11. Is there a high probability of the effect occurring?

n/a

12. Will the effect continue for a long time?

n/a

13. Will the effect be permanent rather than temporary?

n/a

14. Will the impact be continuous rather than intermittent?

n/a

15. If it is intermittent will it be frequent rather than rare?

n/a

16. Will the impact be irreversible?

n/a

17. Will it be difficult to avoid, or reduce or repair or compensate for the effect?

n/a

Annex 5

ANALYSIS OF THE FRACTION OF NON-RENWEABLE WOODY BIOMASS

BASICS
From methodology

NRB = H – MAI

Xnrb = (NRB/H) = (H-MAI)/H

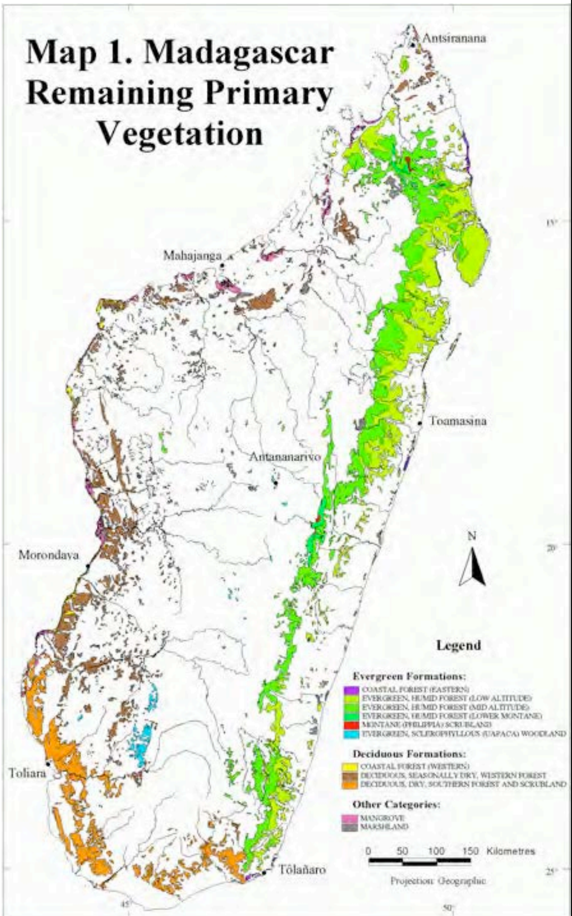
NRB = non-renewing biomass [**ha**, m3 or tonnes]
H = annual harvest [**m3**, tonnes or ha] in fuel collection area A [ha]
MAI = sum of mean annual increment [m3, regrowth in area A]

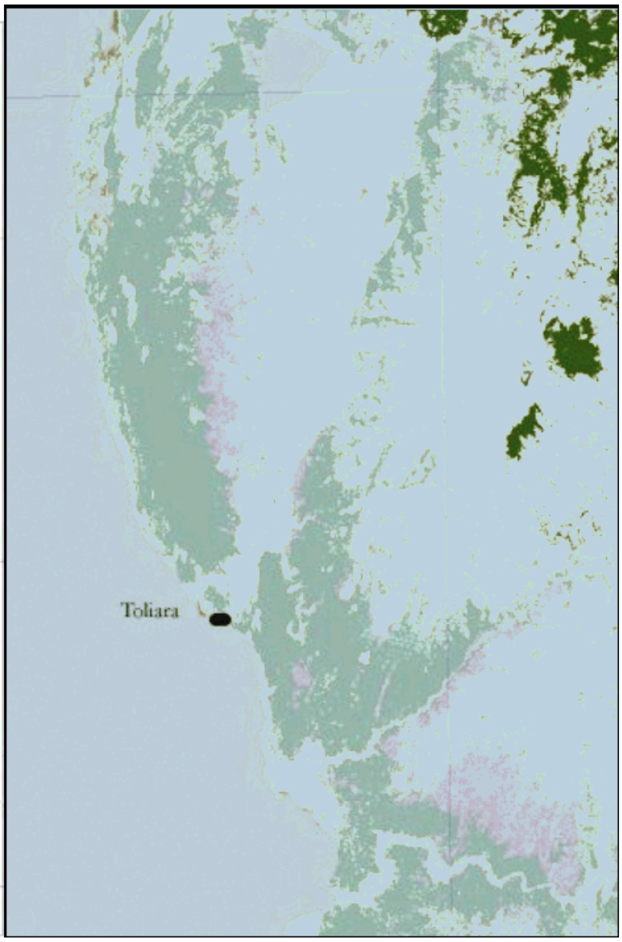
Provinces and regions, geography

Madagascar is divided into six autonomous provinces (*faritany mizakatena*), and 22 regions. The regions will be the highest subdivision level when the provinces are dissolved by 2009.

Toliara (also **Toliary** or **Tuléar**) is a province of Madagascar (number 6 in the map above) with an area of 161,405 km². It has a population of 2,229,550 (July, 2001). Its capital is Toliara. Near Toliara is the "spiny forest".

Madagascar: July 2007 estimate 19,448,815 - 1993 census 12,238,914





http://www.kew.org/gis/projects/madagascar/download.html

Figure 1: Deforestation between 1990 and 2000 (forest areas are depicted in green and deforested areas in red)
Source: Conservation International, 2003

AVAILABLE DATA
Wood density

1. Quantitative Non-Renewable-Biomass Assessment

Forest types and their volumes

Forest type	*Area (ha)*	*Volume m³/ha*	*Volume m³*
Dense humide indeciduous forests of low altitudes of the East and of Sambirano	2 574 450	310	798 079 500
Dense humide indeciduous forests of middle altitudes and of the central mountain areas	3 146 550	270	849 568 500
Dense arid deciduous forests of the West	3 987 000	80	318 960 000
Dense arid deciduous forests and Xerophiles of the South	2 447 000	29	70 963 000
TOTAL	12 155 000	-	2 037 571 000

Source: Direction des Eaux et Forêts 1996 (Direction des Eaux et Forêts, Ministère de l'Environnement. 1996. Plan d'Actions Environnementales, Inventaire Ecologique Forestier National, Programme Environnemental - Phase 1. Problématique, objectifs, méthodes, résultats, analyses et recommendations)

Forest Area A

Madagascar	1990	2000	2005
Forest	13,692	13,023	12,838
Other wooded land	21,148	18,453	17,054
Forest and other wooded land	34,840	31,476	29,892

FRA 2005 categories Area (1000 hectares)
Source : FAO, Global Forest Resources Assessment 2005 [http://www.fao.org/forestry/fra2005/en/ , 24/09/2007]

Dense arid deciduous forests of the West	30%	3 987 000ha
Dense arid deciduous forests of the South	8%	1 003 000ha
Xerophile forest of the South	11%	1 444 000ha

Source: Direction des Eaux et Forêts 1996 (Direction des Eaux et Forêts, Ministère de l'Environnement. 1996. Plan d'Actions Environnementales, Inventaire Ecologique Forestier National, Programme Environnemental - Phase 1. Problématique, objectifs, méthodes, résultats, analyses et recommendations)

Importance of forest resources in Madagascar in 1996

National categories	Antananarivo	Antisiranana	Fianarantsoa	Mahajanga	Toamasina	**Toliara**	TOTAL (ha)
Dense humide indeciduous forests	111,000	1,225,000	1,086,000	629,000	2,411,000	**259,000**	5,721,000
Dense sclerophyll forests of middle altitudes	17,000	0	127,000	0	0	**116,0000**	260,000
Forests and sclerophyll spinney of mountain areas	7,000	48,000	1,000	25,000	0	**0**	81,000
Dense arid deciduous forests of the West	3,000	97,000	11,000	2,232,000	3,000	**1,640,000**	3,986,000
Dense arid deciduous	0	0	0	0	0	**1,003,000**	1,003,000

forests of the South							
Xerophile forest of the South	0	0	0	0	0	**1,444,000**	1,444,000
Mangrove	0	57,000	0	207,000	0	**63,000**	327,000
Riverine and/or alluvial forest vegetation	3,000	0	1,000	46,000	0	**72,000**	122,000
Artificial tree population	114,000	28,000	51,000	5,000	114,000	**4,000**	316,000
TOTAL	255,000	1,455,000	1,277,000	3,144,000	2,528,000	**4,601,000**	13,260,000

Source: Direction des Eaux et Forêts 1996 (Direction des Eaux et Forêts, Ministère de l'Environnement. 1996. Plan d'Actions Environnementales, Inventaire Ecologique Forestier National, Programme Environnemental - Phase 1. Problématique, objectifs, méthodes, résultats, analyses et recommendations) available at: http://www.wildmadagascar.org/overview/forest_classification.html [15.10.2008]

Forest Type	Forest Area [ha] in province of Toliara (Direction des Eaux et Forèts, 1996)	%	Forest density [m3/ha] (Direction des Eaux et Forèts, 1996)
Southwest of Madagascar			29-310 m3/ha
Dense arid deciduous forests of the West	1'640'000	**35.6%**	80
Dense arid deciduous forests of the South	1'003'000	**21.8%**	29
Xerophile forest of the South	1'444'000	**31.4%**	29
Other	514'000	**11.2%**	55
Average (weighted with Forest Area)			**50.068**

Region	1990 [ha]	2000 [ha]	2005 [ha]	2008 (extrapol.) [ha]	Loss per year [ha] (=NRB) 2000-2005
Menabe	958788	906159	874915	856169	6249
Atsimo-Andrefana	2034131	1790209	1702795	1650347	17483
Androy	500119	469015	453561	444289	3091
Anosy	534499	509361	476987	457563	6475
TOTAL Province Toliara	4027537	3674744	3508258	**3408366**	**33297**

Source: MEEFT, Ministère de l'Environement des Forêts et du Tourisme [http://www.meeft.gov.mg/index.php?option=com_content&task=view&id=9&Itemid=10, 24/09/2008]

MAI

Forest Types	Area (Source: Direction des Eaux et Forèts, 1996)	MAI [m3/ha/an] (Source: PARTAGE 2008)*
Dense arid deciduous forests of the West	35.6%	1
Dense arid deciduous forests of the South	21.8%	1
Xerophile forest of the South	31.4%	0.2
Other	11.2%	1
TOTAL Average for Province of Toliara	100%	**0.7488 (calculated)**

*PARTAGE [Participation a la Gestion de l'Environnement]. 2008. La Stratégie de l'ABETOL. Rapport d'Elaboration. PARTAGE, Avril 2008. Annex 1, page 16.

Data summary

	Forest Area [ha]	Forest density [m3/ha]	H [m3/y]	MAI [m3/ha/y]	NRB [m3/y] [ha/y]
Region Touliara	3,408,366ha 2008 of which 67% is reachable for the people* -> **2'296'112** ha 2008	**50.068 m3/ha**[10] avg Toliara	Calculated (see below)	**0.7488 m3/ha** avg Toliara	**33,297ha/y**2000-2005

* The methodology requests to consider the reachable fuel wood collection area. The reachable / accessible area was assessed as follows; From the total woody area, areas with slopes of more than 30%, national parks & areas with less than 2 persons per square kilometre were deducted (see calculation below). It was assumed that for forests the same percentage of area has steep slopes and a low population density than on average in the region. This is a very conservative assumption as slopy parts are more likely to be still forested and population density will probably be much lower in forests than in non-forests.

	ha	% of area	Source
total woody area in project area	3'408'366	100%	
Area with slopes >45% (1%)	34'084	1%	http://www.fao.org/countryprofiles/Maps/MDG/08/sl/index.html
Area with slopes 30-45% (7%)	238'586	7%	http://www.fao.org/countryprofiles/Maps/MDG/08/sl/index.html
National parks	498'748	15%	http://www.parcs-madagascar.com/madagascar-national-parks.php?Navigation=25
Area with <2 pers per sqm	340'837	10%	http://www.fao.org/countryprofiles/Maps/MDG/10/pt/index.html
Reachable area	2'296'112	67%	

The calculation of an accessible / reachable forest area of 67% is high when compared to figures from other countries in the literature. According to government data, reachable forest areas in Nepal vary from 38% to 78% (FAO 1999). And a recent study from Papua New Guinea has concluded that only 34.3% of the forestry estate in 2002 is accessible for logging (Sherman et al. 2008).

Sources;

FAO, 1999. FRA 2000. Forest resources of Nepal. country report. Food and Agriculture Organization, Rome. Table 10. Forest and shrub area by Development regions. http://www.fao.org/docrep/007/ae154e/AE154E09.htm#P1010_112014 , accessed 20th May 2009.

FAO, 2009. Madagascar – Maps. Population & Slope. http://www.fao.org/countryprofiles/maps.asp?iso3=MDG&lang=en, accessed 26th May 2009.

Sherman et al. 2008. State of the Forests of Papua New Guinea. Remote Sensing Centre, University of Papua New Guinea. http://gis.mortonblacketer.com.au/upngis/Downloads/State%20of%20Forests%20of%20PNG.pdf

CALCULATION

Southwest Madagascar (former province of Tuléar)

NRB Tuléar: **33,297**ha/y * 50.07m3/ha = **1.67 mio m3/y**
MAI Tuléar: 0.75m3/ha * **2'296'112**ha = **1.72 mio m3/y**
H Tuléar: = NRB + MAI = **3.39 mio m3/y**
Share of non-renewable biomass = NRB / H = **49.26%**

2. Qualitative Non-Renewable-Biomass Assessment

Local expert estimate the share of non-renewable biomass to be much higher than calculated in the quantitative assessment. Otfried Ischebeck, energy advisor for the government, assumes nearly 100% of all wood collected from primary forests as non-renewable and mentions Tuléar as one of the regions were more than 85% of the fuel wood is illegally collected from primary forests as opposite to plantations (Source: Personal communication between ADES and Otfried Ischebeck in August 2008. Also see: Ischebeck, Otfried, 2008. Energie à Madagascar et la cooperation germano-malgache au secteur de l'énergie. Rapport préparé pour les consultations gouvernmentales germano-malgaches). Further, Dr. Daniel Kotonirina RAMAMPIHERIKA from the University of Tuléar points out the inefficient use of wood fuel and the corresponding problem of deforestation and its associated negative impact in the region. He also states based on research conducted in the region that biomass resources are largely overused and concludes that 100% of biomass is used unsustainably in Southwest Madagascar (several personal communications between ADES and Dr. RAMAMPIHERIKA throughout 2008 and see Dokument "Dr_RAMAMPIHERIKA_University_Tulear_2008.doc").

3. Discussion of Results

The large difference between the quantitative and the qualitative results on non-renewable-biomass is not really surprising. National statistics usually do not reflect aspects such as fuel wood harvest by individual households. Moreover, fuel wood is to a large extent collected illegally (85%) with the result that statistics are unable to track this share of consumption. Local expert knowledge therefore does better reflect the actual situation considering such aspects resorting on many years of profound experiences in the region. However, in order to ensure a very conservative assessment of non-renewable biomass fraction, the result of the quantitative approach is considered resulting in a **value of 49.3%** for the share of non-renewable-biomass.

4. Sensitivity Analysis

In the sensitivity analysis we test the impact of the variation of the main parameters like the NRB and the MAI, on the final NRB fraction result.

Variation of NRB

CALCULATION II

In Calculation II there is a variation of the NRB value due to the inclusion of a longer time period for annual deforestation rates. The calculation of the NRB is based on the data from 1990 until 2005 from the MEEFT report.

Southwest Madagascar (former province of Tuléar)
(With average loss per year 1990-2005 according to MEEFT)

NRB Tuléar: **34,619**ha/y * 50.07m3/ha = **1.73 mio m3/y**
MAI Tuléar: 0.75m3/ha * **2'296'112**ha = **1.72 mio m3/y**
H Tuléar: = NRB + MAI = **3.45 mio m3/y**
Share of non-renewable biomass = NRB / H = **50.88%**

Table II

Region	1990 [ha]	2000 [ha]	2005 [ha]	2008 (extrapol.) [ha]	Loss per year [ha] (=NRB) 1990-2005
Menabe	958788	906159	874915	856169	5592
Atsimo-Andrefana	2034131	1790209	1702795	1650347	22089
Androy	500119	469015	453561	444289	3104
Anosy	534499	509361	476987	457563	3834
TOTAL Province Toliara	4027537	3674744	3508258	3408366	**34619**

Data Source: MEEFT, Ministère de l'Environement des Forêts et du Tourisme
[http://www.meeft.gov.mg/index.php?option=com_content&task=view&id=9&Itemid=10, 24/09/2008]

CALCULATION III

In calculation III there is a variation of the NRB value due to the use of a different data source. The used data source is the article: Determination of Deforestation Rates of the World's Humid Tropical Forest." published in Science in 2002. The mentioned article identifies the annual deforestation rate in Madagaskar between 1,4 – 4,7%. In this calculation we use the minimum of 1,4% deforestation rate to see its impact on the finale NRB fraction result.

Southwest Madagascar (former province of Tuléar)

(With average loss per year =1,4% 2005-2008 according to Archard)

NRB Tuléar: **49,115** ha/y * 50.07m3/ha = **2.46 mio m3/y**
MAI Tuléar: 0.75m3/ha * **2'296'112**ha = **1.72 mio m3/y**
H Tuléar: = NRB + MAI = **4.18 mio m3/y**
Share of non-renewable biomass = NRB / H = **58.85%**

Table III

Region	**2005 [ha]**	**2008** (extrapol. with annual deforestation rate = 1.4) **[ha]**	**Loss per year [ha] (=NRB) 2005-2008**
TOTAL Province Toliara	3508258	**3360913**	**49115**

Data Source: Archard et all (2002): Determination of Deforestation Rates of the World's Humid Tropical Forest. Tropical Forests. Science Vol 297 9. http://web.mit.edu/12.000/www/m2006/kvh/deforest%20rates.pdf.

CALCULATION IV

In calculation IV there is a variation of the NRB due to the use of the maximum deforestation rate for Madagaskar of 4,7% as mentioned in the article: Determination of Deforestation Rates of the World's Humid Tropical Forest.", Science 2002.

Southwest Madagascar (former province of Tuléar)

(With average loss per year =4,7% 2005-2008 according to Archard)

NRB Tuléar: **168,888** ha/y * 50.07m3/ha = **8.25 mio m3/y**
MAI Tuléar: 0.75m3/ha * **2'296'112**ha = **1.72 mio m3/y**
H Tuléar: = NRB + MAI = **9.97 mio m3/y**
Share of non-renewable biomass = NRB / H = **82.74%**

Table IV

Region	**2005 [ha]**	**2008** (extrapol. with annual deforestation rate = 4.7) **[ha]**	**Loss per year [ha] (=NRB) 2005-2008**
TOTAL Province Toliara	3508258	**3113594**	**164888**

Data Source: Archard et all (2002): Determination of Deforestation Rates of the World's Humid Tropical Forest. Tropical Forests. Science Vol 297 9. http://web.mit.edu/12.000/www/m2006/kvh/deforest%20rates.pdf.

Variation of MAI

In Table VII there is a variation in the calculation of the Mean Annual Increments of wood species in area A due to variation of the allocation to the annual productivity rate classes as given by PARTAGE 2008 (see Table VI). The in Calculation I chosen MAI = 0.75 is considerably the highest average productivity rate value and therefore the most conservative one.

Table VI

Formations	Productivité m3/ha/an
Forêts denses sèches, série à Dalbergia, Commiphora, Hildegardia	1,25
Forêts denses sèches, série à Didieracea	0,82
Forêts sèches, série à Didieracea, dégradée et/ou secondaire	0,80
Forêts ripicoles	1,27
Savanes ou pseudo-steppes avec éléments ligneux	0,2

ABETOL 2007

Source : PARTAGE [Participation a la Gestion de l'Environnement]. 2008. La Stratégie de l'ABETOL. Rapport d'Elaboration. PARTAGE, Avril 2008. Annex 1, page 16.

Table VII

Forest Types	**Area** (Source: Direction des Eaux et Forèts, 1996)	**MAI [m3/ha/an]** (PARTAGE 2008)*	**MAI [m3/ha/an]** (PARTAGE 2008)*	**MAI [m3/ha/an]** (PARTAGE 2008)*
Dense arid deciduous forests of the West	35.6%	0.87 (average)	0.82	1
Dense arid deciduous forests of the South	21.8%	0.87 (average)	0.82	1
Xerophile forest of the South	31.4%	0.2	0.2	0.2
Other	11.2%	0.87(average)	1.27	1
TOTAL Average for Province of Toliara	100%	**0.6596 (calculated)**	**0.68662 (calculated)**	**0.7488 (calculated)**

Data Source : PARTAGE [Participation a la Gestion de l'Environnement]. 2008. La Stratégie de l'ABETOL. Rapport d'Elaboration. PARTAGE, Avril 2008. Annex 1, page 16.

Overview

CALCULATION V

Southwest Madagascar (former province of Tuléar)

(NRB = 3329ha/y, MAI = 0.66)

NRB Tuléar: **33,297**ha/y * 50.07m3/ha = **1.67 mio m3/y**
MAI Tuléar: 0.66 m3/ha * **2'296'112**ha = **1.52 mio m3/y**
H Tuléar: = NRB + MAI = **3.19 mio m3/y**
Share of non-renewable biomass = NRB / H = **52.35%**

CALCULATION VI

Southwest Madagascar (former province of Tuléar)

(NRB = 3329ha/y, MAI = 0.69)

NRB Tuléar: **33,297**ha/y * 50.07m3/ha = **1.67 mio m3/y**
MAI Tuléar: 0.69 m3/ha * **2'296'112**ha = **1.58 mio m3/y**
H Tuléar: = NRB + MAI = **3.25 mio m3/y**
Share of non-renewable biomass = NRB / H = **51.38%**

CALCULATION VII
Southwest Madagascar (former province of Tuléar)
(NRB = 34619 7ha/y, MAI = 0.66)

NRB Tuléar: **34619** ha/y * 50.07m3/ha = **1.73 mio m3/y**
MAI Tuléar: 0.66m3/ha * **2'296'112**ha = **1.52 mio m3/y**
H Tuléar: = NRB + MAI = **3.25 mio m3/y**
Share of non-renewable biomass = NRB / H = **53.23%**

CALCULATION VIII
Southwest Madagascar (former province of Tuléar)
(NRB = 34619 7ha/y, MAI = 0.69)

NRB Tuléar: **34619** ha/y * 50.07m3/ha = **1.73 mio m3/y**
MAI Tuléar: 0.69m3/ha * **2'296'112**ha = **1.58 mio m3/y**
H Tuléar: = NRB + MAI = **3.31 mio m3/y**
Share of non-renewable biomass = NRB / H = **52.27%**

CALCULATION IX
Southwest Madagascar (former province of Tuléar)
(NRB = 49115 7ha/y, MAI = 0.66)

NRB Tuléar: **49115** ha/y * 50.07m3/ha = **2.46 mio m3/y**
MAI Tuléar: 0.66m3/ha * **2'296'112**ha = **1.52 mio m3/y**
H Tuléar: = NRB + MAI = **3.98 mio m3/y**
Share of non-renewable biomass = NRB / H = **61.80%**

CALCULATION X
Southwest Madagascar (former province of Tuléar)
(NRB = 49115 7ha/y, MAI = 0.69)

NRB Tuléar: **49115** ha/y * 50.07m3/ha = **2.46 mio m3/y**
MAI Tuléar: 0.69m3/ha * **2'296'112**ha = **1.58 mio m3/y**
H Tuléar: = NRB + MAI = **4.04 mio m3/y**
Share of non-renewable biomass = NRB / H = **60.89%**

CALCULATION XI
Southwest Madagascar (former province of Tuléar)
(NRB = 164888 7ha/y, MAI = 0.66)

NRB Tuléar: **164888** ha/y * 50.07m3/ha = **8.26 mio m3/y**
MAI Tuléar: 0.66m3/ha * **2'296'112**ha = **1.52 mio m3/y**

H Tuléar: = NRB + MAI = **9.78 mio m3/y**
Share of non-renewable biomass = NRB / H = **84.45%**

CALCULATION XII
<u>Southwest Madagascar (former province of Tuléar)</u>
(NRB = 164888 7ha/y, MAI = 0.69)

NRB Tuléar: **164888** ha/y * 50.07m3/ha = **8.26 mio m3/y**
MAI Tuléar: 0.69m3/ha * **2'296'112**ha = **1.58 mio m3/y**
H Tuléar: = NRB + MAI = **9.84 mio m3/y**
Share of non-renewable biomass = NRB / H = **83.94%**

Overview Table: Variation of Parameters

Table V: Overview Sensitivity Analysis

Xnrb = (NRB/H)	MAI = 0.6596 [m3/ha/y]	MAI = 0.68662 [m3/ha/y]	MAI = 0.7488 [m3/ha/y]
NRB = 33297	52.35%	51.38%	**49.26%**
NRB = 34619	53.23%	52.27%	50.88%
NRB = 49115	61.80%	60.89%	58.85%
NRB = 164888	84.45%	83.94%	82.74%

Discussion of Results of the Sensitivity Analysis:
In the overview Table V it is clearly shown that the chosen NRB fraction of 49.26% is the most conservative value of all scenarios. The variation of the parameters due to the use of different data sources or different classification results in a change of the NRB fraction, although it can be said, that the NRB fraction is relatively stable around the assumed 50%. A really big impact on the result has the scenario of the assumed deforestation rate of 4,7% as described in the article published in Science. In the most extreme case, the NRB fraction could reach the value of 84.45%, which is almost double of our chosen NRB fraction.