Verification Document for Eritrea Dissemination of Improved Stoves Program (EDISP) for Gash-Barka Region And Year 2005/6 Project Implementation

Final draft, March 24, 2007

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1. Introduction

In this report we provide the CO_2 Verified Emissions Reductions (VER) estimate for the Eritrean Dissemination of Improved Stove Program (EDISP) for projects implemented in the Gash-Barka region of Eritrea during the years 2005 and 2006. EDISP is a project of the Energy Research and Training Center (ERTC) of the Ministry of Energy and Mines (MoEM) of the Government of Eritrea that is implemented in partnership with other government organizations and NGOs.

The background, purpose and justification for the EDISP project is provided in the project design document. See:
http://www.punchdown.org/rvb/mogogo/ProjectDsgnDoc200301.html

The project design document also provides the description of the CO_2 emissions estimation methodology.

The amount of ERs claimed for the 36 villages by ERTC/MoEM was 6,632 stoves and 13,264 metric tons assuming an average of 2.0 tons per claimed stove. The claim was adjusted slightly from 36 villages to 32 villages covered in this study. Two villages are part of a different project type (i.e. a combined improved stoves and solar lighting project) and will be credited at a later date. Two villages in the claim were merged into one village (i.e. Meskerem and Adal were merged into the single village of *golj*). And one village was neither visited during ERTC monitoring, nor found in the Verifier's reference place names list and was thus removed from the claim.

The total emissions reductions estimated in this report are found to be more than 14,658 metric tons for projects implemented in 2005/2006 with a total estimated emissions reduction (ER) of 2.09 ER per stove in the adjusted claim and 3.95 tons per permanent working additional stove. Since the stoves were installed throughout both 2005 and 2006, the stove installations are assigned equally to these two years, with 50% of installations assigned to 2005 and 50% of installations assigned to 2006. Note that the ER estimate is very conservative, and it is estimated to be more than 90% likely that the carbon sequestration arising from stove projects in the villages claimed will in actuality exceed the 14,658 metric ton estimate by the end of 2013.

The emissions reductions from these projects will occur over a period of nine years (from 2005 through 2013 inclusive). Approximately 32% of the emissions reductions or 4,589 tons CO2e occur from 2005 through 2007. Since the verification study was conducted in 2007 and VER need to be verified *a posteriori*, then of the 14,658 ER estimated from the project, 4,589 are VER. The remaining 10,024 ER need to be verified in follow-up verification studies.

The verifier traveled to Eritrea twice in the conduct of this verification study: during April 2007 and November 2007. During the April 2007 visit, not all data collection and organization work was completed by the MoEM, so a follow-up visit was necessary. From November 11 to November 23, 2007, the Verifier travelled to Eritrea. Working together with ERTC and MoEM, the Verifier was able to resolve many of the data difficulties and uncertainties. The specific issues that were resolved during this period were:

1. The MoEM VER registration office demonstrated that it had specifically referenced all claimed projects to an authoritative source of village names and geographic locations, and for villages not in the reference list it systematically added new place names to the reference list when warranted. It also demonstrated an excellent capacity and a newly established practice of keeping a consistent national account of VERs and preventing double-counting of projects and claims. The Verifier and the MoEM VER registration office are now in the process of coordinating a consistence authoritative referencing scheme for EDISP projects and VER claims.
2. In order to resolve accuracy issues regarding the counting and monitoring of stoves actually installed and in use, the Verifier and ERTC agreed to a revision in monitoring procedures where a list of participating households will be collected and randomly checked. This improvement in monitoring procedures will provide a more accurate estimate of stoves actually installed and in use relative to project claims. The Verifier and ERTC staff began implementation of the new procedures in evaluation of the MoEM VER claim for verification studies subsequent to this one.
3. While information and testimony regarding the ERTC participation in the projects was available, the ERTC has not documented in detail its physical and budgetary participation in the claimed projects. In the future, the ERTC will need to provide better documentation of its physical and financial contribution to project implementation. When such documentation supporting additionality is not available, the emissions reductions from villages that may not be additional will be deducted from the VERs.
4. A more careful analysis of available household survey data confirmed that very close to 100% of the fuel supply used in the project villages is wood, thus the appropriate BLife parameter in the emissions reduction estimate was selected.

In this verification study, the Verifier was able to independently estimate implementation efficiency and collect information on satisfaction of additionality criteria, this is unlikely to be the case for future claims. The Verifier suggests that for future monitoring and verification reports that the MoEM collect, archive and make available the following information to support their claims:

1. A list of the specific contributions made by ERTC to the projects in specific villages or groups of villages with lists of materials and training services with specific quantities, dates and budget expenditures and staff names for support services.
2. Specific lists of stove program beneficiaries for each claimed village.

While the second recommended action may seem particular onerous, local project organizers actually maintain such lists of beneficiaries for their own implementation accounting. The ERTC needs to consistently collect and archive this information regarding project implementation. It is now possible to copy and archive such lists with the click of a digital camera. The camera makes it possible to digitally photograph and archive photos of these lists rather than copy hundreds of names by hand. Without such lists the actual number of beneficiaries is very difficult to verify on the ground, and it is difficult to measure accurately the efficiency and rate of actual project implementation.

The 36 villages included in the VER claim are shown in Table 1. This claim includes village stove projects that were implemented by the National Union of Eritrean Women (NEUWs) with the support of the Energy Research and Training Center (ERTC) of the Ministry of Energy and Mines (MoEM) of the Government of Eritrea. The ERTC provided the training, the stove design, the molds for stove parts construction and monitoring and evaluation services in support of project implementation in the Gash Barka Region. NEUWs provided a budget of approximately $13 per stove to pay for training, transportation and stove parts that were not constructed with ease from local materials including metal doors for the stove firebox, cement pipe sections for chimney construction, a metal rain cap, and a metal air control valve. NEUWs is a quasi-governmental organization that has an extensive network of women project organizers which penetrate to the local village and neighbourhood level. The typical NEUWs grassroots organizer is responsible for organizing in the range of 50 to 250 households. NEUWs used this extensive network to distribute parts and training to households participating in the project. NEUWs obtained funding for its portion of the project implementation from the United Nations Child and Education Fund (UNICEF), the United Nations Development Program (UNDP), and IFAD (International Fund for Agricultural Development). The ERTC relies on funding from the MoEM and carbon credits to pay for its participation in the project.

Table 1: Villages Included in VER Claim

ERTC Place Names				Verifier Place Names		
Subzone	**Kebabi**	**Village**	**Stoves**	**Subzone**	**Kebabi**	**Village**
(region)	**(county)**		**Claimed**			
Logo anseba	Kolkolgea	adi ma`amray	11	logo `anseba	adena	kolkolojeQa
Barentu	Auda	Tmalsti	100	barentu	ketema barentu	zoba awde
Barentu	Auda	Fethi	200	barentu	ketema barentu	zoba awde
Barentu	Auda	Auda	100	barentu	ketema barentu	zoba awde
Logo anseba	Adena	Adena	20	logo `anseba	adena	adena
Mensura	Mensura	Mensura	50	mensura	mensura	mensura
Mensura	Mensura	Migrah	50	mensura	tnx'ay	mgraH
Akordat	Akordat	Fethi	150	aQurdet	ftHi	ftHi
Akordat	Engernea	Engernea	100	aQurdet	Ingerne	Ingerne
Akordat	Akordat	Tekreriet	100	dge	teKreret	tekrerot
Mogolo	Mogolo	Areda	100	mogolo	areda	areda
Molki	Molki	Fawlina	150	molqi	fawlina	fawlina
Molki	Molki	Safra genet	150	molqi	sfra genet	sfra genet
Molki	Molki	Molki	200	molqi	molqi	molqi
La`aily gash	shilalo	Adi tetser	350	molqi	`adi SeSer	`adiSeSer
shambko	shambko	shambko	200	xambqo	xambqo	xambqo
Barentu	zoba selam	zoba selam	100	barentu	ketema barentu	zoba selam
Gonyea	Deski Hade	Dasie	100	goN	dase	dase
Forto	Forto sawa	Forto sawa	150	frto	sawa	kurba sawa
Haikota	Haikota	Haikota	100	haykota	haykota	haykota
Haikota	Haikota	Alebu	100	haykota	aleb	me`aseker sdeteNa
La`aily gash	Awgaro	Awgaro	45	la`llay gax	awgaro	awgaro
La`aily gash	shilalo	shilalo	700	la`llay gax	xlalo (deqidaxm)	deqidaxm
La`aily gash	shilalo	Habela	120	la`llay gax	xlalo (deqidaxm)	Habela
La`aily gash	shilalo	Adi hakin	300	la`llay gax	`adihekin	`adihekin
La`aily gash	shilalo	shesabit	200	la`llay gax	xexebit	xexebit
Lailay gash	Tokombya	Tokombya	200	la`llay gax	toKombya	toKombya
Golij	Golij	Meskerem & Adal	500	omHajer	golj	golj
Golij	Golij	Gerset	200	omHajer	golj	grset
Golij	Tebeldya	Tebeldya	240	omHajer	tebeldya	tebeldya
Golij	Gergef	Gergef	250	omHajer	tebeldya	gergef
Tesenay	Tesenay	Tesenay (sheab)	700	teseney	teseney	zoba x`lb
Tesenay	Aligider	Aligider	86	teseney	`aligdr	aligdr
Tesenay	Aligider	Hadish maasker	110	teseney	`aligdr	Hadix ma`asker

1.1 Objectives and VER Standards

The objective of this verification report is to obtain the best possible, conservative estimate of emissions reduction resulting from improved stove efficiency project activities undertaken in 32 villages in the Gash Barka Region from 2005 to 2006. The Department of Energy of the Government of Eritrea (EDOE) sells emissions reduction credits for its improved stove projects in an effort to raise revenues for supporting and expanding its improved stove activities. This report examines the extent to which the MoEM activities and projects in the 32 villages in the Gash-Barka region generate past, present and future ERs.

1.2 Verification and Credit Sales History

This verification report follows a verification report that was completed in December 2006 for credits that were claimed for 2004/2005 for projects in nine villages carried out in the Central (*ma`Ikel*) and Southern (*debub*) regions of Eritrea. In April 2006, the EDOE approached the verifier, Dr. Robert Van Buskirk with a request to verify ERs for the improved stove projects conducted by EDOE in 2004, 2005 and 2006. The initial effort to satisfy the April 2006 verification request resulted in the December 2006 verification report. During late 2006 and throughout 2007, EDOE continued to sign contracts for VER sales. At the same time the ERTC stepped up its monitoring and data collection activities and produced its version of two monitoring and verification projects for 36 villages in the Gash-Barka zone on February 22, 2007, and a first phase monitoring report for the Debub zone for 23 villages on March 29, 2007 and a second phase monitoring report for 79 villages in the Debub zone on September 10, 2007.

This verification report covers only the claim corresponding to the February 22, 2007 monitoring report from the ERTC.

The EDOE has a standing request for the verifier to provide official, independent verification reports for its stove project emissions reduction claims. The verifier visited Eritrea in late April 2007, and spent approximately one week analyzing monitoring and stove test data and visiting villages in order to verify and evaluate the claims made in the February 22, 2007 monitoring report. The verifier made a follow-up visit to Eritrea from November 11 to November 23, 2007 which provided additional information for this report.

During his visits to Eritrea, the verifier has advised the ERTC and the EDOE on procedures and activities that would improve the monitoring data and documentation for the EDISP VERs and ERs. During the verification activities conducted in August 2006, the verifier provided specific procedures for the EDOE to follow to improve its documentation and data collection in ways that would enhance documentation for future verifications. To comply with this request, the EDOE set up an office for recording and documenting VER claims and certifications that is now staffed at 50% commitment by Berhane Ghidey. Hard copy documentation of VER claims and certification now include a project registration form, an ownership claim form, a project monitoring form, and a verification and certification form. As of April 2007, the EDOE VER claims and certification office was in the process of refining a national database for tracking projects

throughout the country, and procedures for specifically tracking VER contracts, and sales so that they can be matched to specific village-level project implementation. During the visit in April 2007, there was a lack of routine data transfer between the ERTC and the registration office. The verifier informed the ERTC that without clear cooperation with the official project registration office, the ERTC claims to VERs may be reduced due to quality and consistency issues regarding data records and procedures.

Between April 2007 and November 2007 the ERTC and the EDOE registration offices have made major improvements in data collection, data archiving and reporting. The ERTC has continued and improved the quality of its data collection and reporting activities. Meanwhile, the VER project registration office of the EDOE had done an excellent job of making sure data is correct and consistent, entering data from hard copy forms into spreadsheets and databases, and producing summary reports of registered, monitored and verified projects. The projects also have been geo-referenced and the office has produced maps of project distributions.

Given feedback from VER purchasers in February/March 2008, an adjustment was made in the method for allocating VERs and ERs to particular vintages. Previous VER reports had allocated emissions reduction in the year of stove installation, the new VER and ER allocation method now allocates emissions reductions over the entire estimated period of biomass accumulation. The increased efficiency of improved stoves ultimately results in emissions reductions because the carbon that is in the wood is no longer burnt, but accumulates in the surrounding ecosystem. This accumulation of carbon occurs gradually for a period or years but this period is only a limited number of years (characterized by the BLife parameter in the emissions reduction formula). The new method of assigning emissions reduction vintages spreads the emissions reduction credit over a period of years that is equal to the BLife parameter in the cumulative emissions reduction formula. See Appendix 1 of this report for more detail.

1.3 Scope

The verification visits for the Gash-Barka 2005/2006 projects were carried out during a visit to Eritrea by the verifier between April 15 and April 30, 2007. During this trip, the verifier reviewed documentation, data and analysis at the ERTC. The verifier also conducted two short orientation seminars for ERTC staff on carbon markets and the carbon credit project implementation, monitoring and verification process. The verifier also consulted with the EDOE VER claims and certification office and provided documentation and recommendations in support of its claims processing and tracking procedures. And the Verifier participated in a field trip with ERTC staff to projects in the Gash Barka region to evaluate and assist in the accurate interpretation of the project monitoring data.

Given the fairly extensive data collection activities carried out by the ERTC, the focus of this particular verification was on interpretation, analysis and error estimation for inputs into the VER calculations. One key input is the estimation of the actual number of stoves that achieve actual permanent operation given the initial planned and documented project implementation estimate. A second key input into the VER estimation is the average lifetime of the biomass that is conserved with more efficient stoves. When households stop harvesting biomass that has a long lifetime in the surrounding ecosystem, then the increased stove efficiency creates net carbon sequestration over a

longer time period. And a third key input that is estimated with increased accuracy for this verification report is the decreased input energy and wood use from the improved stoves. The ERTC conducted a fairly extensive series of in-field tests of stove energy use and produced an updated set of energy use curves for the improved stoves in comparison to the traditional stoves.

Given the improved VER estimation inputs resulting from increased data collection, the emissions reduction for the project stoves were calculated using Method #1 in the Project Document. This calculation resulted in a total forecast VER and ER estimate of 14,658 metric tons for years 2005/2006 compared to the initial claim of 13,264 tonnes of emissions reductions.

1.4 GHG Project Description

A fairly detailed project description for the Eritrean improved stove project is provided by a project design document that was drafted in 2002/2003 which is available at: http://www.punchdown.org/rvb/mogogo/ProjectDsgnDoc200301.html

2. Methodology

In general terms, the methodology used in this verification study was to first review documents and data regarding the VER claim, and then to conduct interviews of both project staff and persons who were directly involved in project implementation either as project organizers or project beneficiaries.

2.1 Review of Documents

The review of documents consisted of three steps. The first step was to enter the national list of villages into a spreadsheet so that the claimed villages could be referenced relative to an authoritative list of villages. The second step was to review all of the project data and to compile a comprehensive list of project villages for the history of the project, and the third step was to review internal Energy Research and Training Center reports concerning stove project activities.

For compiling the comprehensive list of villages, the ERTC has a copy in paper form of the 1996 village census data with village and county names in Tigrigna. This data was transliterated using the SERA transliteration scheme (http://www.abyssiniacybergateway.net/fidel/sera-faq.html) and then entered into a spreadsheet to provide a comprehensive list in digital form.

Given the comprehensive list, source data on previous projects was entered into the spreadsheet. This included projects and planned projects information collected from previous verification studies which were recorded in a less comprehensive list, data provided in a project compilation made by the Energy Research and Training Center (ERTC) in July 2005, and other data gleaned from internal work reports.

In its February 22, 2007 monitoring report, the VER claim shown in Table 1 in the introduction of this report was made by the ERTC and the MoEM.

2.2 Follow-up Interviews and Village Visits

Because many villages can be relatively remote, one of the most expensive and time consuming aspects of both project implementation and project monitoring and verfication is visiting the villages participating in a project. Visits were made to a random sub-sample of villages to verify estimates of the input parameters to the emissions reduction equations.

2.3 Resolution of Outstanding Issues

The key outstanding issues for VERs for the Eritrea improved stoves project are (1) maintaining the detail and completeness of monitoring documentation, (2) improving the accuracy and reliability of data collected in the future, and (3) assuring the financial additionality of the VER sales and the reinvestment of revenues in project expansion.

A discussion of these issues—including a description of recent progress and the expectations for the next level of improvement—are provided in the introduction of this report.

3. Verification Findings

A total of 14,658 metric tons of CO2-equivalent ERs are estimated for 2005/2006 for the Eritrea Dissemination of Improved stoves project for 32 of the 34 villages listed in Table 1. Two villages will be verified in a later study. The verification consisted of visits to six of the 32 villages which were used to estimate the factors used to calculate the emissions reductions obtained from the ERTC/MoEM projects. Four key adjustments were made: (1) when the place name for the project could not be corroborated by the Verifier, or the ownership of the project credits was uncertain, the village and its corresponding stoves was removed from the claim, (2) the number of stoves actually installed was decreased relative to the claim to account for observed inefficiencies in project implementation (i.e. households that were not using the claimed stove), and (4) a direct fuel savings estimate was used in the emissions reduction estimate of 1.5 kilograms per cooking session due to new field data on stove energy use testing. Given these adjustments to the emissions reduction estimation factors, the claimed emissions reduction for 6,232 project stoves was recalculated using a variant Method #1 in the Project Document, resulting in an ER estimate of 14,658 metric tons compared to the initial claim of 13,264 tonnes of emissions reductions and an ERTC internal monitoring report estimate of 42,975 tonnes of emissions reductions. Of the 14,658 estimated ER from the project, 4,589 are VER with 925 of vintage 2005, 1832 of vintage 2006, and 1832 of vintage 2007.

The high ERTC internal report estimate was the result of a computational error in the ERTC calculation where the ERTC added an erroneous factor of 3.67 to the emissions reduction equation. When this computation error is corrected, the verifier estimate of the emissions per permanent stove is slightly higher than the emissions reduction per working stove estimate made by ERTC staff.

3.1 Project Design

The project approach for the Eritrean stove program during the year 2004 was to partner with NGO's and local agencies in providing training and materials for stove construction. A local women's committee would sign up households to take the materials and build stoves, and through either the local women's committee or the local village government administration they would track the delivery of materials and construction of the stoves. The materials provided by the project would include molds for making hollow bricks for constructing the stove firebox, cement pipe for constructing the chimney, clay or metal fire grates (which provide the bottom of the firebox), doors for the firebox, sometimes a rain cap for the chimney, and moulds for forming air inlets. After training and delivery of materials much of the responsibility for project implementation was organized through local project promoters.

3.2 Baseline

The baseline condition for the project is use of the traditional unimproved stove. The unimproved stove typically does not have a chimney nor an air inlet that allows air to enter the firebox from below. Fairly extensive tests and surveys have shown the traditional stove to require approximately twice as much wood for cooking as an improved stove.

3.3 Monitoring Plan

In the implementation of the improved stove project, there are approximately five villages visits that are part of project implementation and monitoring:

1. Project education and negotiation meeting: In this meeting the NGO and local government staff meet with village participants, explain the project and negotiate project implementation.
2. Demonstration construction and training: In this visit, the NGO staff conduct education and demonstration of stove construction techniques and methods.
3. Follow-up training and dissemination monitoring: In this visit, Ministry staff check the implementation of the project by the villagers.
4. Evaluation and monitoring: In this visit, Ministry staff conduct household interviews and stove tests to collect data on project impacts and performance.
5. Verification and/or follow-up: For this visit, Verification and Ministry personnel visit villages to confirm project implementation and verify project performance and persistence.

For this particular verification, visits 1, and 2 were conducted by members of the national union of Eritrea women, but visits 3 were not generally conducted, while visits 4 and 5 were conducted as a combined visit with different levels of data collection undertaken. For verification, the verifier visited approximately five of the 32 villages in the adjusted claim: *tessenei, aligidir, golj, barentu* and *tebeldya*.

The Verifier made recommendations to the MoEM/ERTC to improve monitoring and verification activities for its stove projects. In response, the MoEM/ERTC specifically assigned staff to improve monitoring data collection and archiving

3.4 Calculation of GHG Emissions

The GHG emissions estimate of previous verification reports are detailed in the project document (http://www.punchdown.org/rvb/mogogo/ProjectDsgnDoc200301.html), and here we use a slightly modified version of Method #1 that calculates the total savings using the difference in efficiencies between the improved and traditional stoves. Based on previous research the traditional stove is usually assumed to be 10% efficiency while the improved stove is assumed to be typically 20% efficient. For this verification report, more recent stove test field data is available that indicates that the fuel savings from the improved stove is an average of 1.5 kilograms wood equivalent per cooking session.

The method provided in the design document is described as:

Method #1: CO_2 Emissions Estimate from Food Consumption Measurement

The first method for estimating CO_2 emissions is described by the following equation:

$$CO_2/capita/FuelType = FracPerm * FuelFrac * InjC * EInj * (1/Eff1 - 1/Eff2) * 1/EBio * BLife * 1/WetEff * (1+BGBio) * CCont$$

Which also can be expressed as:

$$CO_2/capita/FuelType = FracPerm * FuelFrac * Delta\text{-}Fuel * BLife * (1+BGBio) * CCont$$

where:

FracPerm = The fraction of the population that permanently convert to the new mogogo once they have converted their traditional stove to an improved stove. For this particular verification report a conservative value of 60% of claimed stoves are assumed to be permanent and additional. The actual fraction is likely to be substantially higher than this.
FuelFrac = The fraction of cooking energy obtained from a particular fuel type. The fuel energy is related to the fractional fuel mass by *FuelMass * EBio = FuelEnergy*. Note that in this report we use wood fuel energy since household interview data indicates that more than 90% of fuel is wood.
InjC = The average injera consumption per year per person in units of kilograms/year.
EInj = The energy intensity of injera production with a 100% efficient stove in units of megajoules/kilograms.
Eff = The efficiency of the injera stove in dimensionless units.

EBio = The energy content of the dry biomass fuel in units of megajoules per kilogram.
BLife = The average lifetime of biomass in the ecosystem in years defined in terms of biomass stocks that result from a change in harvest rate. It is the stock of biomass in the ecosystem that results from a unit decrease in the annual harvest rate. Here we assume a lifetime of 8.5 years. A life of 9.4 years is expected for wood in the Eritrean ecosystem, but we conservatively decrease the estimate by 10% to account for some small faction of fuel that my be dung or other forms of biomass that may have a short lifetime.
WetEff = The efficiency of burning wet biomass compared to burning dry biomass. This quantity is dimensionless.
BGBio = The fraction of biomass that is below ground. It is assumed that as above ground wood biomass is removed that a corresponding amount of below ground biomass is indirectly removed from stocks through decay of roots and loss of soil carbon. This quantity is dimensionless.
CCont = The CO_2 content of biomass fuel in units of kg CO_2/kg Biomass. This is 1.8 for cellulose/wood.
Delta-Fuel = The change in fuel consumption between the efficient and the inefficient stoves, for this report we had direct measurements of differences in fuel consumption from field tests. These measurements provided a value of 1.5 kg wood savings per cooking session. We then estimated 2.5 cooking sessions per week (surveys indicate 3 sessions per week, but a statistically large sample direct surveys were not made for these particular projects, so the value was decreased to indicate the most conservative number supported by previous data) times 90% cellulose content (i.e. up to 10% water content) times 52 weeks provided the annual fuel savings estimate.

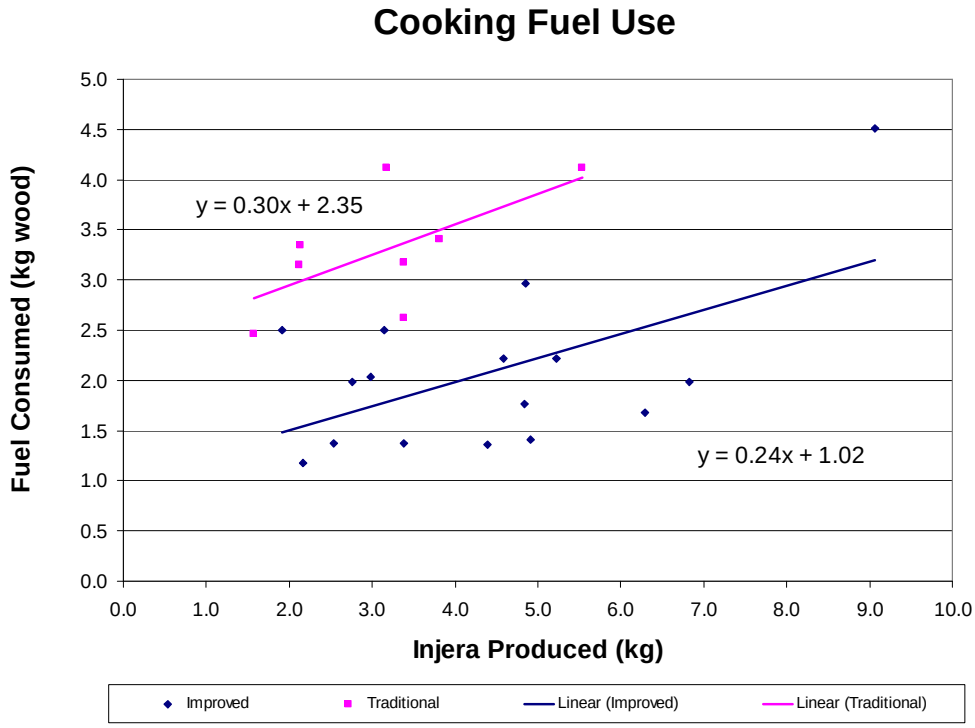
With the values estimated for this verification study, the result is:

*= 60% * 100% * (0.9 * 1.5 * 2.5 * 52) kg/year * 8.5 years * 1.0 * 1.47 * 1.8*
= 2368 kg/claimed-stove = 3947 kg/permanent-stove

3.4.1 Measurement of Fuel Savings

During 2006 and 2007 the ERTC conducted a series of field tests to verify and refine the fuel savings estimate from the improved stoves relative to the traditional stoves. Field tests are much preferred to laboratory tests because they capture the often unknown factors that can affect cooking energy use such as changes in cooking styles or methods that may happened with a changed design.

Figure 1: Fuel use vs. *injera* produced for traditional and improved stoves



As can be seen from Figure 1, fuel use for the improved stove is substantially lower than for the traditional stoves. There is substantial variability, but the difference is large enough to be measurable with confidence on average. For typical cooking amounts relevant to this verification report (in the range of 3 to 4 kilograms of injera produced per cooking session), the fuel savings is slightly greater than 1.5 kilograms of wood per cooking session on average.

3.5 Environmental Impacts

In addition to greenhouse gas emissions reduction benefits, the project also leads to decreased deforestation due to decreased wood harvesting, increased soil fertility due to decreased dung burning, and improved indoor air quality due to decreased overall smoke production and venting of smoke from the stove with a chimney.

3.6 Comments by Local Stakeholders

Typical comments from stakeholders and participants in the stove project include:

“With old mogogo my eyes watered while cooking and the eyes would be stung and upset by the old mogogo’s smoke, the new mogogo is smokeless.”

“Labor saved with the new mogogo comes from the less smoke and better burning. This allows one to cook injera and do other things at the same time. With the old mogogo you had to stay to blow air on the fire, but now you can walk away and it burns well. You also do not have to worry about the kids.”

"Why do some people not get the new mogogo? Some people don't understand the new mogogo or out of not wanting to contribute the local labor. If it is built for them they are willing. A few households have old people who are willing to remain without the new mogogo, but almost all of the young householders try to get it. Plus, for the older households who is going to do the labor? Once enough people have the new mogogo the others will want to join in."

"Many people ask how to build the new mogogo and they want to have one. They measure it and try to build themselves, but the government campaign facilitates it better."

4. Compliance with VCU Verification Criteria

4.1 Project Category

The project category of this project is energy efficiency which leads to decreased fuel harvesting and the new sequestration of carbon in the ecosystem.

4.2 Geographic Location

The locations of the projects are described in table 1.

4.3 Eligible GHGs

The only eligible GHG claimed for the VERs is Carbon Dioxide

4.4 Project Start Date

At the largest scale, field implementation of improved stove projects started in the year 2000, but the start date of the individual village projects included in this VER claim is 2005 and 2006.

4.5 Emissions Reduction Start Date

The emissions reduction start date is the date that the stove begins to be used by a household.

4.6 Public Funding and Grants

In Eritrea, the commercial sector is relatively small. Many productive activities are either supported or run by the government, especially in rural areas. Thus the entities that promote and distribute stoves and many other energy services are often government agencies or NGO's. For the projects in this VER claim the implementing agency is the National Union of Eritrean Women (NUEWs).

For the Eritrean improved stove program, funds received by the Ministry contribute to the budget of the Energy Research and Training Center (ERTC) which then buys materials and engages in research and training activities in support of the stove program. The

ERTC is the national institution that invented the stove, and which provides continuing improvements in design. The ERTC also provides training and material and logistical support to NGO's and other Eritrean government organizations that are implementing stove programs. NUEWs is a quasi-governmental implementing organization that consists of an official network of community women organizers that are coordinated with a national level organization that parallels the structure of the local government administration system.

4.7 Project Boundary/GHG Assessment Boundary

The project boundary for the Eritrean improved stove program is the village and the surrounding environs where the project is implemented. Emissions include the emissions from stoves and the emissions from biomass that may be left in the surrounding ecosystem when biomass fuels are not harvested. Decreased emissions from decreased wood burning results in increased emissions from decaying biomass in the ecosystem. The difference between the emissions decrease from burning and the increased decay of biomass in the ecosystem represents the net carbon that is sequestered in the ecosystem from decreased biomass fuel harvesting.

4.8 Calculation Methodology

The calculation methodology is explained in detail in:

http://www.punchdown.org/rvb/mogogo/ProjectDsgnDoc200301.html

and shown in section 3.4 of this verification report.

4.9 Secondary Effects

The GHG Assessment Boundary incorporates all primary effects and significant Secondary Effects of the project.

4.10 VER+ Standard and Project Additionality

The project satisfies the following three additionality criteria:

The project is not common practice

The improved wood burning stoves in Eritrea are a recent development that began in approximately the year 2000. To date less than 10% of households nationally have access to the improved stoves and there is an active effort to promote and extend these stoves to more households at significant cost to the project implementer and other collaborating organizations and agencies.

Approximately 80% of the Eritrean population lives in rural areas with no access to electricity. It takes time, investment, training, materials, and active rural village capacity-building programs to transform existing traditional stove building practices to improved

stove building. Specifically, training needs to be provided in stove construction techniques, and the molds necessary for the building of stove parts need to be provided. Improved stoves require more effort, expertise and care to build than traditional stoves. This requires investment on the part of a national public interest institution which can make the organizational and material investment in return for social and public benefits on a national scale. Given the many very urgent public investment demands on the Eritrean government, carbon finance provides a key source of additional revenues that enables improved stove investments that otherwise would not have the resources necessary for effective and timely implementation.

The project is not required by regulation

There are no laws in Eritrea that require or mandate households to have efficient biomass stoves. In addition, there are no laws that mandate that the MoEM must support or promote improved stove installation or programs.

The project is not the least cost option

On a first cost basis, the traditional stoves—which do not have a chimney or an air inlet that allows the air to come in below the fuel—are substantially cheaper than the improved stoves. Provision of improved stoves requires an active promotion program by the government and NGO's which provide training and materials to villages making the transition from traditional to improved stoves.

4.10.1 Financial additionality

The Verifier's best estimate is that without carbon finance, there definitely would have been project implementation delays but it is possible that the projects would have been implemented at a later date. Fewer projects would have been implemented in fewer villages in any given year, and it may have taken 2-5 years longer to implement the project in any of the claimed project villages.

For the particular villages claimed and evaluated in this report, interviews with project implementers and ERTC staff indicate that the ERTC provides specific, inputs to project implementation with the knowledge that VER revenues would enable sustained support and expansion of the project.

4.10.2 Barrier Analysis

In the case of EDISP, the project alternative is trivially determined as non-implementation of the project which would mean that the MoEM would not be active in the implementation and promotion of EDISP. The MoEM is not legally mandated to work on improved stove efficiency and there is no requirement for the MoEM to spend any budget on such activities. Under this scenario, MoEM support for improved stoves would cease and dissemination of the improved stove would proceed at whatever rate would be supported by other actors.

With respect to financial additionality, an investment analysis of additionality is not relevant to the project. The MoEM is not an investment entity that makes decisions based on investment rate-of-return criteria and there are no rate-of-return criteria to evaluate. Similarly, under the project alternative the MoEM does not bear any costs, so a traditional cost comparison analysis also is not relevant. Therefore we determine additionality under step 3, a barrier analysis.

In a barrier analysis of financial additionality, the verifier answers the question of whether or not the project faces barriers that:

1. Prevent the implementation of this type of proposed project activity; and
2. Do not prevent the implementation of at least one of the alternatives.

The barriers that are resolved by carbon finance, is the barrier of being able to cover costs for extra-ordinary project implementation expenses that would not be incurred under the no project implementation alternative. Under the no-project alternative, the MoEM would still incur the expenses of office space, and staff salaries, but the implementation of the EDISP project results in additional expenses. Key expenses for the implementation of the project are travel and staff per-diem expenses along with the material expenses associated with the training, monitoring, evaluation, promotion and other support services that the MoEM provides to diverse partners in the implementation of the EDISP program. Most of these expenses are associated with the travel necessary for conducting such support activities, along with any materials provided. Travel expenses include car rentals of $150/day, and staff per-diem expenses are approximately $3/person/day though this may often be insufficient to cover basic expenses of staff. Material expenses include molds, locally manufacture stove parts like custom bricks and fire grates and key stove parts like firebox door frames and cement pipes for chimneys.

The Verifier has been visiting Eritrea and the MoEM for more than a decade. There was a period during 2004 – 2006 when the MoEM was not receiving carbon finance. During that time, the Verifier directly observed the idling of many MoEM improved stove activities due to the lack of budget for the travel, per-diem and material expenses of MoEM project participation.

Under the VER+ additionality criteria a barrier analysis identifies barriers of four potential types: (1) Investment barriers such as the lack of debt financing or access to international capital, (2) Technical barriers such as lack of skilled labour or lack of infrastructure, (3) Lack of prevailing practice or experience with project technology or (4) project is ‘first of its kind.’

With the assistance of carbon credit financing, the MoEM has largely resolved much of the technical and prevailing practice barriers associated with improved stoves. The MoEM has develop skilled personnel who specialize in improved stove design, program monitoring, evaluation, and management, and the MoEM has performed a large number of ‘train the trainers’ type activities where MoEM staff would train organizers within the Ministry of Agriculture, or the National Union of Eritrea Women amongst others in improved stove design and construction. With respect to technical infrastructure the MoEM has enabled both small and medium makers of improved stove parts such as fire grates and custom clay bricks which are used for the construction of the improved design.

The remaining barrier is the transaction cost of working with villages to train women at the local level in improved stove construction, provision of the production molds for stove parts, and purchase of those key stove parts that may be difficult to construct at the local level with high durability and quality (such as metal doors and sometimes concrete pipe for chimneys).

In the implementation of EDISP, the MoEM acts to help resolve the investment barriers that households and villages have with respect to implementing the project on their own. Rural households in Eritrea have little or no access to capital or finance. This is especially true since much of the savings that accrue from improved stoves are non-monetary in terms of time saved collecting wood by either children or women of the household. In addition, another very large benefit is the improved comfort and health of the women cooking on the stove. This labour is also completely unpaid, and therefore savings cannot be used to repay debt financing at the household level.

The remaining additionality issue is determining when a project activity would have occurred even without MoEM participation. Since the program alternative is for the MoEM to not engage in improved stove activities, it is conceivable that some actors or partners in the EDISP program could or would continue installing stoves even if there was no carbon finance.

With respect to this issue, the Verifier determined case-by-case if a particular implementer for a particular village received support from the MoEM that resolved critical barriers to implementation for that project or program implementer. If the Verifier did not have evidence that the MoEM played a significant or substantial role in the implementation of EDISP in a particular village, then the Verifier did not allow credits for that village in the final VER determination until such evidence could be provided. Evidence required for determination of a significant and substantial role on the part of the MoEM is documentation of training and material supply services to the implementer or the implemented villages during the approximate period of the project implementation.

Some MoEM staff claim that because the stove design was invented by the MoEM, all implementations of the project allow for a claim by MoEM for ownership of the VERs. This Verifier rejects this interpretation of additionality by members of the MoEM. The improved stove design was developed without carbon finance, and initial implementation of the project was made to the first one to two dozen villages before the MoEM knew of the potential of carbon finance. Therefore since the invention of the stove was not financed with VERs, the MoEM cannot claim that carbon finance has played any role in removing the initial barrier of creating the stove design.

But the Verifier does allow in this report for the MoEM to claim ownership of the credits if they performed the training of key staff in the implementation of the project villages. For this particular claim, the MoEM provided both molds and training to NUEWs staff to enable implementation in the project villages. This was confirmed by the verifier though conversations and interviews with ERTC and NUEWs staff.

As the construction of the improved stove becomes common knowledge in Eritrea, the Verifier expects that increasing documentation will be necessary to support the additionality requirement from year 2008 and beyond. Documentation will be required

from the MoEM to demonstrate a sharing of budget and/or resources with project partners. This requirement will mean that the MoEM will need to provide documentation of specific training services provided directly for specific project implementations rather than relying on Verifier records or interviews. In addition the MoEM currently provides detailed information and narrative regarding the monitoring and evaluation of improved stove projects in all of Eritrea. This activity is explicitly funded through carbon finance by the MoEM, and the Verifier assumes that in addition to enhancing training and material support services to partners through carbon finance, that the MoEM will continue its monitoring and evaluation activities with the same or even improved levels of detail and quality.

4.11 Quality of Reductions

The implementation of the project has a very large positive impact on the sustainable development of the villages. By removing smoke from the kitchen it improves the health of the women and children in the household. By decreasing biomass demand, it allows regeneration of the local ecosystems (or at least mitigation of unsustainable harvesting).

5. Comments by Parties, Stakeholders and NGOs

Several stakeholder comments on improved mogogo project have been solicited in interviews, some of which have be recorded on video and posted to the Internet. Comments on the improved mogogo (and related projects) can be seen by searching under the key words “Eritrea” and “Village” under video.google.com. While comments are in the local language Tigrigna, translation of some of these comments is provided below:

6. Verification Opinion

A total of 14,658 metric tons of CO2-equivalent VERs and ERs are estimated for the period of 2005 through 2013 for project implemented in 2005 and 2006 for the Eritrea Dissemination of Improved stoves project for the villages listed in Table 2. Of this amount, 4,589 are VER with 925 of vintage 2005, 1832 of vintage 2006, and 1832 of vintage 2007. The verification consisted of visits to four project areas, including *tesseney*, *aligidir*, *golj*, *tebeldya*, and *barentu*. Given adjustments to the emissions reduction estimates made by the verify to assure that the emissions reduction is conservative, the claimed emissions reduction for the 6232 project stoves was recalculated using a a variant of Method #1 in the Project Document, resulting in a VER and forecast ER determination of 14,658 metric tons compared to the initial claim of 13,264 tonnes for 6632 stoves.

The allocation of verified emissions reductions to particular vintages and villages is provided in Table 2:

Table 2: Summary of Verified Emissions Reductions (VERs) Gash-Barka 2005/6

Subzone	Kebabi	Village	Stoves		Verified Emissions Reductions (tons CO2e)				Expected Future Emissions Reductions (tons CO2e)						Grand Total
(region)	(county)		claim	ver	2005	2006	2007	05-07	2008	2009	2010	2011	2012	2013	
logo `anseba	adena	kolkolojeQa	11	n/a	0	0	0	0	0	0	0	0	0	0	0
barentu	ketema barentu	zoba awde	400	240	61	118	118	297	118	118	118	118	118	59	946
logo `anseba	adena	adena	20	n/a	0	0	0	0	0	0	0	0	0	0	0
mensura	mensura	mensura	50	30	7	15	15	37	15	15	15	15	15	6	118
mensura	tnx'ay	mgraH	50	30	7	15	15	37	15	15	15	15	15	6	118
aQurdet	ftHi	ftHi	150	90	23	44	44	111	44	44	44	44	44	23	354
aQurdet	lngerne	lngerne	100	60	13	30	30	73	30	30	30	30	30	13	236
dge	teKreret	tekrerot	100	60	13	30	30	73	30	30	30	30	30	13	236
mogolo	areda	areda	100	60	13	30	30	73	30	30	30	30	30	13	236
molqi	fawlina	fawlina	150	90	23	44	44	111	44	44	44	44	44	23	354
molqi	sfra genet	sfra genet	150	90	23	44	44	111	44	44	44	44	44	23	354
molqi	molqi	molqi	200	120	30	59	59	148	59	59	59	59	59	29	472
molqi	`adi SeSer	`adiSeSer	350	210	54	103	103	260	103	103	103	103	103	53	828
xambqo	xambqo	xambqo	200	120	30	59	59	148	59	59	59	59	59	29	472
barentu	ketema barentu	zoba selam	100	60	13	30	30	73	30	30	30	30	30	13	236
goN	dase	dase	100	60	13	30	30	73	30	30	30	30	30	13	236
frto	sawa	kurba sawa	150	90	23	44	44	111	44	44	44	44	44	23	354
haykota	haykota	haykota	100	60	13	30	30	73	30	30	30	30	30	13	236
haykota	aleb	me`aseker sdeteNa	100	60	13	30	30	73	30	30	30	30	30	13	236
la`llay gax	awgaro	awgaro	45	27	8	13	13	34	13	13	13	13	13	7	106
la`llay gax	xlalo (deqidaxm)	deqidaxm	700	420	104	207	207	518	207	207	207	207	207	103	1656
la`llay gax	xlalo (deqidaxm)	Habela	120	72	20	35	35	90	35	35	35	35	35	19	284
la`llay gax	`adihekin	`adihekin	300	180	47	88	88	223	88	88	88	88	88	47	710
la`llay gax	xexebit	xexebit	200	120	30	59	59	148	59	59	59	59	59	29	472
la`llay gax	toKombya	toKombya	200	120	30	59	59	148	59	59	59	59	59	29	472
omHajer	golj	golj	500	300	74	148	148	370	148	148	148	148	148	74	1184
omHajer	golj	grset	200	120	30	59	59	148	59	59	59	59	59	29	472
omHajer	tebeldya	tebeldya	240	144	36	71	71	178	71	71	71	71	71	35	568
omHajer	tebeldya	gergef	250	150	37	74	74	185	74	74	74	74	74	37	592
teseney	teseney	zoba x`lb	700	420	104	207	207	518	207	207	207	207	207	103	1656
teseney	`aligdr	aligdr	86	52	15	25	25	65	25	25	25	25	25	14	204
teseney	`aligdr	Hadix ma`asker	110	66	18	32	32	82	32	32	32	32	32	18	260
TOTAL	---		**6232**	**3721**	**925**	**1832**	**1832**	**4589**	**1832**	**1832**	**1832**	**1832**	**1832**	**909**	14658

Note: The villages of *kolkolojeQa* and *adena* are part of a combined stoves and solar lighting pilot project of 20 villages and they will be credited under a different verification study.

Signed,

Robert Van Buskirk, Ph.D.

7. Reductions assignment to buyers

The reductions verified with this report were bought by the buyers listed below :

	Climat Mundi	Buyer to be finalized at a later date	**Total**
2005	0	925	925
2006	1168	664	1832
2007	1832	0	1832
Total	3000	1589	**4589**

The accounting of which credits are assigned to which buyers is maintained by the credit registry office of the Ministry of Energy. In this registry all VER are assigned a village and a year. Each buyer is set of VER for each village and each vintage is assigned to a particular buyer, or is kept in inventory until delivery of the credits is finalized.

8. Factors that May Affect Actual Emissions Reductions

There are many factors and uncertainties that can affect EDISP project greenhouse gas impacts. Different assumptions, approximations, and unaccounted-for factors may result in more, less, or unknown changes in project VER's. Fundamentally, the certainty of a VER estimate is a matter of judgement and risk evaluation.

Potential factors that may result in a lower VER estimate include:

1. Over-estimation of improved stove fuel savings—currently estimated as 1.5 kilograms of wood equivalent per cooking session—compared to the fuel use of the unimproved stove.
2. Over-estimation of the total number of stoves likely to be in permanent, and continuing use. (estimated at 60% of the claimed stove installations).
3. Under-estimation of the water content of the measured fuel (currently estimated 10% by weight)
4. Over-estimation of the below-ground biomass (currently estimated 47% of utilized biomass).
5. Over-estimation of the average lifetime of unharvested biomass in the ecosystem (currently estimated as an average of 8.5 years for the fuel used in the project area).
6. Possibly the fraction of fuel that is wood is over-estimated

Factors that may result in a higher VER estimate include:

1. No accounting is made for the energy and fuel savings from cooking qiCa bread on the improved moqolo stove, or of sauce being cooked on the improved sauce stove.
2. No accounting is made for non-CO_2 greenhouse gases.

3. Under-estimation of improved stove efficiency, below-ground biomass, or lifetime of unharvested dung and wood in the ecosystem.
4. No accounting made of soil fertility impacts from unburnt dung.
5. No accounting of positive leakage: i.e. households adopting improved stoves outside the efficiency project implementation.
6. The average fraction of fuel coming from wood may be underestimated.
7. Because wood is more expensive than dung, fuel savings and easier combustion may result in greater savings in wood than in dung. Currently it is assumed that wood and dung fuel savings are proportional. And the savings is estimated from the improved stove fuel use measurements. Greater wood savings would result in a higher VER estimate.

On balance, given the various factors and their potential impact on the VER estimate, it is likely that the VER estimate in this report is conservative: That is, the actual CO_2 emissions reductions from the project are estimated by the Verifier to have a greater than 90% chance of being higher than the estimate provided in this report for the collection of projects evaluated.

9. Long Term Sustainability of VERs

Because the improved stove dissemination project has been operating at a relatively large scale for only a few years, the long term sustainability of the VERs is just now being revealed in monitoring and verification data. The Verifier recommends that as part of continuing monitoring and verification studies, a review of early vintage VERs be made. Any loss of early vintage VERs should be charged against the VERs claimed in the current year through the use of a replacement VER tranfer. In fact future verification of the 2008 through 2013 ERs listed in this report will provide an incentive for maintaining long term program sustainability and monitoring data for assuring the long-term sustainability of the program. This way a reliable, and sustainable accounting of total project VERs is likely to be maintained through the long term continuing development and carbon finance support of the Eritrean improved stove dissemination program. The VER registration office of the MoEM has both the technical capacity and information that will allow it to monitor long term sustainability and provide replacement VERs for those projects that prove to not be sustainable.

10. References

IPCC, 1996, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual International Panel on Climate Change
http://www.ipcc-nggip.iges.or.jp/index.html

Project Design Document for Eritrea Dissemination of Improved Stoves Program
http://www.punchdown.org/rvb/mogogo/ProjectDsgnDoc200301.html

Verification Document for the Eritrea Dissemination of Improved Stoves Program (EDISP), March 2003, Eritrea Technical Exchange Project of the International Collaborative for Science Education and the Environment (ETEP/ICSEE), 3217 College Ave., Berkeley, CA 94705, March 2003. URL:
http://www.punchdown.org/rvb/mogogo/EDISPVerifyDoc200303.html

Appendix 1: Update of VER and ER Vintage Assignment Method

In previous verification reports for the EDISP program, the cumulative emissions reductions due to improved stove efficiency was credited in the year that the stove was built. In earlier reports, this was less of an issue because much of the fuel savings was biomass with a relatively short lifetime in the ecosystem, so much of the emissions reduction actually did occur in the first few years after stove construction.

Starting in this report an improvement is being adopted in the assignment of emissions reductions to different years or vintages. Here the cumulative emissions reductions are assigned to a period of years that is the smallest integer less than the BLife parameter in the cumulative emissions reduction equation. Net emissions reductions from the stove occur over a period of years and the simplest way to represent the emissions reduction time series is to attribute them to a period of BLife years with no emissions reductions after this period. In reality, the net emissions reduction from a stove will be complex function over time, but the assumption of a constant emissions reduction over the period of BLife is a reasonable and conservative approximation of this complex behaviour where the net emissions are under estimated during for the early years, over estimated for the late years, and properly estimated on average.

This new methodology of emissions reduction assignment to different years is illustrated in Table 2 of this report. Approximately 50% of stoves were installed in 2005 and 50% were installed in 2006, which means that emissions reduction occur over the nine-year period from 2005 through 2013. Note that some of the exact values in the first and last year vary slightly due to round-off error corrections.

Appendix 2: Dr. Robert Van Buskirk Biography

Dr. Robert Van Buskirk is a Program Manager in the Environmental Energy Technologies Division of Lawrence Berkeley National Laboratory (EETD/LBNL). He currently leads the development of technical cost/benefit analysis for Federal Energy Efficiency Conservation Standards for the U.S. Department of Energy for distribution transformer and electric motors. He previously performed analyses cost/benefit analyses for energy efficiency standards for residential air conditioners and clothes washers.

Dr. Van Buskirk obtained his Ph.D. in Physics from Harvard University in 1991 on a computational fluid dynamics topic, the fluid dynamics of the Red Spot of Jupiter. While a graduate student he ran a volunteer exchange program with universities in Nicaragua that provided long-term teaching and research volunteers. Upon graduation he worked with Natural Resources Consulting Engineers (and Eritrean-owned consulting engineering firm) performing technical water rights studies regarding Native American water rights. In 1993 he obtained a Fulbright Scholar award to work as an Assitant Professor of Physics at the University of Asmara in Eritrea. From October 1995 to August 1997, he joined the Energy Research and Training Center of the Eritrean Department of Energy and helped launch the Eritrean government's research programs in wind and solar resource assessment and stove efficiency. This included developing stove efficiency testing protocols and training staff in research and data collection.

In March 1999, Dr. Van Buskirk joined EETD/LBNL and has conducted and lead diverse research and analyses in energy efficiency and renewable energy policy analysis, cost/benefit evaluation and development potential.

More detail on selected work by Dr. Van Buskirk can be found with a relatively simple google search:

http://www.google.com/search?hl=en&q=%22Robert+Van+Buskirk%22+Energy