# Monitoring Report

## Issuance 3: 16 May 2012 - 28 February 2013

Version 6: September 17, 2013[1]

## Project name: GS 949; Clean and Efficient Cooking and Heating Project, China

**Report filename**: GS 949; Monitoring Report; 120516 - 130228
**Period(s) reported:** 16 May 2012 through 28 February 2013

**Project Database period** (stove sales eligible for crediting): 29 March 2009 - 28 February 2013
**Emissions Reduction crediting period:** 16 May 2012 to 28 February 2013 (3rd Issuance Period)
**Start of Project crediting**: 29th March 2011, 2 years retroactive beginning 29th March 2009

Submitted by Impact Carbon on behalf of Project Stove Manufacturers with assistance from MyClimate and local partner, China Association for Rural Energy Industries (CAREI)

Huifeng Stove (Guizhou)

Jinqilin Stove (Shanxi)

Zhiqi Stove (Enshi)

[1] Previously MR versions were submitted to the DOE on the following dates: March 15, 2013 (version 1); May 22, 2013 (version 2); June 3, 2013 (version 3); June 11, 2013 (version 4); and July 23, 2013 (version 5).

## Contents

# 1. Introduction

With respect to the registered Voluntary Gold Standard PDD authored by Impact Carbon and titled **PDD, GS 949 Design Change Highlights v4**[2], and the Voluntary Gold Standard Passports titled **Passport GS949 V7_26042011, Annex 30, Enshi Passport and Annex 31, Guizhou Passport** for GS 949 project labelled "Clean and Efficient Cooking and Heating Project, China," registered on 29th March 2011[3]**:**

This report documents the installation and on-going monitoring of three types of stoves sold from 05 March 2009 – 28 February 2013:

- Improved agricultural residue semi-gasifier cooking stoves in Shanxi Province, China as sold by Jinqilin Stove Manufacturers Ltd. (Model CKQ),
- Improved biomass stoves that function as both cooking and heating technologies, as sold by Enshi Zhiqi Biomass Energy Science and Technology Development Co. Ltd (Zhiqi – Model ZQ-JG-220) and Anshun Huifeng Energy Saving Stove Company Ltd (Huifeng – Model HK-HF-70) in coal endemic areas of Enshi state, and Guizhou province, respectively. The project began crediting these stoves at the start of Issuance-2 on October 1st, 2010. Sales are retroactively eligible for crediting beginning with the signing date of the VERPAs; which are 18th November 2008 (Zhiqi, listed as Annex 37) 5 January 2009 (Huifeng, listed as Annex 38).

This Monitoring Report (MR) documents the emissions reductions generated by project stoves sold in the Issuance 3 Monitoring period between 16th of May, 2012 and the 28th of February, 2013.

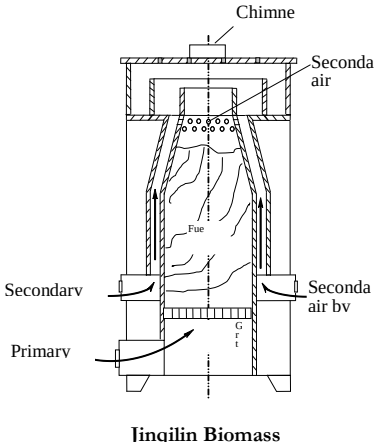
# 2. Project Description and Summary

The project partnership promotes the use of efficient and clean household energy technologies that can be used for cooking and heating throughout coal endemic areas of China, and generates carbon credits in the voluntary market based on the associated greenhouse gas emission reductions of these these technologies. Additional energy savings technologies may be added during the project period as new fuel-saving technologies are identified.

The first technology presented for crediting is classified as "semi-gasifier," but here after shortened to "gasifier." This gasifier is manufactured by Shanxi Jinqilin Energy Technology Company Ltd (Figure 1) and features carefully engineered airflow and insulated combustion chambers to burn biomass crop residues cleanly and efficiently. The thermal efficiency in laboratory testing using biomass residues for the Jinqilin stove model CKQ 80 is 41.4%, and for model CKQ80I is40.4%.[4] Published research shows 8-15% traditional coal stove efficiencies when performance was measured in-homes, and lab testing of traditional coal stoves shows efficiencies of 20%.[5,6]

**Figure 1.** Technical specifications for Jinqilin improved stove

[2] Project design change approved by the GS on April 29, 2013.
[3] The project is listed as "issued" on the GS project registry, having issued twice thus far. The project issued credits most recently in May 2013.
[4] Lab test results available to DOE. Both models CKQ and CKQI have identical combustion chamber designs. CKQ model additionally has a chamber for heating water and an optional fan to facilitate combustion.
[5] Thermal efficiency testing on traditional coals stoves conducted by: The Center of China Rural Energy Research and Training Add: Rm 801, Maizidian Street No.41 Chaoyang District, Beijing China. Tel. 0086 10 65928412 Mr. Xiao Mingsong, xiaoms@sohu.com
[6] The first generation of improved coal stoves (now considered old and "traditional" technologies) in China introduced in the 1980s and early 1990s had efficiency standards of 20%, but field studies and lab testing have shown efficiencies ranging from 8-10%, well below the proposed benchmarks. These published findings further support Yu County government coal stove efficiency test results. See the following study for comprehensive explanation of technical performance of stoves resulting from NISP: Sinton, J. E., K. R. Smith, et al. (2004). "An Assessment of Programs to Promote Improved Household Stoves in China." Energy for Sustainable Development **8**(3): 33-52.


Jinqilin Biomass

| Jinqilin Stove Specifications | | |
|---|---|---|
| Testing data[7] | CKQ 80 | CKQ 80I |
| Thermal Efficiency | 41.4% | 40.4% |
| Cooking Power | 4.2 kW | 3.8 kW |

Both Jinqilin CKQI and CKQ model stoves can use unprocessed crop residues and processed "briquette" crop residues, which are continually loaded with a manual fuel-feed. The stoves increase combustion efficiency by using primary airflow that flows up through the grate at the bottom of the stove, and secondary airflow that enters the combustion chamber through holes added on the upper part of the stove. The primary airflow coming into the lower grate results in biomass fuel that is burned incompletely. This incomplete burning releases combustible gases into the upper combustion chamber, where the secondary airflow facilitates further burning of the released gases. This transforms the two-phase burning between solid biomass fuel and released gases into one-phase of gas burning. This semi-gasification combustion method is fuel efficient and improves indoor air quality by reducing particulate matter and carbon monoxide emissions. The CKQ model stove also utilizes a small electric fan that forces ventilation and air turbulence in order to facilitate primary and secondary air flow and increased thermal efficiency and high power cooking. The project has installed approximately 1000 model CKQ 80I stoves, and roughly 12,400 model CKQ 80 stoves, for crediting in the first verification period.

The second verification included two new stove manufacturers- Enshi Zhiqi Biomass Science and Technology Co., Ltd (here within referred to as "Zhiqi") and Anshun Huifeng Energy Saving Stove Company Ltd (here within referred to as "Huifeng").

The Zhiqi improved stove is classified as "semi-gasifier," but here after shortened to "gasifier." This gasifier is manufactured by Enshi Zhiqi Biomass Energy Science& Technology Development Company Ltd and features carefully engineered airflow and insulated combustion chambers to burn woods and biomass residues cleanly and efficiently. The thermal efficiency for combined heating and cooking in laboratory testing using biomass residues for the Zhiqi stove model ZQ-JG-220 is 81.5% against the Standard GB/T 16157-1996, HJ/T398-2007 and DB11/T540-2008.

**Figure 2.** Technical specifications for Zhiqi biomass gasifier stove

[7] Stove specifications certified by: Shanxi Mechanical Products Quality Supervision and Testing Center. Address: No.228 Shengli Street Taiyuan, Shanxi province. Tel. 0351-3184754

| Item | Testing Data |
|---|---|
| Thermal Efficiency for combined heating & cooking | 81.5% |
| Cooking Power | 3.1kw |
| Weight | 43kg |
| Top size | 750mm×750mm |
| Body size | ∮290mm*62mm |
| Base size | 440mm*440mm*140mm |

The Zhiqi stove can use unprocessed woods, crop residues and processed "briquette" crop residues, which are continually loaded with a manual fuel-feed. The stoves increase combustion efficiency by using primary airflow that flows up through the grate at the bottom of the stove, and secondary airflow that enters the combustion chamber through holes added on the upper part of the stove. The primary airflow coming into the lower grate results in biomass fuel that is burned incompletely. This incomplete burning releases combustible gases into the upper combustion chamber, where the secondary airflow facilitates further burning of the released gases. This transforms the two-phase burning between solid biomass fuel and released gases into one-phase of gas burning. This semi-gasification combustion method is fuel efficient and improves indoor air quality by reducing particulate matter and carbon monoxide emissions.

The stove is designed to be used especially in winter for heating. It can also meet users' cooking needs at the same time. The big size of stove ensures the heat radiation to warm the room. People can sit around the stove and use the stove as a table due to the big top.

The Huifeng improved stove is classified as "semi-gasifier," but here after shortened to "gasifier." This gasifier is manufactured by Anshun Huifeng Energy Saving Stove Company Ltd and features carefully engineered airflow and insulated combustion chambers to burn woods and biomass residues cleanly and efficiently. The thermal efficiency for combined heating and cooking in laboratory testing using biomass residues for the Huifeng stove model HF-CS is 88.7% against the Standard GB/T 16157-1996, HJ/T398-2007 and DB11/T540-2008.

**Figure 3.** Technical specifications for Huifeng biomass gasifier stove

| Item | Testing Data |
|---|---|
| Thermal Efficiency for combined heating & cooking | 88.7% |
| Cooking Power | 3.6kw |
| Weight | 36kg |
| Top size | 650mm×650mm |
| Body size | ∮250mm*60mm |
| Base size | 420mm*420mm*160mm |

The Huifeng stove can use unprocessed woods, crop residues and processed "briquette" crop residues, which are continually loaded with a manual fuel-feed. The stoves increase combustion efficiency by using primary airflow that flows up through the grate at the bottom of the stove, and secondary airflow that enters the combustion chamber through holes added on the upper part of the stove. The primary airflow coming into the lower grate results in biomass fuel that is burned incompletely. This incomplete burning releases combustible gases into the upper combustion chamber, where the secondary airflow facilitates further burning of the released gases. This transforms the two-phase burning between solid biomass fuel and released gases into one-phase of gas burning. This semi-gasification combustion method is fuel efficient and improves indoor air quality by reducing particulate matter and carbon monoxide emissions.

The stove is designed to be used especially in winter for heating. It can also meet users' cooking needs at the same time. The large stove size ensures the heat radiation to warm the room. People can sit around the stove and use the stove as a table due to the big top.

During the period from March 2009 through today, this project has achieved significant results in three areas: business development among local enterprise; social, economic and environmental co-benefits to local communities; and greenhouse gas emissions reductions.

The Project's first implementing partner and stove manufacturer, Jinqilin, is transitioning from a make-shift village level business into an efficient and well-structured company exhibiting sustainable growth and improved practices. With assistance from project partners, Jinqilin has established sound business operating practices, including tracking of procurement and distribution supply chains, and expanded assembly and maintenance operations.

Jinqilin has developed a quality control system for the stove production process in order to increase the average lifetime of stoves sold. To this end, Jinqilin is also establishing a customer service system which will assist with end-user technical support. Since project inception Jinqilin's reporting and record keeping has become progressively more clear, rigorous, and comprehensive. For carbon credit generation, the system was set up to provide a conservative catalogue of stoves distributed.

The Project now also credits stoves produced by two additional Manufacturing Partners; Enshi Zhiqi Biomass Energy Science and Technology Development Co. Ltd (Zhiqi) and Anshun Huifeng Energy Saving Stove Company Ltd (Huifeng). Zhiqi is based in Enshi, Hubei Province, China. Huifeng is based in Guizhou Province, China. Both companies manufacture, distribute and maintain stoves for local communities.


Enshi Guizhou

Both of these new Project Manufacturing Partners have begun to develop quality control systems as well as mechanisms for customer support. In the last year, both Zhiqi and Huifeng were able to invest in additional and more advanced manufacturing equipment, which enables improved stove quality, as well as additional human capacity. Both Partners were also able to engage in market development activities, such as participating in stove exhibitions and demonstrations and gaining media exposure.

***Figure 4.*** *Stakeholders in Guizhou participate in a local stakeholder meeting. Overwhelmingly, stakeholders continue to provide positive feedback and are eager for carbon finance to increase rural residents' ability to access and benefit from these efficient technologies.*

**Clustering Definitions**

| Cluster Name | Project Technologies Distributed | Current Distribution | Implementing Partner |
|---|---|---|---|
| Shanxi Province | CKQ stove model | Direct Sales | Jinqilin Stove Manufacturers Ltd. |
| Enshi State | ZQ-JG-220 stove model | Direct Sales | Zhiqi Biomass Energy Science Technology Development Co. Ltd. |

| | | | |
|---|---|---|---|
| Guizhou Province | HK-HF-70 stove model | Direct Sales | Huifeng Energy Saving Stove Company Ltd. |

Manufacturing Partners continue to undergo regular recordkeeping spot checks and receive regular business development support and feedback from the Project as part of capacity building and maintaining rigor of data quality.

***Figure 5.*** *Village level stove usage training ensures proper use, combined with overall improved customer service, increases the trust and reputation of the Manufacturing Companies. Depicted here is a Huifeng user training in Guizhou Province.*

***Figure 6.*** *Workers are provided with a steady workflow, and a steady income, as a result of the business development introduced by the project proponents. Pictured here is an artisan crafting the Zhiqi stove.*

In addition to business development, this project provides many ancillary benefits in Shanxi, Guizhou and Enshi. Locally, the project provides employment for significant numbers of workers, office staff and field technicians, and continues to do so as the companies grow - Zhiqi employed 32 employees in this monitoring period, Huifeng employed 66 employees, and Jinqilin employed 35 employees. The program aims to reach underprivileged families, which normally cannot afford improved stoves, by subsidizing the manufacture and sale of high quality, long lasting stoves with financial subsidies. This is an opportunity that was not previously viable without carbon finance to help cover project implementation expenses during the credit period. This becomes increasingly true as

the cost of raw materials and other manufacturing expenses rise – carbon finance is thus an integral component in both ensuring low-income families' ability to afford and access the stoves and providing opportunity for Manufacturing Partners' growth and scale.

***Figure 7.*** *Traditional coal heating practices in Guizhou Province result in black stained kitchen floors from cooking indoors with coal fuels.*

Reduced coal consumption, and subsequent cost savings for regular families using Jinqilin, Zhiqi and Huifeng stoves is a significant social benefit of this project. Families spend between 10% and 14% of their annual income and 14% to 17% of their total living expenditures on cooking fuels in rural settings in Shanxi, Enshi, and Guizhou.[8]

Once a family owns a stove, reduced coal consumption (and the subsequent financial savings and other benefits for families using Project Stoves) are evident social benefits of this project as well. In Shanxi, where low-income families spend as much as 12% of annual income on cooking fuels, the cost savings are immense: families using the Jinqilin stove can save an average of ¥1,961 RMB (US$319) per year. Users provide positive feedback on the stove:

***Figure 8.*** *"I was one of the first persons to get a Jinqilin stove 4 years ago. Through a government subsidy program I was able to buy it for a good price. Before the stove, we would throw away our corn cobs. We had no use for them, so we burned them in the fields to get rid of them. Now we save our corn cobs and use it for fuel with our Jinqilin stove. It is so fast and easy to use, much better than the long wait time for our old coal stove. But what I like most about the stove, besides the convenience, is that since buying the stove I've saved so much money from not having to buy coal for cooking. It is wonderful, every home in our Shanxi should have one."*

[8] Calculated using self-reported coal prices from KS, average annual coal consumption for each region from the KPTs, and net income and living expenditure data from 1) China Yearly Provincial Macro Statistics, 2011 Basic Statistics for People's Livelihood, 2) Enshi 2011 Statistical Yearbook, 9-8 Basic Conditions of Rural Households, and 3) Guizhou 2011 Statistical Yearbook, 10-1 People's Livelihood in Urban and Rural Areas.

The Project also introduces environmental benefits through reduced fossil fuel coal use. The dissemination of high-efficiency cooking stoves, in provinces in which more than 80% of the population cooks with traditional stoves and coal fuels, is an example of the kind of solution that is needed to address increasing trends of fossil fuel usage.

Project proponents have taken steps to prepare Manufacturing Partners for sustainable growth that could meet the future projected demand for stoves. First, the project proponents assisted with developing a monitoring and tracking system for stove sales. This has allowed Manufacturing Partners to better prepare for potential future cost barriers, as well as more accurately track customer locations and needs. With respect to the latter, the project proponents are assisting with the development of a customer service and technical maintenance division at the factories. This new division will help to ensure quality follow-up is available for both village level customer training as well as technical training related to maintenance issues. This new division addresses an important barrier to systemically changing fuel use in coal-rich Shanxi, which is the lack of a concerted and sophisticated customer service operation to create market trust and technological reliability.

***Figure 9. Above Left:*** *Raw coal being delivered and sold for cooking and heating in rural Shanxi.* ***Above Right****: Household corn yield being dried before the kernels are removed for sale. The remaining corn cobs will be saved for use with the Jinqilin stove.*

Several new initiatives are planned to improve the customer service division:

- Setting up an increased sales network and stove production and promotion
- Expanded marketing activities and increased media exposure and awareness
- Enhance after-sales service
- Strengthen technology innovation based on user feedback
- Partnership with Cummins Emission Solution on stove design improvement

Site visits and Kitchen Surveys reveal that the project continues to achieve the intended social, economic, and environmental impacts. Kitchen Surveys also regularly assess the project's continued positive social impacts. Environmentally, the project achieves all positive impacts outlined in the PDD, as stove sales continue to reduce pressure on inefficient use and burning of fossil fuel coal. Economically, Manufacturing Partners continue to improve the limited incomes of impoverished rural Chinese families, and are also helping to improve their indoor air quality and health. Further detail can be found in the Kitchen Survey reports, **Annexes 04, 05, and 06**. Information on sustainable development indicators can also be found in Section 9 of this report.

Impact Carbon is focused on changing the household energy paradigm in China from inefficient and unhealthy cookstoves to efficient, improved stoves. Achieving this shift on a national scale requires sustained business development assistance and stove subsidies financed by expected carbon payments.

In 2013, with expectation of future emissions reductions from retroactive carbon credits, Huifeng is planning to build new manufacturing facilities to handle expanded production and stove promotion. This facility will also help to ensure steady work for employees by allowing excess stoves to be stored in the storage facility prior to actual sales. The project proponents have also worked with Project Manufacturing Partners to improve the quality and durability of their stoves. During the project period, all manufacturers bought more advanced manufacturing equipment. Jinqilin changed the location on the stove where fuel is added based on customer feedback.

The project proponents are also collaborating with Manufacturing Partners on creating a strategic vision for long-term growth. Jinqilin hopes to eventually reach poor rural households outside of Yangquan City, and has also begun to explore possible biomass pellet technologies that could be cost-competitive with coal fuels for communities with less biomass supplies. With carbon revenues, Jinqilin will have the resources to product test pellet technologies and new distribution networks in other regions of Shanxi.

New Project Manufacturing Partners, Zhiqi and Huifeng, also have strategic growth plans which primarily focus on reducing barriers to access for their customer population and making the stoves more affordable. Future carbon revenues will help to ensure the growth and availability of improved stove technologies in these regions.

The sales price of all project stoves are supported by the carbon revenues associated with this project. Without support from carbon finance and local government, the stoves would be much more expensive. The Jinqilin stove currently costs 489 RMB to make, and sells for 600 RMB. The Zhiqi stove currently costs 520 RMB to make, and sells for 650 RMB. The Huifeng stove costs 558 RMB to make, and sells for 700 RMB. However, all of these retail prices are reduced via the use of subsidies supported by the project, making the stoves more affordable and accessible to the end user.

# 3. Monitoring of parameter values and QA/QC

The tables below summarize the updated values of all the monitored parameters as defined in the PDD monitoring plan. The source of each value is given in the table, and the relevant reports are separate files submitted with this document. The values applied were assessed in the Baseline Study, subsequent KPT and Aging KPT studies from prior issuances, and Quarterly Kitchen Surveys and Usage Surveys conducted for this monitoring period.

The following tables reproduce the parameters listed in the PDD Section B.7.1., and include the value of data as determined by the monitoring conducted.

Data and parameters monitored:

**Table 1. Data and Parameters Monitored**

| **Data / Parameter:** | $N_{y,i,c}$ |
|---|---|
| Data unit: | Number |
| Description: | Number of stoves sold in year y of technology i in cluster c |
| Source of data to be used: | Manufacturer sales database<br>- Annex 17; Sales Record, Shanxi 2009 – Feb 2013<br>- Annex 18; Sales Record, Enshi, 2009 – Feb 2013<br>- Annex 19; Sales Record, Guizhou 2009 – Feb 2013 |

| | |
|---|---|
| Value of data | |

| | Shanxi | Guizhou | Enshi | TOTAL |
|---|---|---|---|---|
| 2009 | 7,101 | 8,546 | 3,383 | 19,030 |
| 2010 | 6,672 | 2,727 | 3,338 | 12,737 |
| 2011 | 9,020 | 15,663 | 9,722 | 34,405 |
| 2012 | 6,844 | 12,696 | 5,441 | 24,981 |
| 2013 | 242 | 2,111 | 527 | 2,880 |
| **TOTAL** | **29,879** | **41,743** | **22,411** | **94,033** |

| | |
|---|---|
| Description of measurement methods and procedures to be applied: | Sales cards are collected for each stove at the point of sale for as many stoves as possible. The card includes the user's address, phone number, name, and signature consent to waive rights to the carbon offsets. End user information is inputted into an electronic sales database categorized by village and date. |
| QA/QC procedures to be applied: | A random sample of annual sales was selected for follow-up by the VER director. The combination of surveys and direct phone calls to households verifies the information in the electronic sales database. |
| Any comment: | All data collected as part of monitoring is archived electronically and will be kept at least for 2 years after the end of the last crediting period. |

| | |
|---|---|
| **Data / Parameter:** | $U_{y,i,c}$ |
| Data unit: | Fraction |
| Description: | Cumulative annual usage rate for stove age y of stove technology i in cluster c |
| Source of data to be used: | Usage surveys (see specific sources in tables below) |
| Value of data | |

| Shanxi - Parameter | Value | Units | Source |
|---|---|---|---|
| Usage, Age 0-1 | 100% | fractional | Annex 07b; Usage Survey, Shanxi |
| Usage, Age 1-2 | 85% | fractional | Annex 07b; Usage Survey, Shanxi |
| Usage, Age 2-3 | 85% | fractional | Annex 07b; Usage Survey, Shanxi |
| Usage, Age 3-4 | 76% | fractional | Annex 07b; Usage Survey, Shanxi |

| Guizhou - Parameter | Value | Units | Source |
|---|---|---|---|
| Usage, Age 0-1 | 100% | fractional | Annex 08b; Usage Survey, Enshi |

| | | | | |
|---|---|---|---|---|
| Usage, Age 1-2 | 100% | fractional | Annex 08b; Usage Survey, Enshi | |
| Usage, Age 2-3 | 100% | Fractional | Annex 08b; Usage Survey, Enshi | |
| Usage, Age 3-4 | 100% | fractional | Annex 08b; Usage Survey, Enshi | |

| Enshi - Parameter | Value | Units | Source | |
|---|---|---|---|---|
| Usage, Age 0-1 | 100% | fractional | Annex 09b; Usage Survey, Guizhou | |
| Usage, Age 1-2 | 100% | fractional | Annex 09b; Usage Survey, Guizhou | |
| Usage, Age 2-3 | 100% | Fractional | Annex 09b; Usage Survey, Guizhou | |
| Usage, Age 3-4 | 100% | fractional | Annex 09b; Usage Survey, Guizhou | |

| | |
|---|---|
| Description of measurement methods and procedures to be applied: | As per the methodological requirement, usage surveys were conducted in each Province for this this monitoring period on stoves ages 3-4.[9] |
| QA/QC procedures to be applied: | A random sample of stoves was selected from the current monitoring period's Sales Record of for follow-up by the 3rd party BUCT monitoring team. A combination of household visits and phone calls to households verified information in the electronic sales database and determine usage drop-off rates. 76%, 70%, and 60% of interviews were conducted through a household visit in Shanxi, Enshi, Guizhou, respectively. |
| Any comment: | For increased accuracy, usage factors are assessed annually rather than biennially. These numbers are applied to each year. Previous usage survey data for all clusters was verified for Ages 0-1, 1-2, and 2-3. For stoves Ages 3-4, refer to **Annex 07a Usage Monitoring Report, Shanxi**; **Annex 08a Usage Report, Enshi** and **Annex 09a Usage Report, Guizhou**.<br><br>All data collected as part of monitoring is archived electronically and will be kept at least for 2 years after the end of the last crediting period. |

| | |
|---|---|
| **Data / Parameter:** | $AF_{py,Dcoal,y,i,c}$ |
| Data unit: | Kilograms/day /household |
| Description: | Net quantity of coal consumed per day in the project activity by traditional coal stoves in project households with improved stove technology I, that is of age y years, in cluster c. |
| Source of | This parameter is re-assessed biennially (every 2 years) by a KPT/fuel use study report. |

[9] Usage data from Enshi and Guizhou shows 100% usage rates for all stove age groups. This is attributed to long stove lifespans and usage for only a limited number of months out of the year (see KS survey reporting). Usage surveys included 100 HHs per stove age within each province. HHs were randomly selected from the sales database (see usage survey reporting for further details).

| | |
|---|---|
| data to be used: | The findings of the most recent monitoring KPTs were reported in the previous Issuance 2 period in GS 949; Monitoring Report; 101001-120515. The reported Baseline and Project Fuel consumption values were updated to include all current stove vintages at the time of Issuance 2. The Project was due for an Aging KPT on the original cluster as well as new-stove KPTs on the newly added clusters (thus 2 biennial-annual KPTs were conducted). |

Value of data

**Shanxi**[10]

| FUEL USE PER HH | Baseline Coal Consumption | | | | | |
|---|---|---|---|---|---|---|
| Fuel Type | N | Daily Mean Coal Use (kg/day) | Lower 90% CI Adjustment Factor (kg/day) | Adjusted Daily Mean Coal Use - Lower 90% CI (kg/day) | Avg. Annual Coal Use (Months) | Annual Mean Coal Use (tons/yr) |
| Coal | 38 | 7.74 | 87% | 6.71 | 12.00 | 2.83 |
| **FUEL USE PER HH** | **Project Coal Consumption** | | | | | |
| Fuel Type | N | Daily Mean Coal Use (kg/day) | Lower 90% CI Adjustment Factor (kg/day) | Adjusted Daily Mean Coal Use - Lower 90% CI (kg/day) | Avg. Annual Coal Use (Months) | Annual Mean Coal Use (tons/yr) |
| Coal | 38 | 7.74 | 87% | 6.71 | 3.07 | 0.72 |

**Enshi**

| FUEL USE PER HH | Baseline Coal Consumption | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Fuel Type | N | Daily Mean Coal Use (kg/day) | CI +/- | 90% CI Lower | Precision | 90/30 Met? | Lower 90% CI Adjustment Factor (kg/day) | Adjusted Daily Mean Coal Use - Lower 90% CI (kg/day) | Avg. Annual Coal Use (Months) *based on cumulative weighted KS data* | Annual Mean Coal Use (tons/yr) |
| Coal | 84 | 13.92 | 0.92 | 12.99 | 7% | YES | 93% | 12.99 | 5.03 | 2.13 |
| **FUEL USE PER HH** | **Project Coal Consumption** | | | | | | | | | |
| Fuel Type | N | Daily Mean Coal Use (kg/day) | CI +/- | 90% CI Lower | Precision | 90/30 Met? | Lower 90% CI Adjustment Factor (kg/day) | Adjusted Daily Mean Coal Use - Lower 90% CI (kg/day) | Avg. Annual Coal Use (Months) *based on cumulative weighted KS data* | Annual Mean Coal Use (tons/yr) |
| Coal | 84 | 0.00 | NA | NA | NA | NA | NA | NA | 5.03 | 0.00 |

**Guizhou**

| FUEL USE PER HH | Baseline Coal Consumption | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Fuel Type | N | Daily Mean Coal Use (kg/day) | CI +/- | 90% CI Lower | Precision | 90/30 Met? | Lower 90% CI Adjustment Factor (kg/day) | Adjusted Daily Mean Coal Use - Lower 90% CI (kg/day) | Avg. Annual Coal Use (Months) *based on cumulative weighted KS data* | Annual Mean Coal Use (tons/yr) |
| Coal | 78 | 12.96 | 1.40 | 11.56 | 11% | YES | 89% | 11.56 | 4.38 | 1.73 |
| **FUEL USE PER HH** | **Project Coal Consumption** | | | | | | | | | |
| Fuel Type | N | Daily Mean Coal Use (kg/day) | CI +/- | 90% CI Lower | Precision | 90/30 Met? | Lower 90% CI Adjustment Factor (kg/day) | Adjusted Daily Mean Coal Use - Lower 90% CI (kg/day) | Avg. Annual Coal Use (Months) *based on cumulative weighted KS data* | Annual Mean Coal Use (tons/yr) |
| Coal | 78 | 0.00 | NA | NA | NA | NA | NA | NA | 4.38 | 0.00 |

[10] In Shanxi, kitchen surveys show that households use the stove for more months per year than just the non-heating months; actually, it is common for stove users to continue usage of the improved stove through part or all of the heating season. Therefore, as "self-reported non-heating months" do not always correlate with "self-reported actual months of usage", PP now uses self-reported actual months of usage. As this data is only available during the 2nd biennial aging KPT for Shanxi, PP conservatively uses a weighted average to account for using self-reported non-heating months (7.75 months) for stoves Age 0-1, and using self-reported months of actual use (9.25 months) in for stoves Age 1+, as was previously done for the last issuance period. These calculations are available and can be transparently traced in GS 949; Monitoring Report; 101001-120515, Annex 01. Moreover, as new clusters have been added for efficient heating stoves, the description for parameter Afpy,Dcoal, y, i, c is no longer appropriate as was listed in the original PDD; limiting the parameter to only non-heating months is no longer appropriate. This has been up-dated as part of the design change (see page 43 of PDD, GS 949 Design Change Highlights V4): whereas parameter Afpy,Dcoal, y, i, c was listed as "the mass (kg/day) of fossil fuel coal consumed daily during the non-heating season in the project activity by traditional coal stoves in year y specific to HH's with stove technology i and cluster c" -- clause 'non-heating season' has been updated to 'usage season.'"

Data on self-reported months of usage is available for Shanxi, whereas it is not yet been included in the monitoring of Guizhou and Enshi. PP will include this question in future monitoring surveys for new clusters also.

| | |
|---|---|
| Description of measurement methods and procedures to be applied: | Per GS VER Methodology: An "Aging-Stove KT" should be undertaken not less frequently than bi-annually for sales made in the first year, to measure coal fuel reduction and other relevant factors in successive years of stoves of Age y years, Age y+1 years, and so on. A linear extrapolation is applied to all stoves of intermediate age and extended age, when calculating overall project GHG reductions. |
| QA/QC procedures to be applied: | Review by VER Director |
| Any comment: | All data collected as part of monitoring is archived electronically and will be kept at least for 2 years after the end of the last crediting period. |

| | |
|---|---|
| **Data / Parameter:** | $AF_{py,Apellet,y,i,c}$ |
| Data unit: | Tons per year |
| Description: | Net quantity of biomass pellets produced per year for use in the project activity in year y by pellet production technology i for cluster c. |
| Source of data to be used: | Quarterly monitoring survey |
| Value of data | No pellets have been distributed yet. |
| Description of measurement methods and procedures to be applied: | The project does not currently use biomass pellet fuels in the project activity. This parameter will be assessed during the relevant future verification period once a biomass pellet technology has been identified and installed in the project activity. |
| QA/QC procedures to be applied: | Review by VER Director |
| Any comment: | All data collected as part of monitoring will be archived electronically and will be kept at least for 2 years after the end of the last crediting period. |

| | |
|---|---|
| **Data / Parameter:** | $EF_{Pellet\ Machine,i,c}$ |
| Data unit: | MWh/kg |
| Description: | Emission factor (MWh/kg) for electricity consumption in year y for use by biomass pellet production technology i in cluster c |
| Source of data used: | Lab test for NCV, or publicly available data |
| Value applied: | No pellets have been distributed yet. |
| Justification | The project does not currently use biomass pellet fuels in the project activity. $EF_{Pellet\ Machine,i,c}$ will |

| | |
|---|---|
| of the choice of data or description of measurement methods and procedures actually applied: | be assessed during the relevant future verification period once a biomass pellet technology has been identified and installed in the project activity. |
| Any comment: | None |

| | |
|---|---|
| **Data / Parameter:** | $EF_{EL,y,i,c}$ |
| Data unit: | $tCO_2/MWh$ |
| Description: | Emission factor for electricity generation in year y for use by biomass pellet technology i in cluster c |
| Source of data to be used: | China Bureau of Statistics – Energy Statistical Yearbook |
| Value of data | N/A |
| Description of measurement methods and procedures to be applied: | No pellets have been distributed yet. |
| QA/QC procedures to be applied: | Review by VER Director |
| Any comment: | None |

| | |
|---|---|
| **Data / Parameter:** | $EC_{pj,y,i,c}$ |
| Data unit: | MWh |
| Description: | Quantity of electricity consumed in the project activity in year y by biomass pellet technology i in cluster c |
| Source of data to be used: | Quarterly monitoring surveys |
| Value of data | N/A |
| Description of measurement methods and | No pellets have been distributed yet. |

| | |
|---|---|
| procedures to be applied: | |
| QA/QC procedures to be applied: | Review by VER Director |
| Any comment: | All data collected as part of monitoring will be archived electronically and will be kept at least for 2 years after the end of the last crediting period. |

| | |
|---|---|
| **Data / Parameter:** | $TDL_{y,i,c}$ |
| Data unit: | Percentage |
| Description: | Average technical transmission and distribution losses in year y for providing electricity to biomass pellet technology i in cluster c |
| Source of data to be used: | China Bureau of Statistics – Energy Statistical Yearbook |
| Value of data | N/A |
| Description of measurement methods and procedures to be applied: | No pellets have been distributed yet. |
| QA/QC procedures to be applied: | Review by VER Director |
| Any comment: | All data collected as part of monitoring will be archived electronically and will be kept at least for 2 years after the end of the last crediting period. |

| | |
|---|---|
| **Data / Parameter:** | $LE_{pj,y,c,i}$ |
| Data unit: | tCO2/stove per lifetime of stove |
| Description: | One-time leakage emission factor applied to stove sales during project activity year “y” in cluster “c” by transport and/or production of project technologies and activities “i” |
| Source of data to be used: | Multiple, see Annex 20, Leakage Assessment |
| Value of data | Negligible (See Section 5) |
| Description of measurement methods and procedures to be applied: | Leakage is assessed biennially using actual sales records.<br>Leakage assessments have been conducted for each issuance period, summarized in Section 5 and Annex 20. |

| | |
|---|---|
| QA/QC procedures applied: | Review by VER Director |
| Any comment: | All data collected as part of monitoring will be archived electronically and will be kept at least for 2 years after the end of the last crediting period. |

| **Data / Parameter:** | **Sustainability** |
|---|---|
| Data unit: | Variable |
| Description: | Sustainability Indicators |
| Source of data to be used: | Quarterly Kitchen Surveys were conducted in this monitoring period to assess the impact of the sustainability indicators listed in the GS Passport. See the following annexes:<br>- Annex 04; KS Report, Shanxi<br>- Annex 05; KS Report, Enshi<br>- Annex 06; KS Report, Guizhou |
| Value of data | Refer to Sustainability Monitoring in Section 9 of the Monitoring Report |
| Description of measurement methods and procedures to be applied: | Per GS VER Methodology, *"The wider social and economic impact of the project should be investigated biannually and an assessment made of its contribution, positive or otherwise, to sustainable development in the area."*<br>Quarterly Kitchen Survey data collected in each Province for this Monitoring Period was used to assess and report the project's impact on the sustainable indicators as outlined in the GS Passport, Section G: Sustainability Monitoring Plan.<br><br>The results of this monitoring and details on the Project's achievements are outlined in the Monitoring Report Section 2 "Project description and summary." |
| QA/QC procedures to be applied: | Review by VER Director |
| Any comment: | All data collected as part of monitoring is archived electronically and will be kept at least for 2 years after the end of the last crediting period. |

| Data / Parameter: | **fNRB** |
|---|---|
| Data unit: | fraction |
| Description: | Fraction of non-renewable biomass |
| Source of data to be used: | Biennial study |
| Value of data | **Shanxi:**<br>N/A: renewable agricultural residue<br><br>**Enshi:**<br>0.00<br><br>**Guizhou:**<br>0.00 |
| Description of measurement methods and procedures to be applied: | A biennial study evaluates fNRB for each applicable region using fuelwood in the project activity. Publicly available literature, government statistics, or study data are used to determine fNRB. |
| QA/QC procedures to be applied: | Review by VER Director |
| Any comment: | All data collected as part of monitoring will be archived electronically and will be kept at least for 2 years after the end of the last crediting period. |

**Table 2. Summary of Monitored Parameters**

| | Monitored Parameter Description | | | | | Values for each Cluster | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Item** | **Revised Description** | **Revised Parameter** | **Unit** | **Frequency** | **Tool** | **Shanxi** | | **Enshi** | | **Guizhou** | |
| 1 | Number of units installed of technology i in year y to cluster c | $N_{y,c,i}$ | # units/yr | On-going | Sales Database | 29,879 | | 22,411 | | 41,743 | |
| 2 | Percent sales of project technology i in year y to cluster c to baseline fuel group coal users | $S_{bl,coal}$ | % | Annual | Kitchen Survey | 94.59% (baseline coal use during non-heating season) | | 96.51% (baseline coal use during heating season) | | 88.67% (baseline coal use during heating season) | |
| 3 | Net quantity of coal consumed per day in baseline by traditional coal stoves | $AF_{bl,Dcoal,c}$ | kg / day | As necessary | Kitchen Test | 7.74 | | 13.92 | | 12.96 | |
| 4 | Net quantity of coal consumed annually in baseline by traditional coal stoves | $AF_{bl,Acoal,c}$ | t / year | Biennial | Kitchen Test | 2.83 | | 2.13 | | 1.73 | |
| 5 | The mass of coal consumed daily during the project activity in traditional coal stoves by project households with project stove technology[11] | $AF_{py,Dcoal,c}$ | kg / day | As necessary | Kitchen Test | 0.00 | | 0.00 | | 0.00 | |
| 6 | The mass of coal consumed annually during the project activity in traditional coal stoves by project households with project stove technology[12] | $AF_{py,Acoal,c}$ | t / year | Biennial | Kitchen Test | 0.72 | | 0.00 | | 0.00 | |
| 7 | Usage of project technologies in place | $U_{y,c,i}$ | % | Biennial | Usage Survey | Age 0-1 | 100% | Age 0-1 | 100% | Age 0-1 | 100% |
| | | | | | | Age 1-2 | 85% | Age 1-2 | 100% | Age 1-2 | 100% |
| | | | | | | Age 2-3 | 85% | Age 2-3 | 100% | Age 2-3 | 100% |
| | | | | | | Age 3-4 | 76% | Age 3-4 | 100% | Age 3-4 | 100% |
| 8 | Average self-reported months of usage | $T_{usage\ months,c}$ | months / year | On-going for KS, Biennial for KT | Shanxi - KT Enshi – KS Huizhou - KS | 8.93 | | 5.03 | | 4.38 | |

[11] The values listed for this parameter represent coal per day consumption during the usage months of the project activity.

[12] $AF_{py,Acoal,c} = (AF_{py,Dcoal,c} * T_{pj\ usage\ days,c}) + (AF_{bl,Dcoal,c} * T_{py\ non\text{-}usage\ days,c})$. The values listed for this parameter represent annual coal consumption (including months of non-usage).

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | Average self-reported days of usage | $T_{usage\ days,c}$ | days / year | On-going for KS, Biennial for KT | Shanxi - KT<br>Enshi – KS<br>Huizhou - KS | 271.64 | 153.00 | 133.23 |
| 10 | Non-renewable biomass in project | $X_{nrb,pj,y}$ | Fraction | As required | Study | 0% | 100% | 100% |
| **Item** | **Revised Description** | **Revised Parameter** | **Unit** | **Frequency** | **Tool** | **Shanxi** | **Enshi** | **Guizhou** |
| 11 | Leakage from project technologies | $LE_{pj,c}$ | tCO2e/stove-lifetime | Biennial | Study | Negligible | Negligible | Negligible |
| 12 | CO2 emission factor for coal fuel | $EF_{coal,co2}$ | kg CO2/TJ | Fixed | IPCC Default | 94600 | | |
| 13 | CH4 emission factorfor coal fuel | $EF_{coal,CH4}$ | kg CH4/TJ | Fixed | IPCC Default | 300 | | |
| 14 | N2O emission factor for coal fuel | $EF_{coal,N2O}$ | kg N2O/TJ | Fixed | IPCC Default | 1.5 | | |
| 15 | Net calorific value of coal | $NCV_{coal}$ | TJ / Gg | Fixed | IPCC Default | 25.8 | | |
| 16 | Global warming potential of CO2 | $GWP_{CO2}$ | | Fixed | IPCC Default | 1 | | |
| 17 | Global warming potential of CH4 | $GWP_{CH4}$ | | Fixed | IPCC Default | 21 | | |
| 18 | Global warming potential of N20 | $GWP_{N2O}$ | | Fixed | IPCC Default | 310 | | |

## Project Forward Action Requests

Table 3 below outlines the forward action requests (FARs) issued from previous project verifications as well as PP actions fulfilled this issuance period to meet these requests.

**Table 3.** FARs

| Issuance | FAR # | Repeat Assessment? | Description | PP Comment |
|---|---|---|---|---|
| 1 | FAR 1 | **NO** | Please note that the incentive scheme to discourage the use of old stoves is also part of SD monitoring plan, being a retroactive period it is not possible to discuss the same for this monitoring period. The **PP** shall monitor the same and report in next verification. | The PP has included old stove disposal in KS monitoring and has reported on the incentive scheme in the previous and current verifications.<br><br>Shanxi KS results show that no end users have disposed of their old stove because the stoves are built into the homes and are very difficult to remove. During the months that the project stove is use, the old baseline stoves are used for a large kitchen table.<br><br>KS questionnaires for Enshi and Guizhou were updated to gather information needed to evaluate the incentive scheme to discourage the old stove use after the monitoring for this verification period was complete. Enshi and Guizhou KS analysis for next verification period will evaluate the incentive scheme in these regions. |
| 2 | FAR 1 (DOE) | **YES** | During the site visit and interviewing with local manufacturer in Shanxi Province, the audit team could confirm the improved stoves became popular in the nearby counties and regions. When the periodic KPT and KS is performed by the monitoring team, the random sampling selection shall cover all the regions where improved stoves were sold, to be assured the survey results are representative. The same situation may apply with the new clusters approved. | All regions where improved stoves were sold during the crediting period were included in the sampling frame for the KS. |
| 2 | FAR 1 | **Yes** | Please make sure SD indicators will be reported in each monitoring report even though SD monitoring might be less frequent than issuance request. | SD indicators are reported on in Section 9 of the Monitoring Report. |
| 2 | FAR 2 | **No** | At each time of verification the verification DOE shall validate and confirm that eligibility of the project activity is not undermined by the post registration changes. | N/A |

| | | | | |
|---|---|---|---|---|
| 2 | FAR 3 | **Yes** | As the footnote no.1 and the paper 'Bottom-up estimate of biomass burning in Mainland China' indicate, the crop residue used as fuel accounts for 25% of the total biomass, a fraction much higher than the baseline level of 2% HHs use biomass. GS requires that during future requests for issuances it should be discussed in the monitoring report and verified by DOE whether new households added to the cluster(s) defined in registered PDD meet the specifications of the cluster(s) particularly 'coal as predominant fuel for cooking'. If kitchen surveys show different fuel mix where large amount of biomass is consumed as cooking fuel then a new cluster shall be formed and new baseline shall be established and validated. | Kitchen surveys show that for all clusters coal is used as the predominant fuel for cooking. See Annexes 01, 02, 03, 04, 05, 06 for Kitchen Survey Analysis and Reports for each cluster. |
| 2 | FAR 4 | **No** | Post-registration Changes requiring the creation of new clusters that were not described in the original PDD must attain formal authorization following the Requirements of the Gold Standard Procedures For Approval of Design Changes 28/12/2010. Specific authorization is provided to include: a. Household biomass cooking and heating stoves manufactured by companies other than Jinqilin b. Institutional biomass cooking and heating stoves manufactured by companies<br>than Jinqilin c. Other improved cooking and heating technologies that displace baseline coal<br>consumption<br>The above inclusions will be validated at the time of future verification. | New clusters have not been added this issuance period. New inclusions will be validated during the issuance periods in which they have been added. |
| 2 | FAR 5 | **Yes** | The project developer will have to identify whether the project will use a fixed or evolving baseline for new clusters. | No new clusters have been added this issuance period. |

**Carbon Calculator Inputs:**

Based on the fuel consumption values determined by the Kitchen Tests conducted in the Issuance 2 Monitoring Period and the Kitchen Survey data collected for this Monitoring Period, the estimated emissions reduction per stove year is calculated to be the following:

- **Shanxi**: **5.20** tonnes CO2e per stove-year
- **Enshi**: **5.37** tonnes CO2e per stove-year
- **Guizhou**: **4.01** tonnes CO2e per stove-year

(Detailed calculations of the ER values can be found in the Issuance 3 Project Calculation Files).

Annual emission reductions (ERs) are based on the mean value (according to 90/30 rule) for daily baseline coal use, annual usage drop-off rates, and average self-reported heating months during which the Project stove is used (see Table 1).

# 4. Emission Reductions Calculations

Table 4 shows the CO2e emissions reductions achieved during the project period reported by the GS VER project ***Clean and Efficient Cooking and Heating Project, China***. Crediting for these stoves is for the Issuance 3 crediting period (16 May 2012 – 28 February 2013).

**Table 4.** Summary of emission reductions during crediting period 16 May 2012 – 28 February 2013:

**Verification Period:** 16 May 2012 - 28 February 2013

**Total Emission Reductions (tCO2e):** **303,121**

| | Cluster: | Shanxi | | Guizhou | | Enshi | | Leakage | Total ERs |
|---|---|---|---|---|---|---|---|---|---|
| Year | Quarter | Stove Years | tCO2e | Stove Years | tCO2e | Stove Years | tCO2e | tCO2e | tCO2e |
| 2012 | 16May - 30Jun | 3,004 | 15,624 | 4,304 | 17,237 | 2,072 | 11,134 | Negligible | 43,996 |
| | Q3 | 6,005 | 31,230 | 9,329 | 37,363 | 4,294 | 23,070 | Negligible | 91,664 |
| | Q4 | 6,381 | 33,189 | 9,805 | 39,268 | 5,000 | 26,865 | Negligible | 99,323 |
| 2013 | 1Jan - 28 Feb | 4,309 | 22,413 | 6,597 | 26,423 | 3,593 | 19,303 | Negligible | 68,139 |
| | **Total** | **19,699** | **102,457** | **30,035** | **120,292** | **14,959** | **80,373** | **-** | **303,121** |

| | |
|---|---|
| Total Vintage 2012: | 234,982 |
| Total Vintage 2013: | 68,139 |

**Explanation of Emission Reduction Calculations**

The Emissions Reduction (ER) Calculator calculates total emissions reductions on a quarterly basis for each stove in the Project Database. The ER Calculator is run separately for each cluster of stoves defined for the project.

The calculator accounts for the day that each stove begins use and calculates the usage of each stove in each quarter. It factors in the monitored annual drop-off in usage as stoves age, and other monitored parameters[13]. Stove usage is calculated in stove-years[14], the number of stove days the stove was used divided by 365 (days). Quarterly usage[15] (stove-years) for the cluster is multiplied by the emissions reduction per stove-year (tCO2e/stove-year) calculated in the PDD to quantify total ERs per project quarter.

The 'Parameters' worksheet of each ER Calculation workbook states 'Usage Rates', and 'Emission Reductions' (tCO2e/stove-year). Project sales are listed in the 'Project Database' worksheet.

Stove quantities and 'Usage Start-Dates' are linked from the 'Usage Record' worksheet to the 'Age 0-1', 'Age 1-2, 'Age 2-3', and 'Age 3-4'worksheets. These 'Use' worksheets calculate usage on a daily basis for each day of the project period (x-axis) for each 'Usage Start-Date' and the corresponding stove quantity (y-axis). The 'Use' worksheets are separate to account for stove usage at different ages: Usage for all stoves aged 0 - 1 year, which are in their 1st year of use, is accounted in the 'Age 0-1' worksheet. Usage for all stoves aged 1 – 2 years, which are in their 2nd year of use, is accounted in the 'Age 1-2' worksheet. Usage for all stoves aged 2 – 3 years, which are in their 3nd year of use, is accounted in the 'Age 2-3' worksheet. Usage for all stoves aged 3 – 4 years, which are in their 4nd year of use, is accounted in the 'Age 3-4' worksheet.

Daily stove use (stove-days) is calculated using Annual Usage Rates for stoves of different ages (agei_j). The Annual Usage Rates are calculated to reflect annual usage drop-off from the Cumulative Usage Rates (CumUi) determined in the monitoring studies below. The Annual Usage Rate (agei_j) is the average annual drop-off in usage. That rate is applied to all stoves equally over the full year they are of a given age (Age 0-1, Age 1-2, etc.). Per Gold Standard and DOE request, PP has improved the sampling approach for usage surveys and has applied random sampling to sales made in the first year of the project (as opposed to following a cohort of stoves).

Calculating Annual Usage Rates (agei_j) from Cumulative Usage Rates (CumUi) is straightforward: If 100 of 100 monitored stoves are still in use after one year, the Cumulative Usage Rate (CumU1) after one year is 100%. If 50 of the original 100 stoves are still in use after two years, the Cumulative Usage Rate (CumU2) after two years is 50%. The Annual Usage Rate (age0_1) in year 1 is 100%. The Annual Usage Rate (age1_2) in year 2 is 75% ((100%+50%)/2).

Once daily stove usage (stove-days) is accounted in the 'Use' worksheets for stoves from each 'Usage Start-Date', it is converted to stove-years by dividing stove-days by 365. Stove-years of usage are aggregated on a quarterly basis in the 'ER Calculations' worksheet.

Finally, on the 'ER Calculations' worksheet, aggregate quarterly stove use (stove-years) is multiplied by ERs per stove-year (tCO2e/stove-year) to calculate total ERs on a quarterly basis. The values from the 'ER Calculations' worksheet provides a summary of ERs for the current verification crediting period.

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[13] The full set of parameters is given in the monitoring tables below.

[14] Stove years are the number of days that the stove was used divided by the number of days in the year. So, for example, one stove-day may be 1/365th stove year. In the case of a leap-year, this is accounted for – the tab in the calculator lists out all of the days in a year, giving each day its own row; on leap-years, this day is automatically considered. This can be checked in the "Project Database" tab of the calculator files. For every stove that goes into use, the stove-days are tracked in the calculator and added up. The tCO2e value as measured by the KPT (and adjusted based on seasonal months of usage as explained in the MR and on site) is used to calculate tons of CO2e reduced per stove-year; factoring in stove years enables the calculator to account for the fact that not all stoves are used for 100% of each usage season (for example, some are sold later in the season, whereas others may have been in use and then go out of use, based on the usage monitoring). This method of calculation has been verified for 3 GS projects, including this China project.

[15] Excel Worksheet: Summary ERs

# 5. Leakage Assessment

The PDD outlines the data and information that is to be collected in order to monitor leakage effects of the project activity. In accordance with Gold Standard VER methodology "Improved Cookstove Kitchen Regime-V.02, " the project assessed each of the listed forms of leakage. The project finds leakage in section D "*The project population compensates for loss of the space heating effect of inefficient cook-stoves by adopting some other form of heating or by retaining some use of inefficient stoves" (see analysis below)* . No leakage is found for fuel production in the project activity since pellets were not used. Leakage is, however, applied for stove transport in the project activity.

**Table 5.**Leakage Assessment for each Stove Manufacturer (from PDD Section B.6.1)

***d) The project population compensates for loss of the space heating effect of inefficient cook-stoves by adopting some other form of heating or by retaining some use of inefficient stoves.***

Justification (d): Leakage.

**Jinqilin (Shanxi):** The project now credits actual months of use for the Jinqilin stove, starting with the Aging KPT in 2011 (as can be found in Footnote 8, the project was previously crediting "non-heating" months only; this was deemed to be less accurate as many users actually use the stove outside of the heating season as well; therefore, now the project begins to ask users about actual months of Jinqilin use; the project then uses a weighted fuel savings to account for this switch in this verification. The duration of months used was determined from over 400 kitchen surveys. During winter months in which light space-heating is required, users continue to use the Jinqilin stove for cooking as well as for heating purposes. The project conservatively applies non-heating season coal use values (coal used for cooking) to the heating season usage. This is conservative because heating requirements during the winter season are much higher than for cooking in non-heating season. Therefore the project conservatively under-credits the coal actually replaced in the winter by Jinqilin users, as a KPT done in this season would likely demonstrate that users actually consume more coal during the winter in the baseline scenario. In absence of this data, the project conservatively assumes that the values measured in the non-heating months are applicable year-round.

**Zhiqi (Enshi):** The Project conservatively assumes that the Zhiqi improved stove is not used during most of the non-heating months and credits only 5.03 usage months of displaced coal used for heating. The duration of heating and non-heating months was determined from cumulative quarterly kitchen surveys (N=228). During months in which space-heating is not required, it is assumed that local users revert to traditional stoves or electric stoves, and discontinue use of the improved stove. Although it is possible that some biomass stoves are used during the non-heating season for cooking, the project conservatively excludes coal replacement during non-heating heating months due to biomass stove use.

**Huifeng (Guizhou):** The Project conservatively assumes that the Huifeng improved stove is not used during most of the non-heating months and credits only 4.38 heating months of displaced coal used for heating. The duration of heating and non-heating months was determined from cumulative quarterly kitchen surveys (N=246). During months in which space-heating is not required, it is assumed that local users revert to traditional stoves and electric stoves, and discontinue use of the improved stove. Although it is possible that some biomass stoves are used during the non-heating season for cooking, the project conservatively excludes coal replacement during non-heating heating months due to biomass stove use.

***f) Significant emissions from transportation or construction involved in the project activity, including emissions associated with production/transport of the efficient stoves themselves, or production/transport of project fuels (for example briquette manufacture and supply may be energy-intensive).***

Justification (f): Leakage.

All biomass fuels are manually harvested and sourced locally. Project activities will result in a reduction in production and transport of raw coal, which is generally much more energy intensive than household biomass harvesting. With regards to technology distribution, all stoves sold during the 3rd verification period have been

distributed locally within their respective Provinces.

**Jinqilin (Shanxi):** During the period May 16th 2012 to February 28th 2013, 3,890 Jinqilin stoves, weighing 45 kg each, were trucked in bulk 92 times to villages in Yu County. Each delivery truck contained about 42 stoves, weighed approximately 2 tonnes, and furthest possible distance it travelled was 67 km to the village delivery site. Applying the a conservative mid-point estimate of 0.12427 kgCO2/ton-km, total transport emission is 0.375 kg CO2, or 0.007% of total annual stove emission reductions (5,202 kgCO2e/stove). No leakage is applied as transport emissions are insignificant by virtue of constituting less than 1% of overall emissions.

**Zhiqi (Enshi):** During the period May 16, 2012 to February 28, 2013 5,968 Zhiqi stoves, weighing 42.8 kg each, were trucked in bulk 195 times to villages in Enshi State. Each delivery truck contained an average of 30 stoves, weighed approximately 1.31 tonnes, and the furthest possible distance it travelled was 107 km from Enshi City to the village delivery site. Applying the a conservative mid-point estimate of 0.12427 kgCO2/ton-km, total transport emission is 0.57 kg CO2 per stove, or 0.01% of total annual stove emission reductions (6,074 kgCO2e/stove). No leakage is applied as transport emissions are insignificant by virtue of constituting less than 1% of overall emissions.

**Huifeng (Guizhou):** During the period May 16th 2012 to February 28th 2013, 9,857 Huifeng stoves, weighing 40 kg each, were trucked in bulk 171 times to villages in Guizhou Province. Each delivery truck contained an average of 58 stoves, weighed approximately 2.31 tonnes, and the furthest possible distance it travelled was 171 km to the village delivery site. Applying a conservative mid-point estimate of 0.12427 kgCO2/ton-km, total transport emission is 0.85 kg CO2 per stove, or 0.021% of total annual stove emission reductions (4,005 kgCO2e/stove). No leakage is applied as transport emissions are insignificant by virtue of constituting less than 1% of overall emissions.

The table below presents the inputs and calculations for the transportation emissions leakage assessment for each Province. Please see **Annex 20** for the full leakage calculations and details on the number and distance of deliveries made in all three provinces for Issuance 3.

**Transportation Leakage Emissions Assessment**

| | Jinqilin (Shanxi) | | | Zhiqi (Enshi) | | Huifeng (Guizhou) | |
|---|---|---|---|---|---|---|---|
| ***Inputs*** | Issuance 1 | Issuance 2 | Issuance 3 | Issuance 2 | Issuance 3 | Issuance 2 | Issuance 3 |
| Truck deliveries | 97 | 130 | 92 | 334 | 195 | 331 | 171 |
| Distance traveled per delivery *(km)* | 67 | 67 | 67 | 107 | 107 | 171 | 171 |
| Stove weight *(t)* | 0.045 | 0.045 | 0.045 | 0.0428 | 0.0428 | 0.04 | 0.04 |
| Stoves sold | 13,403 | 12,586 | 3,890 | 13,060 | 5,968 | 21,758 | 9,857 |
| Emission factor Heavy Goods Vehicle Truck (tCO2/tonne-km) | 0.12427 | 0.12427 | 0.12427 | 0.12427 | 0.12427 | 0.12427 | 0.12427 |
| ***Calculations*** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stoves per delivery truck | 138.175 | 96.815 | 42.28 | 39.102 | 30.61 | 65.734 | 57.75 |
| Weight of Stove Freight (t) | 6.218 | 4.357 | 1.90 | 1.67 | 1.31 | 2.63 | 2.31 |
| Tonne-km single delivery | 416.598 | 291.898 | 127.48 | 179.80 | 140.73 | 449.80 | 395.19 |
| Tonne-km all deliveries | 40,410.045 | 37,946.790 | 11,728.35 | 60,054.60 | 27,443.02 | 148,883.24 | 67,448.39 |
| **Emissions all deliveries (kg CO2)** | **5,021.76** | **4,715.65** | **1,457.48** | **7,462.99** | **3,410.34** | **18,501.72** | **8,381.81** |
| **Transport emissions per stove (kg CO2/stove)** | **0.375** | **0.375** | **0.375** | **0.571** | **0.571** | **0.850** | **0.850** |
| **Emissions Reductions (ER) per stove (tCO2e/stove year)** | | | 5.20104 | | 5.37300 | | 4.00500 |
| **ER per stove (kg CO2e/stove year)** | **4,770** | **4,770** | **5,201** | **5,530** | **5,373** | **4,480** | **4,005** |
| **% transport leakage emissions of total ER** | **0.008%** | **0.008%** | **0.007%** | **0.010%** | **0.011%** | **0.019%** | **0.021%** |

# 6. Project Database: Quality assurance

Both Partners have established recordkeeping systems that enable them to meet the monitoring requirements in GS VER "Methodology for Improved Cook-stoves and Kitchen Regimes V.02 – 08/02/2010," Page 22: all stove sales record the name, phone, and address of all bulk purchases, and the same information for households (as many as possible). If a stove is returned for any reason, or replaced with a new stove, the Partners ensure that the electronic database is updated to ensure no double counting. Monitoring of parameter values can be found in Section 3.

In accordance with the Project's PDD Section B.7.1.*Data and parameters monitored*, careful attention has been paid to the accuracy of the sales record. As explained in this section, the Project Database for each manufacturer is a conservative record of all stoves that have entered use.

The project began in 2008 selling and distributing stoves with the expectation of carbon finance to assist with carbon asset development costs and stove subsidies. In 2009, a system was set up to track stoves sold. The current system does not count stoves that go missing from the Factories to further ensure conservativeness; only invoiced sales are credited.

**Method of Collection:**
A Project Database is kept electronically by Impact Carbon: each Excel Calculator a tab titled *Project Database*. The database logs how many stoves entered use on each day based on the sales records (**Annexes 17, 18, and 19**). Impact Carbon maintains this file as a password protected excel document.

The Project Database is created from the Manufacturers' Sales Records. The Sales Records log sales and distribution information in an excel spreadsheet. Manufacturers save paper sales receipts that allow cross checks of sales. The sales records were checked by the Beijing based Ministry of Agriculture NGO – China Association for Rural Energy Industries (CAREI). CAREI audited sales entries and contacted customers to confirm that sales records were accurate. Paper invoices and receipts are saved to provide an additional cross-check.

**Project Database Electronic Record History:**
Project Manufacturers supplement their paper sales record with an electronic record stored in Microsoft Excel. The electronic file records the day of sale, county and village, and number of stoves sold.

# 7. The Detailed Customer Database

The Detailed Customer Database is maintained by Impact Carbon to capture records of Kitchen Survey interviews.

**Project Database Information**
Sales cards are collected for each stove at the point of sale. The card includes the user's name and contact information. End user information is inputted into an electronic sales database categorized by location and date. CAREI verifies the sales database against paper sales cards, follow-up phone calls and site visits.

# 8. Quality Assurance

Quality assurance measures have been implemented by the China Association for Rural Energy Industries (CAREI). CAREI is a Chinese non-profit staffed by rural energy experts based in Beijing, China. CAREI is housed under a branch of the China Ministry of Agriculture (MOA), and was founded by previous MOA minister Madam Deng Keyun. CAREI was instrumental in the 1980's and 1990's in organizing MOA's National Improved Stove Program (NISP) that disseminated over 180 million improved stoves throughout China. Although the NISP stoves are now considered inefficient and "traditional" by today's standards, CAREI continues monitoring and evaluation, and outreach efforts to sustain the rural energy infrastructure set up by the NISP. CAREI has extensive experience developing and employing household energy survey tools, and with assistance from Dr. Liu Guangqing, Professor of Environmental Engineering at the Beijing University of Chemical Technology, has extensive experience conducting trainings in customer and group assessment. To date, CAREI and BUCT have conducted extensive surveys and site visits to verify all Manufacturing Partners' sales records. CAREI and BUCT are also responsible for applying random spot checks by calling the phone numbers on sales cards to ensure the validity of information gathered. CAREI continues to work with each Manufacturing Partner to implement a system of precise and accurate production and inventory accounting.

The BUCT monitoring team consists of 3 professors, 3 Ph.D. students and 4 master students. The professors are in charge of overall supervision and consulting work. Students are responsible for on-site monitoring, data input and analysis, and record keeping. In 2008 and 2009, 3 Ph.D. students were trained by and assisted Berkeley Air Monitoring Group to conduct a kitchen survey (KS), kitchen performance test (KPT) and indoor air pollution (IAP) monitoring in more 700 HHs in Yu County and Pingding County in Shanxi, and Tongliang County in Chongqing. All the activities were conducted to monitor and evaluate the effectiveness of improved biomass stoves for USEPA project "Scale-up of High-Efficiency Low-Emissions Biomass Household Stoves in Western China" as well as for the development of carbon project activities by the project team. Subsequently, the Ph.D. students have trained other BUCT surveyors in monitoring techniques, data processing, and quality control. The training program begins with intensive class training of KS and KPT forms in the lab. Surveyors then conduct pilot interviews and practice fuel weighing to harmonize methods and techniques, and may go to the field after demonstrating competency.

The data collection and field measurements included pre-field deployment training of field personnel, including training through pilot testing that helped to ensure high response rates and harmonization of enumerators. Field teams were trained by team leaders who had conducted previous KPT and Survey testing in other regions of China (eg. In Shanxi Province for GS ID#949 that have previously verified and issued credits). The survey methods and questionnaires have been field tested multiple times throughout China, which helps ensure reliable data and unbiased data. Two enumerators were used to provide data transfer between paper to electronic records, and the paired enumerators subsequently cross-checked each other's data input.

Both BUCT and CAREI ensure Quality Assurance for the program.

# 9. Sustainable development indicators

The project has monitored the SD indicators according the registered Monitoring plan as outlined in the registered Passport. Project achievements have been outlined in the Monitoring Report Section 2 "Project description and summary." The following table monitors the most sensitive sustainable development indicators:

**Table 6.** Sustainable Development Indicators

<table>
<tr><th>Sustainable Development Indicator</th><th>Monitoring source</th><th>Variables, Units and Frequency of Measurements</th><th>Monitored result</th></tr>
<tr><td>Air quality</td><td>Fuel Use Monitoring Report , Field Surveys managed by China Association of Rural Energy Industries and Beijing University of Chemical Technology</td><td>Air pollutants (CO, particulates)</td><td>As stated in the PDD Section A2, improved stoves generally reduce indoor air pollution and improve air quality.<br><br>In every province, all users report their improved stoves reduce cooking time, fuel use, fuel cost, smoke, symptoms of coughing and eye irritation, and are easier to use. See summaries of self-reported stove performance evaluations for each province below.<br><br>Shanxi<br><br>
<table>
<tr><th>Indicator</th><th>More</th><th>Less</th><th>Same</th></tr>
<tr><td>Cooking time</td><td>0</td><td>64</td><td>0</td></tr>
<tr><td>Fuel use</td><td>0</td><td>64</td><td>0</td></tr>
<tr><td>Fuel expense</td><td>0</td><td>64</td><td>0</td></tr>
<tr><td>Ease of use</td><td>64</td><td>0</td><td>0</td></tr>
<tr><td>Amount of smoke</td><td>0</td><td>64</td><td>0</td></tr>
<tr><td>Coughing & eye irritation</td><td>0</td><td>64</td><td>0</td></tr>
</table>
<br>Enshi<br><br>
<table>
<tr><th>Indicator</th><th>More</th><th>Less</th><th>Same</th></tr>
<tr><td>Cooking time</td><td>0</td><td>60</td><td>0</td></tr>
<tr><td>Heating Time</td><td>30</td><td>0</td><td>30</td></tr>
<tr><td>Fuel use</td><td>0</td><td>60</td><td>0</td></tr>
<tr><td>Fuel expense</td><td>0</td><td>60</td><td>0</td></tr>
<tr><td>Ease of use</td><td>60</td><td>0</td><td>0</td></tr>
<tr><td>Amount of smoke</td><td>0</td><td>60</td><td>0</td></tr>
<tr><td>Coughing&eye irritation</td><td>0</td><td>60</td><td>0</td></tr>
</table>
</td></tr>
</table>

**Guizhou**

| SD Indicator | More | Less | Same |
|---|---|---|---|
| Cooking time | 0 | 90 | 0 |
| Heating Time | 0 | 1 | 89 |
| Fuel use | 0 | 90 | 0 |
| Fuel expense | 0 | 90 | 0 |
| Ease of use | 90 | 0 | 0 |
| Amount of smoke | 0 | 90 | 0 |
| Coughing&eye irritation | 0 | 90 | 0 |

Biennial Kitchen Performance Tests further assesses air quality impacts of the Project stoves.

| | | | |
|---|---|---|---|
| *Livelihood of the poor* | KS/KPT Reports. Field Surveys managed by China Association of Rural Energy Industries and Beijing University of Chemical Technology. | *Financial impact* | The impact of the Project on livelihood of the poor was monitored by the amount of money saved by Project stove users based on the price of coal and the amount of fuel savings recorded in the Kitchen Performance Test.<br><br>The Project continues to increase the spending power of lower income residents by reducing the amount families must spend on coal.<br><br>Shanxi: Based on ex-ante surveys and monitoring, the average household using a Jinqilin stove saves 2.83 tonnes of coal per year.[16] The average self-reported coal price in Shanxi was $694 RMB/ton (US $112), therefore the Jinqilin stoves saves households an average of $1,961 RMB (US $319) per year.<br><br>Enshi and Guizhou: Where coal is completely replaced with biomass (i.e baseline consumption equals savings), households saved an average of $2,205 and $2,152 RMB respectively. The average baseline coal consumption costs and their percentage of the average household's annual income and living expenditures for each Province is presented in the table below. |

[16] Reported as $AF_{bl,Acoal,c}$.

**Household Coal Expenditure by Province**

| Calculations - Financial Impacts of Project Activity | Shanxi | Enshi | Guizhou |
|---|---|---|---|
| Self-Reported Cost per coal ton (from KS) | ¥ 694 | ¥ 1,035 | ¥ 1,244 |
| Avg. HH Baseline Coal Consumption (tons/year) (from KPT) | 2.83 | 2.13 | 1.73 |
| Total Annual HH Coal Cost | ¥ 1,961 | ¥ 2,205 | ¥ 2,152 |
| Average # people per household (from KS) | 3.02 | 3.93 | 4.36 |
| Avg Annual Net Income per capita[1] | ¥ 5,601 | ¥ 5,832 | ¥ 3,472 |
| Avg Annual Living Expenditure per capita[2] | ¥ 4,587 | ¥ 4,091 | ¥ 2,852 |
| Average Annual Net Income-household | ¥ 16,915 | ¥ 22,920 | ¥ 15,138 |
| Average Annual Living expenditure-household | ¥ 13,853 | ¥ 16,078 | ¥ 12,435 |
| **% fuel of total income** | **12%** | **10%** | **14%** |
| **% fuel of total living expenditures** | **14%** | **14%** | **17%** |

[1] China Yearly Provincial Macro Statistics, 2011 Basic Statistics for People's Livelihood, 2) Hubei 2011 Statistical Yearbook, 9-8 Basic Conditions of Rural Households, and 3) Guizhou 2011 Statistical Yearbook, 10-1 People's Livelihood in Urban and Rural Areas.
[2] Ibid.

Providing upfront financing in the form of partial subsidies not only assists in expanding the market for cleaner burning and more efficient stoves, but also helps to ameliorate the large economic burden resulting from a reliance on coal for year round cooking needs.

| | | | |
|---|---|---|---|
| *Access to Affordable and Clean Energy* | 02-Electronic Sales Records.xlsx | *Fuel cost, consumption, ease of collection* | As stated in the Passport, "burning surplus agricultural biomass instead of purchasing expensive coal will save users money and provide a cheaper and cleaner alternative to coal fuels." As mentioned above, families |

| | | | |
|---|---|---|---|
| *Services* | | | reduce the quantity of coal they purchase and therefore use per year as a result of having access to these improved stoves. In Shanxi, households save an average of 1,961 RMB per year. In Enshi State and and Guizhou Province, where coal is completely replaced with biomass (i.e. baseline consumption equals savings), households saved an average of 2,205 and 2,152 RMB respectively.<br><br>With each stove sale, more families have the ability to access these stove benefits. Project proponents monitor the access stove manufacturers provide for rural households to efficient energy technologies through sales records. Between May 16, 2012 and February 28 2013, the Project provided Chinese residents with a total of 19,715 stoves (3,980 in Shanxi; 5,968 in Enshi; and 9,857 in Guizhou). This is an average of 1,714 efficient stoves per month (as 11.5 months elapsed between 16 May 2012 and 28 February 2013). Monthly sales records are cross-checked with production records by CAREI and reported to Impact Carbon. |

# 10. Appended files list

Calculation Files:

1. Iss 2 ER Calcs; Shanxi
2. Iss 2 ER Calcs; Enshi
3. Iss 2 ER Calcs; Guizhou
4. Summary ERs

Appendix Files:

1. Annex 1 – Shanxi KS Data Analysis
2. Annex 2 – Enshi KS Data Analysis
3. Annex 3 – Guizhou KS Data Analysis
4. Annex 4 – KS Report; Shanxi
5. Annex 5 – KS Report; Enshi
6. Annex 6 – KS Report; Guizhou
7. Annex 7a – Usage Report, Shanxi
8. Annex 7b – Usage Survey, Shanxi
9. Annex 8a – Usage Report, Enshi
10. Annex 8b Usage Survey, Enshi
11. Annex 9a – Usage Report, Guizhou
12. Annex 9b – Usage Survey, Guizhou
13. Annex 10 – N/A
14. Annex 11 – Jinqilin 2012 Training Record
15. Annex 12 – Zhiqi 2012 Training Record
16. Annex 13 – Huifeng 2012 Training Record, Guizhou
17. Annex 14 – Spot Check, Shanxi Jinqilin
18. Annex 15 – Spot Check Report, Enshi Zhiqi
19. Annex 16 – Spot Check Report, Guizhou Huifeng
20. Annex 17 – Sales Record – Shanxi 2009 – Feb 2013
21. Annex 18 – Sales Record – Enshi 2009 – Feb 2013
22. Annex 19 – Sales Record – Guizhou 2009 – Feb 2013
23. Annex 20 – Leakage Assessment
24. Annex 21 – 2012 KPT Report; Shanxi
25. Annex 22 – 2012 KS_KPT Report; Enshi
26. Annex 23 – KS_KPT Report; Guizhou
27. Annex 24 - NRB Study Enshi Iss 3
28. Annex 25 – NRB Study Guizhou Iss 3
29. Annex 26 – GS949 Design Change Review 21082012