

Implementation of a Dissemination Strategy for Efficient Cook Stoves in Northeast Brazil

Policy For Subsidizing Efficient Stoves

Project No. 10604030

Responsible:

Jörgdieter Anhalt,
Sulamita Holanda



May, 2009

CONTENT

EXECUTIVE SUMMARY	3
INTRODUCTION	4
BACKGROUND ON IMPROVED COOK STOVES	5
BENEFITS OF IMPROVED COKE STOVES	6
PROGRAM IMPLEMENTATION STAGES	7
FUEL EFFICIENT STOVE DEVELOPMENT IN THE WORLD	8
INDOOR POLLUTION	11
CURRENT SITUATION IN BRAZIL FOR ADVANCED COOK STOVE DISSEMINATION	12
ENVIRONMENT	12
COOK STOVES IN USE	12
RURAL POPULATION	14
PRICE OF IMPROVED COOK STOVES	15
SUBSIDY POLICY	16
FINANCING SOURCES OF SUBSIDIES	16
AGRO-FORESTATION	16
COST SAVINGS IN PUBLIC HEALTH	17
CARBON CREDITS	17
PURELY GOVERNMENTAL FUNDING	19
SUBSIDIES	19
SUBSIDIES TO MANUFACTURERS	19
SUBSIDIES TO END USERS OR LOCAL BUILDERS	20
COMMERCIAL APPROACH	20
PROMOTION	20
CONCLUSION	21
INFORMATION SOURCES	22

DIFFERENT EFFICIENT COOK STOVES FROM ALL OVER THE WORLD

EXECUTIVE SUMMARY

Biomass fuels such as wood, charcoal, dung, and crop residues account for approximately half of the industrial and household energy consumption in developing countries. Domestic cooking makes up a major portion of the total energy used in these nations, and nearly three billion people worldwide cook their meals on simple stoves that use biomass fuels.

Efforts to improve the efficiency of biomass cook stoves date back to the 1940s. In recent decades, urban areas in developing nations have experienced higher penetration rates of improved stoves; indeed, many urban households have made the switch to cleaner fuels like liquid petroleum gas (LPG) or kerosene for cooking. On the other hand, most rural households in these countries are not endowed with the necessary infrastructure that could bring them cleaner fuels, nor do they have the adequate income to pay for the fuels if they were available.

Low-income communities located in rural areas without accesses to markets or energy infrastructure are most likely to benefit from improved cook stove projects. The dissemination of efficiency stoves in these households can be a step taken toward curbing indoor air pollution, decreasing time and money spent on fuel wood, and can prevent substantially deforestation.

Brazil, with a rural annual income per capita of just USD 500 and only about 60% percent of its rural households having access to electricity, could greatly benefit from increased efforts in improved stove dissemination.

In view of the problems cited above, several counties have implemented cook stove dissemination programs under diverse promoting and/or subsidizing policies which range from a purely market orientated approach to entire donation strategy.

This paper will give an overview of the cook stove dissemination practices worldwide, address the necessities of an efficient cook stove development program in Brazil, as well as describe possible financing/subsidizing policies suited to the poorest regions of Brazil where traditional cooking habits need to be changed for the sake of the populations health and minimized deforestation.

INTRODUCTION

Since the 1940s, efforts have been made by governments, international development organizations, and NGOs to increase the dissemination of efficient biomass cook stoves. Although many of these programs have been successful in urban areas, improved stoves have still not reached sufficiently households in rural settings in developing countries where three quarters of the world's 1.2 billion extremely poor people reside. This leaves most of the rural poor without access to improved stoves, which prevent indoor air pollution, save time spent collecting firewood and put off deforestation in large regions around the villages.

As the availability of and access to petroleum-based fuels began to increase at the beginning of the 20th century, many urban households in developing countries switched to stoves using kerosene or liquid petroleum gas (LPG), just like their developed nation counterparts. On the other hand, rural households continued their dependence on biomass fuels for cooking and heating purposes. This was mainly due to weak delivery channels for petroleum-based products and rural people's inability to afford these fuels, especially compared to biomass resources, which were and still are more freely available.

The goal of any improved cook stove program is to develop more efficient, energy-saving, and inexpensive biomass cook stoves that can help alleviate local pressure on wood resources, shorten the walking time required to collect the fuel, reduce cash outlays necessary for purchased fuel wood or charcoal, and reduce the indoor-air pollution.

One of the first improved stoves was the "Magan Chula", introduced in India in 1947. A publication called "Smokeless Kitchens for the Millions" advocating the health and convenience benefits of efficient burning of biomass, stimulated the promotion of improved cook stoves. The initial wave of stove programs focused on health aspects rather than reduction of fuel wood. The general objective was to uplift the living conditions of the poor in the developing world. Subsequently, attention shifted to the potential for saving biomass fuels and limiting deforestation.

Currently, paired focus on fuel wood reduction and health impact of improved cook stove utilization is agreed to. Recently stressed aspects on climate change and carbon emissions in conjunction with the preoccupation of increasing respiratory infections are the key issues incorporated into program proposals. The final design of such programs depends highly on local culture and cooking habits, marketing proposition and political motivation to support such ventures.

BACKGROUND ON IMPROVED COOK STOVES

What are improved cook stoves ?



Figure 1.
Different Types
of cook stoves
Source: RWEDP

The most common method of cooking used in developing countries is an open fire. The fire is usually shielded or surrounded by “three or more stones, bricks, mounds of mud, or lumps of other incombustible material”. For short, such fires are called “three-stone” fires, where the stones or surrounding materials act as a support for the cooking pot over the fire. These three-stone fires have continued to be in use for cooking and heating purposes, mainly due to their simplicity. They are easy to build, support a range of fuels and can be adapted to different cooking habits quite easily – i.e. placed on waist-high platforms for more convenience for the women. There are more sophisticated types of traditional stoves, ranging from mud stoves to heavy brick stoves to metal ones (see examples first page). Most sources cite the fuel-efficiency¹ of traditional stoves as five to ten percent. Since nearly three billion people in the world use traditional stoves for cooking purposes, efforts to improve the efficiency of such stoves have been increasingly popular. Improved stoves come in different shapes and sizes. They can be designed and built in various ways, depending on the local traditions and habits, and available materials. In addition, attention is given to invent methods of controlling the upward flow of the combustion gases, so as to increase the heat transfer to the cooking pot.

One should be careful in concluding that traditional stoves are inferior or inefficient and therefore account for the high consumption of biomass resources. A family’s fuel consumption is largely dependent on the fuel scarcity it faces and not necessarily the efficiency of the stove. Studies have shown that in areas that experience fuel scarcity, consumption is about one third of that in areas where fuel is in abundance. This indicates that households already take measures to cut down on fuel use when they feel the “energy pinch”. Moreover, one finds that most of the claims citing the inefficiency of traditional stoves are more anecdotal than scientific. Not all “improved” stoves are more efficient than traditional ones, which have been around for thousands of years and have evolved to meet the local needs in a way that is affordable for the users. Even when the considerable progress in increasing efficiency of cook stoves is taken into account, it is a daunting task to offer these stoves at an affordable price to households, an issue which many cook stove programs face all around the world.

¹ Fuel efficiency is the proportion of energy released by fuel combustion that is converted into useful energy (U.S. Environmental Protection Agency, <http://www.epa.gov/OCEPAterms/fterms.html>). When the term efficiency is used throughout the paper, it relates to “thermal efficiency” which is defined as “the ratio of heat actually utilized to the heat theoretically produced by complete combustion of a given quantity of fuel (which is based on the net calorific value of the fuel)” (<http://rwedp.org/acrobat/fd41.pdf>).

BENEFITS OF IMPROVED COKE STOVES

The benefits associated with improved cook stoves fall in two categories: those that are internal to the household and those that are external.

Internal benefits include:

- Reduced concentrations of smoke and consequently indoor air pollution;
- Money and time saved in acquiring fuel; and
- Reduced biomass use.

External benefits include:

- Less pressure on forest and energy resources (deforestation);
- Reduced greenhouse gases; and
- Skill development and job creation in the community producing and installing the stoves.

Not all the benefits are experienced or perceived immediately by the end users. Since the families feel the impacts of internal benefits directly, these may have a greater influence on the decision to invest in an improved stove. Another important point is that most of the internal benefits work to improve the condition of women, who are predominantly responsible for cooking and collecting fuel wood. Additionally, in many rural settings, women cook with their children strapped on their backs (e.g. Africa) or the children are always around in the kitchen. Any reduction in pollutants emitted from cook stoves (see chapter on Indoor pollution) will be beneficial for children's as well as for women's health.

The external benefits are less likely to be perceived by the rural population; although this is certainly a gross underestimation of the capability of the poor to understand the ecological problems in their surroundings. However, some of these benefits are hard to quantify and even if quantified, they are not fully achievable in monetary terms. However, one should alert governmental entities and environmental organizations in order to seek for quantification of health benefits (cost reduction of public health services), climate change due to carbon emissions and deforestation. Consequent lower agriculture production may lead to migration and subsequent socioeconomic problems.

While the internal and external benefits listed above differ significantly along each country, regional and cultural diversity and depend on the type and use of improved cook stoves, it is safe to say that a combination of these benefits is felt by most users. There are indeed other alternative policies interventions that would help resolve the very problems that improved cook stove programs tackle. Some of those interventions that address at least one or more of the above-cited benefits are listed in Table 1.

Benefit	Alternative Intervention
Reducing indoor air pollution	➤ Transition to less polluting fuels for cooking, such as LPG, Ethanol, or solar energy. ➤ Improving indoor environments with the addition of chimneys, flues, hoods, and ventilation. ➤ Changing household behavior, i.e. modifying cooking practices, keeping children away from the fire. ➤ Rural electrification.
Less pressure on forest and energy resources	➤ Reforestation programs.
Reduced biomass use	➤ Transition to less polluting fuels for cooking.
Reduced greenhouse gases	➤ Rural electrification.
Money and time saved in acquiring fuel	➤ Income and/or fuel price subsidies.
Skill development and job creation	➤ Programs concentrating on income generating activities. ➤ Micro-finance projects.

Table 1. Alternatives to Improved Cook Stove Programs

Naturally, there are some cases when the implementation of one or a combination of these policy interventions may be preferable to improved stove programs. Some rural communities are more likely to benefit from rural electrification programs. The electric grid may reach them in the near future and they may be able to afford the electric appliances necessary. Similarly, some households may switch to cleaner fuels in case easier access to fuel delivery infrastructure is provided. Hence, intermediate steps that will improve the conditions of rural households may also be necessary.

Interventions that encourage the transition to less polluting fuels for cooking are another solution. These fuels include LPG, ethanol, or even solar energy. As in the case of rural electrification, not all households will be able to afford these alternative fuels, or the appliances that are required to use them. Possible cultural barriers may also require specific adaption of possible technology options.

As a result of all the factors explained above, that communities with low incomes located in rural areas² without access to markets or energy infrastructure are most likely to benefit from improved cook stove projects and are the target of a possible market strategies or subsidy programs from governments.

PROGRAM IMPLEMENTATION STAGES

A cook stove program should have generally four different stages of implementation:

1. Research and Development (R&D) Phase, including market study and dissemination strategy development;
2. Growth and Scale-up Phase;
3. Sustained Promotion/Marketing/Subsidy Phase on state or national level and;
4. Maintenance, Support, and Improvement Phase.

From the “R&D Phase” to the “Growth and Scale-Up Phase”, fully accepted cook stove designs must be developed to allow the problem-free implementation at state or national level. The third stage, “Sustained Phase” is reached when large quantities of stoves are implemented via different dissemination channels and optional financial schemes, in an effort to maximize the number of households using improved stoves. The last stage, “Maintenance, Support, and Improvement Phase” is reached when the maximum number of households is penetrated and the program moves on to ensure maintenance and the continued use of the improved stoves as well as making incremental improvements in its performance and technology adoption.

The criteria for the *R&D Phase* are stove performance in terms of fuel savings, improved air quality, and the affordability of the stoves. In the *Growth and Scale-Up Phase*, the annual growth rate in cook stoves implementation (percentage of new households per year) and the degree of dissemination to low-income rural populations should be considered. Finally, for the *Maintenance, Support, and Improvement phase*, the net increase in improved stove use, and net improvements in stove performance have to be valued. Table 2 summarizes the criteria that shall be used to evaluate the success of a program of improved cook stoves in the different phases.

² Low-income households are defined as those below the poverty index estimated by international development organizations.

	Phase 1. Research and Development (R&D)	Phase 2. Growth and Scale-Up	Phase 3. Sustained Promotion	Phase 4. Maintenance, Support, and Improvement
Criteria for Success	- Fuel savings - Improved air quality - Affordability	- Annual growth rate of in dissemination - Degree of dissemination to low-income populations	Annual growth in the number of households using the ICS	- Net increase in improved stove use. - Net improvements in stove performance - Security of maintenance

Table 2. Criteria for evaluating a program of improved Cook Stoves in different Phases.

FUEL EFFICIENT STOVE DEVELOPMENT IN THE WORLD

Improved cook stoves have been developed in many countries all over the world and were specifically adapted to the cooking habits and tradition of the specific country. In the following are listed the countries where efficient cook stoves have been introduced by national dissemination programs or efforts are under way to combat deforestation, poverty and indoor pollution. A list of publications regarding the programs is enclosed (Appendix 1):

AFRICA:

Eritrea, Ethiopia, Ghana, Ivory Coast, Kenya, Lesotho, Madagascar, Malawi, Mozambique, Niger, Rwanda, Senegal, South Africa, Swaziland, Uganda, Zambia, Zimbabwe.

ASIA

Bangladesh, Cambodia, China, India, Indonesia, Laos, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand, Philippines, Indonesia.

LATIN AMERICA

Argentina, Bolivia, Cuba, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Peru.

All of those countries, specifically Africa and Asia, are classified as the poorest in the world where most of the rural and a large part of the urban population is using wood and dung as the main energy source for cooking purposes. Environmental problems and increasing costs for health care have initiated the adoption of several social measures; including the wide spread dissemination of efficient cook stoves. Alone, Brazil is not listed since there are no governmental programs in progress and little activities from NGOs are dispersed³. However, the problems of deforestation, indoor pollution and poverty are comparable with other countries.

Two very large cook stove dissemination programs are described in the following: The Chinese National Improved Cook Stove Program - CNISP and the Indian National Program of Improved *Chulhas* - NPIC.

³ Except the small program of IDER in collaboration with the government of Ceará / Brazil

CNISP started in 1980 promoting the use of approximately 10 different stove models suitable for users in different regions of China, mostly made of prefabricated cast iron, ceramic, or concrete slabs. These stove models were primarily of three types (See Figure 1):

- Cooking only,
- Cooking and space heating, and
- A furnace designed for use in crop processing or other process heat generation.

The price of the improved biomass stoves was on average around 45 Yuan or U\$ 12 in 2002 dollars but can go up to 100 Yuan (U\$ 27) depending on the lay out and materials used for construction. The average annual income for a Chinese rural household is 1400 Yuan or approximately U\$ 170, which puts the average stove price at about seven percent of the household's annual income. The amount of direct government subsidy for the stoves is 4.2 Yuan equivalent 10 % of the average stove cost; total government contributions per stove increase to 15 % when government wages and foregone taxes are included. Most of the subsidy goes directly to the stove manufacturers whereas the families pay the subsidized price.

The CNISP program has disseminated about 144 million improved cook stoves from 1980 until 1994; this number is said to have increased to approximately 180 million by the turn of the century, reaching about 62% of all rural households. The Chinese program has been active for a long time and is to place between the third and fourth phases of implementation. The criterion for success is the annual growth of about 5% in the number of households using improved cook stoves. China seems to be performing well under each criterion, increasing the number of stoves distributed by an average of 6 million annually since 1994.

Figure 1. Examples of Chinese Improved Cook Stoves.

Source: RWEDP 40



Cast Iron Components of the Domestic Fuel-Saving Heating Stove



-CCS showing complete metal parts (left)

The Indian National Program of Improved Chulhas – NPIC started in 1983 under the auspices of the Ministry of Non-Conventional Energy Sources (MNES). It is hard to find a consensus on the total number of stoves disseminated but the number ranges from 28 million to 32 million.

Although close to 80 stove variations were disseminated, the stoves can be grouped into 6 main categories:

- (a) Mud-built, fixed chulha with or without chimney,
- (b) Mud-clad, pottery-lined fixed chulha with or without chimney,
- (c) Portable metallic chulha without chimney,
- (d) Portable metal-clad, ceramic-lined chulha without chimney, and
- (e) Portable chulha with a separate hood chimney system.

The cost of the most simple cook stoves (see figure 2) is approximately US\$ 9, with some variation depending on the region and social status of the households. The support for households comes in the way of direct cash a subsidy, ranging from 50-75 % of the stove's cost. The annual per capita income is approximately US\$ 430. The price of the stove is about 2 % of the average annual income, without the subsidy to end-users. As of 2000, some 20 % of rural households own improved chulhas.

Figure 2 Improved cook stoves of the NPIC program



Source: RWEDP 41

Like the Chinese program, the NPIC is also between the third and fourth phases of implementation. It is hard to get a sense of the annual increase in the number of households that adopt improved Chulhas because of the quota system employed. The increase in the number of households using the improved cook stoves was approximately 230,000 stoves per year resulting in 185 Million stoves implemented until 2000.

Both programs showed a high degree of development throughout extensive years of implementation. An impressive number of cook stove models have been developed and successfully disseminated. These programs had the entire support of the respective governments, which gave financial subsidies either to the manufacturers (China) or directly to the end users (India).

Both subsidy models have their advantages and back draws, and have probably been chosen in respect of the cook stoves models used. The Chinese program mainly adopted stoves made out of cast iron and therefore preferred to hand out subsidies to the manufacturers, while in India are mostly used home-made mud-built stoves with metal-clad liners, which clearly give advantages to end-user subsidies.

Today, both programs have terminated and final records on disseminated stoves are not easy to find. All sources cite numbers only until the year 2000. However, in China were conducted extensive indoor pollution studies in 2005. The program in India was cancelled mainly because inherent organizational problems. Recently, the Shell Foundation in cooperation with the NGO ENVIROFIT has started a campaign that spans continents as part of its vision to sell 20 million improved stoves in five countries in the next five years. First steps are in progress in India whereas the stoves are manufactured in China. At all places, the approach will be purely market driven without subsidy from the governments. It is not published how much financial support is feed in by the Shell Foundation as credit or grant money in this program. Therefore, the model adopted cannot be analyzed in deeps on the topic of true cost recovery.



New cook stove design

www.envirofitcookstoves.org/

INDOOR POLLUTION

Given that half of the humanity is at risk from burning solid fuels and that in the world's poorest countries indoor air pollution is the forth greatest risk factor for death and disease, it would be expected that there would have been more significant actions to address this crisis specifically in Brazil. But this is unfortunately not the case.

Indoor pollution in general persists as a problem because of many interacting factors, not at least are:

- Not understood and ignored link of indoor pollution and respiratory infections or even death. However, there are now a growing number of health studies clearly demonstrating this link, which has recently been quantified for the first time by WHO (see also graph 1).
- Response to childhood acute lower respiratory infection (ALRI) so far have focused on treatment rather than on removing one of the major causes of illness – smoke in the home.
- Smoke mainly affects those perceived to be the lower status members of the community – women and children. Their work and contribution to the society and the economy is rarely calculated in national economic planning. Therefore, the poverty alleviation benefits of improved, clean cooking have not been fully recognized.
- There has been a great deal of work done on improving stove design, with the goals of energy efficiency and fuel saving, lifting the burden of women's time and effort, and with the environment motive of saving forests. It is only in the last few years that attention has turned to the issue of *forest recuperation* and *landscape recovery* due to worldwide preoccupation with climate change and green house gases.
- Policy makers are slowly beginning to recognize smoke as a problem, but it has the disadvantage of being viewed as less significant than more acute issues, such as food, HIV/AIDS, water and sanitation and Malaria. However, the impact of indoor pollution can be as acute and dramatic as Malaria. A child getting pneumonia, for example, and having no access to hospital, will be as acutely in need of help to prevent death as if it had Malaria.⁴

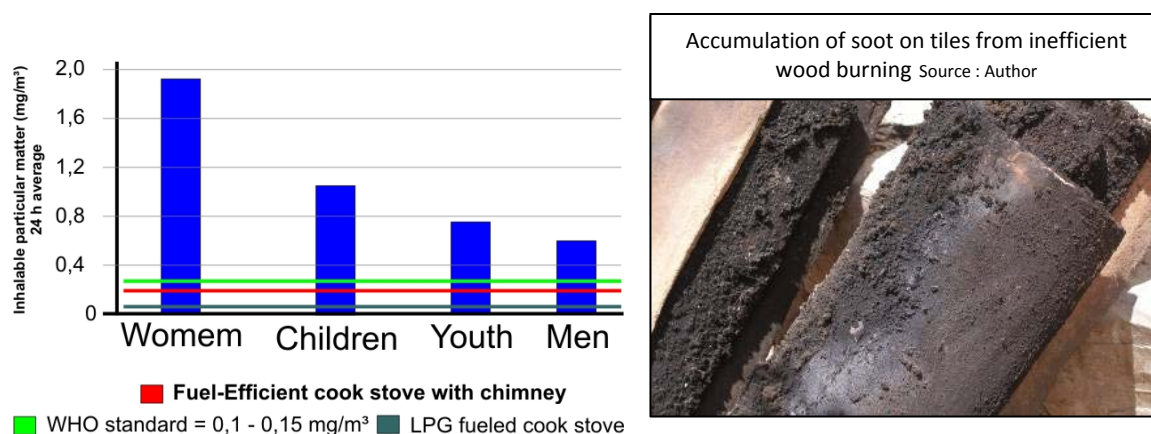


Figure 3 :Pollution effects from smoke particles on users of traditional cook stoves

⁴ When biomass fuels are burnt inefficiently they give rise to high concentrations of pollutants – the main culprits for acute respiratory infections (ARI). According to the WHO World Health Report 2000, the top five respiratory diseases account for 17.4% of all deaths and 13.3% of all Disability-Adjusted Life Years (DALYs). Lower respiratory tract infections, chronic obstructive pulmonary disease (COPD), tuberculosis and lung cancer are each among the leading 10 causes of death worldwide. (World Health Organization Chronic Respiratory Diseases), <http://www.who.int/ncd/asthma/strategy-1.htm>.

CURRENT SITUATION FOR ADVANCED COOK STOVE DISSEMINATION IN BRAZIL

ENVIRONMENT

The target population for dissemination of advanced cook stoves is living in the semi-arid region of Brazil, the so called *Caatinga* (native expression for “White Forest”). The area effected is about 900.000 km² or approximately 10 % of the Brazilian territory. Climate changes caused by extensive deforestation, bad conducted agriculture (burning the woods instead of using organic fertilizer) and intensive cattle breeding have lead to the today’s destructed landscape. Rivers have vanished and the ground water table has faded away. The monetary damage is estimated to U\$ 100 Million per year, not counting the social adversities and migration consequences in terms of growing slums, delinquency and unemployment.

The traditionally used cook stoves take part in this process. However, the quantification of how much fire wood or, in other words, how many square kilometers of forest are annually ruined by these old fashioned stoves is hard to estimate. Considering a population of 17 Million people or ~2,5 Million families⁵ living in the poorest regions of Brazil and estimating that 50% of those burn approximately 5 kg of firewood per day, some 6000 ton of wood are burned daily only for cooking purposes in this region.

COOK STOVES IN USE

The rural population in general is using cook stoves made out of mud with a three-pot-hole rectangular steel top plate. The metal plate is made out of cast iron or metal sheet and can be found at all market places in the small towns in the rural area. They are manufactured by local metal workers or come ready made by foundries from the state of Minas Gerais, where are located the biggest steel manufacturers of Brazil.

All families use fire wood gathered in the neighborhood or even bought from salesmen, which get the wood or vegetal charcoal from forests some 100 km away.

None of those stoves is in any way advanced or specifically designed for less fire wood consumption; mostly they do not have even a chimney and pollute the homes.

Furnaces to fry larger pieces of meat or to bake cake are not commonly in use. Big animals like cows are generally not grown and any kind of storing capacity for large quantities of meat (e.g. freezer) is not available. Making bread is also not a common activity. The population is accustomed to their “tapioca” pancake.

If the economic situation allows, the households have a LPG stove to fry small portions of meat or fish. These stoves are used only for such purposes where instant heat with elevated temperature is needed. The high price of the LPG does not permit continuous use of this cooking tool.

The price to manufacture one of those cook stoves is mandated by the price of the metal plate. The price ranges from R\$ 10 to R\$ 30 (U\$ 5 to 15 (2008 figures)), depending on the size and quality. The other construction materials are mostly found locally and labor may be estimated to R\$ 10 (U\$ 5). In contrary to the cook stoves found in China, India and Africa, the fire place is mounted on a kind of table constructed out of bricks or wood with a fire resistant layer on top. Chimneys are seldom in use due to the local unavailability of metal sheets.

⁵ UNICEF 2003; www.unicef.org.br, Atlas do Desenvolvimento Humano no Brasil

In order to minimize the indoor pollution, some of the stoves are located outside the main house in a primitive shelter. However, the danger for little children to be burned is very high. Numbers of the effect of indoor pollution on the health of the Brazilian rural population have not been established and no surveys are in progress to discover the link between smoke exposure and already existing cases of eye irritation, respiratory infections, cough and breathlessness. IDER has gathered first data on these issues⁶.

Figure 4: Traditional Cook Stoves used in rural households in northern Brazil



⁶ Report on Health Impact is part of this REEEP project.

RURAL POPULATION IN BRAZIL

As earlier stated, the rural population is about 31, 8 Million people.

The economic situation of those families, specifically the 2,5 Million families of the poorest states is very tough. 75% have to survive with only U\$ 180 per month⁷. The portion of illiterates is very high, 75% of the adults and 43% of the youth.

The following table presents the rural population of Brazil with the respective poorness indexes - IDH.

State	Poorness Index (percentage of population with income lower than USD 75,50/m)	Rural Population	IDH
Acre	52,705	187.259	0,697
Alagoas	57,179	902.882	0,649
Amapá	50,314	52.349	0,753
Amazonas	57,891	705.335	0,713
Bahia	53,634	4.297.902	0,688
Ceará	54,438	2.115.343	0,700
Distrito Federal	42,231	89.647	0,844
Espírito Santo	41,671	634.183	0,765
Goiás	40,643	606.583	0,776
Maranhão	56,661	2.287.405	0,636
Mato Grosso	44,447	516.627	0,773
Mato Grosso do Sul	41,713	330.895	0,778
Minas Gerais	43,782	3.219.666	0,773
Paraíba	52,085	996.613	0,661
Paraná	42,315	1.777.374	0,787
Pará	51,081	2.071.614	0,723
Pernambuco	52,321	1.860.095	0,705
Piauí	54,99	1.054.688	0,656
Rio de Janeiro	44,673	569.816	0,807
Rio Grande do Norte	52,03	740.109	0,705
Rio Grande do Sul	41,715	1.869.814	0,814
Rondônia	47,727	495.264	0,735
Roraima	53,116	77.381	0,746
Santa Catarina	40,743	1.138.429	0,822
São Paulo	46,183	2.439.552	0,820
Sergipe	52,191	511.249	0,682
Tocantins	52,346	297.137	0,710
Poorest states are bold	Total rural Population	31.845.211	
	Total rural Families	4.549.316	
	Total rural population in the poorest states	17.399.677	
	Total rural families in the poorest states	2.485.668	

Source : www.unicef.org.br, Atlas do Desenvolvimento Humano no Brasil

Table 3 : Poorness index of the Brazilian rural population

⁷ The minimum salary in 2008 was fixed by the Government to R\$ 415. Most of the families have an income of less than 1/3 of this amount which in turn is about U\$ 100.

PRICE OF IMPROVED COOK STOVES

The price of improved cook stoves may yet be the most important factor impacting their adoption by rural households since they have very low incomes throughout the developing world. Usually, the costs of improved cook stoves are highest in the beginning phase of a stove program, when scale of production is not yet reached and does not allow for savings from mass production. In rural areas where construction materials are hard to come by locally, the cost of obtaining these materials from non-local sources may make it difficult for rural households that have very limited cash earnings to afford the full cost of the improved stoves.



The improved cook stove of the IDER's project design costs about U\$ 100, more than ½ of the monthly minimum salary, not taking in account any subsidies. Naturally, when stated the price of this stove, one has to put in context the purchasing power of rural households in respective regions and the price of currently used cooking devices. Rural incomes and the purchasing power of rural households also vary. This has a large bearing on the ability of households to afford improved cook stoves, which has implications on whether subsidies should be used to assist the households in their

purchase or give aid to manufacturers in order to increase marketing and local income.



Improved cook stove of IDER; original design (above left) and improvements introduced by the users

In the following table are estimated the costs of a middle range scale-up dissemination program suitable for state governments. The fractions can be varied depending on the subsidies available or costs being taken over from other funds.

Cost calculation of cook stove dissemination													
Values in R\$ (June 2007)													
Number of stoves	Implementation and Infra-structure									Installation			Total project costs
	Complete stove frame with chimney, and bricks; without installation	Material costs of stove	Project development	Training of metal shops and masons	Selection and preparation of the communities	Health impact evaluation	Replanting and environmental protection measures	General Project management	Subtotal Implementation and Infra-structure	Supervision of installation	Transport of stoves, material and travel	Subtotal Installation costs	
	Percentage of stove costs		10%	10%	15%	15%	15%	10%		10%	20%		
	Reduction (%) for more than 1000 stoves		35%	30%	15%	10%	10%	20%		30%	30%		
100	250.00	25,000.00	2,500.00	2,500.00	3,750.00	3,750.00	3,750.00	2,500.00	18,750.00	2,500.00	5,000.00	7,500.00	51,250.00
500	220.00	110,000.00	11,000.00	11,000.00	16,500.00	16,500.00	16,500.00	11,000.00	82,500.00	11,000.00	22,000.00	33,000.00	225,500.00
1000	180.00	180,000.00	11,700.00	12,600.00	22,950.00	24,300.00	24,300.00	14,400.00	110,250.00	12,600.00	25,200.00	37,800.00	328,050.00
1500	180.00	270,000.00	17,550.00	18,900.00	34,425.00	36,450.00	36,450.00	21,600.00	165,375.00	18,900.00	37,800.00	56,700.00	492,075.00
2000	180.00	360,000.00	23,400.00	25,200.00	45,900.00	48,600.00	48,600.00	28,800.00	220,500.00	25,200.00	50,400.00	75,600.00	656,100.00
Observation 1.) The installation of the stove is paid for by the end user 2.) the reduction (%) may be higher if the communities are big and/ or close to each other													

Table 4: Cost calculation of efficient cook stoves and respective other implementation costs⁸

This table may be the basis of all project of this kind and may be adapted to different scenarios of financing or subsidized schemes.

SUBSIDY POLICY

Based on the before mentioned assumptions, price structure of cook stoves, ability of the population to afford such stoves, dissemination scenario developed and local demands and necessities different subsidy policies may be agree to. The adoption of one of those policies depends further on local governmental interest and economic situation. Available grant funds may play a key role as much as they may eliminate any distinguished subsidy policy and just decide on donation strategy.

FINANCING SOURCES FOR SUBSIDIES

Independent of the scenario adopted, subsidies of different kind or even donation require financing from one or more different sources.

Concentrating on Brazilian opportunities, assuming governmental financed programs, the following options may be explored:

- a) AGRO-FORESTATION PRONAF – FLORESTAL⁹.

The objective of this program is the adequate utilization of natural resources, stimulate the planting of specific forest vegetation and support small farmers implementing sustainable projects of multiple use, reforestation and agro-forest systems. By this measure the government pretends to satisfy the demand of forest

⁸ A fully operational EXCEL file is available on demand

⁹ Programa Nacional de Agricultura Familiar – National Program for family agriculture – Forest management
<http://www.pronaf.gov.br/florestal/florestal1.htm>

products, preserve the national forests and recuperate degraded areas. Until 2003 PRONAF was restricted only to already preserved regions, but is now available in all Brazil. Moreover, beside very favorable credits for forest recuperation, grant funds are now available for infra-structure investments. The amount offered for each rural family is R\$ 1.500.

The basic idea is to explore in cooperation with the local government and the Engineers' Association CREA the implementation of a dissemination program via this PRONAF fund, where R\$ 500 should be dedicated to the efficient cook stove installation and management (see cost calculation above) and the rest used for tree nurseries and other necessary infrastructure of the family (e.g. tools).

b) COST SAVINGS IN PUBLIC HEALTH¹⁰

Indoor air pollution from solid fuel use is responsible for more than 1.5 million deaths due to respiratory diseases annually. Effective solutions to reduce levels of indoor air pollution and to improve health do exist. Economic evaluation enables explicit and quantitative comparisons of the efficiency of different interventions using a simple-to-interpret summary efficiency measure – cost per impact achieved – as the common outcome measure.

Thus, the economic evaluation of health is becoming increasingly important. In the light of limited funding, such evaluations can provide an important tool to:

- Demonstrate the economic return of investments in intervention;
- Compare the effectiveness of one intervention against another;
- Help policy-makers allocate their limited budget more efficient.

With household energy playing such a central role in people's lives, interventions to reduce indoor air pollution deliver a wide range of benefits in the areas of health and poverty reduction.

The Cost–Benefit–Analysis (CBA) values all the outcomes of interventions in monetary terms. This gives a benefit–cost ratio, which indicates the monetary or welfare benefit per currency unit spent and provides a decision-making tool with a broad societal perspective.

Once performed the CBA and baseline data for the specific region made available, government can easily decide whether or not investment in cook stove dissemination will save public money.

c) CARBON CREDITS

For long-term financing and development of a sustainable and self-reliant stove distribution programs, the benefits of efficient cook stoves for greenhouse gas emission reductions and for climate change mitigation provides the opportunity to access carbon credits which constitute an alternative financing source.

¹⁰ Guidelines for conducting cost–benefit analysis of household energy and health interventions
www.who.int/indoorair/publications/guidelines/en/index.html

Carbon markets encompass a number of different types of markets such as *compliance* and *voluntary* ones on regional and international basis. While they vary in size, significance and degree of integration with other markets, they have in common to be dynamic, fast moving and growing as well as influenced by the development of national and international policies and regulations.

For the analysis of this financing opportunity, it is important to stress some characteristics of efficient stove programs. They differ from other projects as they:

- Are mostly small scale projects and involve relatively low investments;
- Contribute strongly to sustainable development by improvement of health and environmental situation;
- Are highly risky in terms of achievement of their projected emission reductions due to various influential parameters and methodological difficulties to quantify them.

From the perspective of disseminating efficient cook stoves the CDM market offers some advantages but also some major disadvantages. Its major benefits are the larger market size and the higher prices which may be achievable. Unfortunately, so far no efficient cook stove project is approved under this methodology. Therefore, it is not evident if such a project may meet up the practiced requirements. Nevertheless, some projects are in progress and some service providers are working with this CDM methodology.

Besides *compliance markets*, *voluntary carbon markets* are operating. On these markets, carbon credits are purchased by individuals, governments, companies, NGOs on a voluntary basis and do not necessarily meet regulatory requirements. The carbon credits sold can either be CERs generated within the CDM process or so-called *verified* or *voluntary* emission reductions (VERs) which are not bound to the CDM procedure.

Currently the most important standards for projects are:

- Voluntary Carbon Standard 2007 (VCS 2007),
- Gold Standard (GS),
- VER+,
- Voluntary Offset Standard (VOS).

Their requirements are in some cases at least partly based on CDM.

For finally receiving emission reduction certificates for a specific project, the proof of actual avoided emissions is crucial. In the case of efficient cook stoves, the high number of influential parameters makes the factual emission determination a difficult task. The question of a reliable and credible baseline and monitoring method was discussed intensively by stakeholders and lately two comprehensive monitoring approaches were developed; hence, their adaptation to the specific environmental conditions of a project is required.

In light of this, one may reflect on the difficulties to face when applying for Carbon Credits under the methodologies mentioned. A careful upfront calculation is necessary, including all influential parameters such as costs for service providers and monitoring, fees for project homologation, additionalities, and market prices for Vercs and Cers and collateral benefits in order to estimate the economic profit. In some cases, even though the carbon market has a big appeal, the investment in the credit business may eat up the attainable monetary gain.

d) PURELY GOVERNMENTAL FUNDING

Generally, Governments have different kind of funds aimed to finance specific purposes. In some cases of high social, economic and/or political interest, a fund may be created to cover expenses of extraordinary importance. Issues like climate catastrophes, diseases and economical crises are spectacular examples.

The state government of Ceará state in northeastern Brazil became aware of the growing poorness of the population, even though the economical wealth grew substantially. The income distribution privileged middle and higher social categories. Higher revenues of the state in terms of taxes on services and goods were an excellent measure for this occurrence. A so called fund “Fundo de Combate de Pobreza” –Fund to combat poverty was established, feed from a small fraction of the taxes on communication and transport services, since these two areas had the most notable increase. The available resources of this fund grew faster than the government was able to generate and approve effective projects.

The efficient cook stove program from IDER, those days in 2006 still in the pilot phase, was recognized soon due to strong appearances in the media and its measurable benefits. Governmental bodies took the chance which this technically and administrative already fully planned project. In 2007/2008, 4,000 efficient cook stoves could be implemented, and additional 18,000 units are in progress.

The end users do not participate in any financing. The government does understand this program as its contribution under the general understanding of “Social Responsibility”, an actuality, which many other governments deny when it comes to assist the poor. Mostly, international assistance is asked for in these cases, while military expenses are moon rocketing.

SUBSIDIES

In general terms, **subsidy** (also known as a subvention) is a form of financial assistance paid to a business or economic sector. A subsidy can be used to support businesses that might otherwise fail, or to encourage activities that would otherwise not take place. Financial assistance in the form of a subsidy may come from one's government, but the term *subsidy* may also refer to assistance granted by others, such as individuals or non-governmental institutions.

A) SUBSIDIES TO MANUFACTURERS

The subsidy amount may change according to regional and household characteristics, as well as the type of stove. Poorer regions or poorer households may get to pay less per stove. The subsidy may go all the way up to 50 percent of the stove costs if necessary. However, the effect of the subsidy may be negative since the government pays the builders to cover half of the cost for building the stove, which may cause the motivation of the manufacturer to be directed more towards the government than the consumers. This may cause the production to be “hasty and faulty” or does not offer the assured savings in household firewood consumption. Government subsidy for cook stoves may also suppress efforts by small entrepreneurs to disseminate their own improved stoves, as they could not possibly compete with the subsidized government price.

B) SUBSIDIES TO END USERS OR LOCAL BUILDERS

One may decide to adopt full subsidies in regions where the improved stoves cost are a large portion as what a rural household earns in a month. The government may chose to provide all non-local materials to local stove builders – who may be effectively the users themselves. The builders, probably mostly women, volunteer their time for the construction of the stoves to show a willingness to pay for the benefits of shifting to an improved stove. Since all the non-local inputs for the stoves are subsidized, village households only contribute to the construction phase of the project. Assuming that the improved stove takes about two days to build, with labor costs around USD 1.5 per day, the total labor contribution per stove is U\$ 3. Since the rest of the materials for the stove is donated by the government and NGOs, close to 85 percent of the cost of the improved stove is subsidized. In other words, the households that decide to adopt the cook stoves do not have to make any cash contributions.

Both subsidy models have advantages and draw backs. Manufacturer subsidy is easier to monitor than millions of end users. At both cases, quality control is cumbersome, but highly necessary in order to guarantee the efficiency expected. The overhead costs of both methods are high and mostly underestimated from the executing agencies. Facilitated Corruption due to large quantities of civil construction material involved is also an issue. One should be aware of all implicit constraints before deciding on one or the other subsidy model.

COMMERCIAL APPROACH

Another solution would be a program which does not include any subsidies to end-users with minimal support going to individual producers in an initial “capacity building” phase. The project strategy would involve a commercial dissemination approach in which private entrepreneurs are responsible for the production and distribution of the stoves. The project funding will go to the training of the producers, the promotion of the project and environmental protection measures. In case of international funding, capacity building measures to public bodies may be necessary.

PROMOTION

One of the most important aspects of an improved cook stove program is the promotion strategy. Much of the time, rural households are unaware of the benefits of the improved stoves, especially the health-related benefits. The presence of a well-thought-out promotion strategy that can target different segments of the population is crucial in improved cook stove programs. Through a well-designed promotion strategy rural households can be informed of the benefits associated with the improved stoves. This will cause not only higher rates of adoption but cause households value their stoves more once they are adopted.

Public awareness about the improved stoves may be created through radio and television spots as well as local fairs. Locally known music groups, theaters and circus events can be useful for announcing the implementation of the program. In addition, in some places manufacturers and builders shall have an improved stove in place.

The Government may develop permanent demonstration sites, displaying the different models of improved stoves. Training courses may use screenings of a video film on improved stoves.

One method to be used is to first install the stoves in the houses of some early adopters so that the other villagers can see how the stove works.

CONCLUSION

Millions of people in Brazil rely on wood fuels for most of their energy needs, despite the problems associated with traditional use of wood fuel including energy inefficiency, deforestation, increasing use of time for collection of fuel, and deleterious health and environmental effects.

Modern, efficient cook stoves can alleviate some of these problems by reducing some household cash outlays for fuel, diminishing the time spend to collect fuel, reducing air pollution, and relieving local pressure on wood resources. Yet despite the apparent benefits of improved stoves and an elusive number of dissemination programs in many countries, Brazil has failed to adopt an own strategy.

This paper enumerates the successes stove programs of China and India, describes several efficient cook stoves, the current Brazilian situation in terms of environmental problems, effected population, efforts already undertaken via efficient cook stove pilot projects in Brazil and suggests measures for a consistent program, financing means and subsidy strategies. A Program can be most effective where householders pay relatively high prices for wood fuels or the gathering is difficult and time consuming; in such cases, the improved stoves can pay for themselves rapidly in fuel savings, even though they are usually more expensive to produce and buy than traditional stoves. Overall, improved stoves are most popular when they are easily and locally manufactured and have clear advantages in fuel economy, durability, ease of use, and cleanliness.

Cooking with inefficient and poorly-vented stoves has significant health impacts, causing about a large number of premature deaths annually and severe illness of women and children, a fact up to now not enumerated in Brazil. Moreover, they spend many hours a day hauling water and gathering fuels. As a result, they are seriously overburdened and limited in their pursuit of educational and income-generating opportunities.

In addition, high levels of local air pollution, soil and water acidification, and greenhouse gas emissions are directly associated with the outputs from burning wood and biomass in large quantities under ineffective conditions.

In order to achieve sustainable development objectives, conventional approaches to energy must be reoriented toward the promotion of energy systems based on renewable energy, energy efficiency, and cleaner fossil fuel technologies, which will make it possible to address social, economic, and environmental concerns *simultaneously*.

Under the right conditions, the social, economic, and environmental benefits of promoting improved stoves are large. Well placed subsidies may aid in the distribution of stoves but may not result in actual stove use. External support from donors and international organizations can be helpful, especially if focused on testing or consumer surveys and carry out initially necessary studies on air pollution and health impacts. Ultimately, however, dissemination programs are most effective when they allow for interaction and feedback between governmental entities, program administrators, environmental and health care institutions, stove designers, producers, and users.

APPENDIX 1

INFORMATION SOURCES

In the following is given an extensive list of information sources on efficient cook stove programs and related publications on financing, administration, health and environmental protection. Part of these sources were very helpful during the elaboration of this paper. The list is compiled for counties and general issues. Some sources were already cited as foot notes.

GENERAL

- World Bank [What Makes People Cook With Improved Biomass Stoves?](#)
- [Shell Foundation International Conference on Biomass-based Fuels and Cooking](#)
- WELL Water and Environmental Health at London and Loughborough, Jonathan Rouse, [A Review of the Health Impacts of Indoor Air Pollution October 2001](#)
- [Application of Biomass Energy Technologies: Fuel Efficient Cookstoves](#) (1993) UN Habitat
- FAO Photo File: [Myanmar](#); [Nicaragua](#); [India](#);
- [Initial Evaluation of CDM Projects](#) DFID 2000
- [UNDP Renewable Energy Program](#)

AFRICA

- [AFREPREN/FWD](#) - African Energy Policy Research Network/Foundation for Woodstove Dissemination 2004
- [Energy Saving Stoves in Southern Africa](#) Paul Mushamba, Dean Still and Steve Gitonga February 2003
- [GTZ Household Energy Project](#)
- UK ETSU: [Poverty Alleviation Aspects of Improved Cookstoves](#)
- [REGIONAL ACTION PROGRAMME TO COMBAT DESERTIFICATION](#) Regional workshop on the formation of a network for promoting renewable energies and eco-technologies TUNIS 26-29 October 1998

Eritrea

- [DISSEMINATION OF IMPROVED COOKSTOVES IN RURAL AREAS OF THE DEVELOPING WORLD](#): Recommendations for the Eritrea Dissemination of Improved Stoves Program, 2003, by Ayça Ergeneman for Eritrea Energy Research and Training Center (ERTC), Robert Van Buskirk (June 2003) ([pdf 1 MB](#))
- Robert Van Buskirk: [Eritrea Traditional Stove Efficiency](#)
- [Update on Eritrea and Ethiopia](#), October 2002, Robert Van Buskirk
- [Eritrea Energy Research and Training Center: Improving Traditional Stove Efficiency in Eritrea](#)
 - [Design, Promotion, and Dissemination of Energy-Efficient Stoves Project Evaluation Report August 2001](#)
 - [Stove Project Pictures ERTC Damba Demonstration Project](#)

Ethiopia

- ETSU(UK): Cookstoves Commercialization and Testing [Mirte in Ethiopia](#)
- Melessaw Shanko MGP Ltd. [Finnish Turbo Stoves in Ethiopia](#)
- [Update on Eritrea and Ethiopia](#), October 2002 Robert Van Buskirk
- [The Study of Appropriate Technologies Developed to Increase Women's Production and Productivity in Ethiopia](#) Winrock International November 2001
- [Improved poverty cookstove](#) DFID

Ghana

- [Ghana Household Energy Project](#) USAID/Enterprise Works April 2002-September 2003
- [WOODFUEL USE IN GHANA: AN OUTLOOK FOR THE FUTURE?](#) Ministry of Mines and Energy, Energy Commission of Ghana <http://www.energycom.gov.gh/>
- RENEWABLE ENERGY (RESEARCH & PROJECT) DIVISION

- [Hay Sack/Straw Stove](#) [Introducing fuel-saving cooking methods in northern Ghana](#), by Marios Cleovoulou
- UNDP GEF [Construction of Improved Cook stoves Project Fact Sheet](#) Fuel Efficient wood saving Stoves (FEWS) 1998-2000

Ivory Coast

- Ceramique d'Afrique and [Potters for Peace Ceramic Stoves](#) 1999

Kenya

- Rob Bailis Photos of [New Henya Stove Design](#), Kenya, August 2003
- [Henya Stove](#), Richard Njagu, Kiambu District, Kenya, Dean Still (May 2003)
- [CANECOAL, Western Kenya](#) Elsen Karstad, Chardust, May 2003
- [How Charcoal Fires Heat the World](#) Environmental Science and Technology Online April 2003 and Rob Bailis, Majid Ezzati, Daniel Kammen, [Greenhouse Gas Implications of Household Energy Technology in Kenya](#), Environmental Science and Technology 2003, 37, 2051-2059
- [Biomass Use in Kenya Policy Considerations](#) Dominic Walubengo 2002 [ppt](#)
- [Commercial production of energy-efficient biomass stoves for the commercial and institutional sector](#): Manual for producers, promoters and users KAR 6848, Energy for Sustainable Development Limited 96165 July 1999 DFID
- [Lost Opportunities: Woodfuel Data and Policy Concerns in Kenya](#) African Centre for Technology Studies, Nairobi, Kenya, 2002
- [Kenya Country Report](#) 2001, PRES, (Peri-urban and Rural Energy Services) in Ethiopia, Kenya and Uganda Shell Foundation Sustainable Energy Programme([Source Document](#))
- [Kimathi Jiko: Hot Savings on Stoves](#) Kinyanjui Mlringu, Nairobi University Department of Architecture, Design and Development
- [UPESI Rural Stoves Project](#) Kenya, Beatrice Khamati Njenga 2001 [UNDP Energy for Sustainable Development](#)
- D. Kammen [Research Development and Commercialization of the Kenya Ceramic Jiko and Other Improved Stoves in Africa, In Depth Solutions](#)
- M. Ezzatti, D Kammen, [Indoor Air Pollution from Biomass Combustion and Acute Respiratory Infections in Kenya: an Exposure-response Study \(pdf\)](#)
- M Ezzati Mpala Research Station
 - [Household Energy Technology, Household Environment, and Health: The Global Nature of the Question](#)
 - [Traditional and Improved Stoves](#)
 - [Data Collection: Data in Indoor Air Pollution](#)
- ITDG [The Upesi Stove for Households in Kenya](#)
- [Health Impacts of Indoor Emissions from Biomass Combustion](#)
- [Ceramic Jiko Stove](#)
- Biomass energy technologies in Kenya the Maendeleo improved woodstove and ethanol production S. Karekezi ([abstract](#)); ([article](#))
- [Improved Stoves : Time Saving and Health Improving Components?](#) (Maendeleo) Everline Were Ndiang'a Interlink Rural Information Service (IRIS)
- [Ngong Cookstove Project](#) (2001) Kenya Forest Research Institute, US Department of Agriculture/Winrock, Energy and Water for Sustainable Living
- [A Guide to Make Your Own One Pot Maendeleo Jiko Stove - GTZ \(pdf\)](#)
- [Rural Stoves Program, Western Kenya](#), Tropical Forestry Projects Information System, Overseas Development Institute

Lesotho

- Lesotho: [Nokoko Household Stove and Bread Oven](#), Peter Scott, Aprovecho/GTZ, November 2003
- Lesotho: [Nkokonono Stove](#) Peter Scott, Aprovecho/PROBEC, October 2003

Madagascar

- [Kenya Ceramic Jiko](#) ITDG Steve Gitonga

Malawi

- [How to Make a Food Warmer / Fireless Cooker](#), Christa Roth, (IFSP), Mulanje, Malawi, September 2003
- [How to Make a Portable Clay Stove](#) IFPS Malawi/GTZ ProBEC (Hedon)

- [Energy Efficient Stoves in Southern Malawi](#) IFPS
- [Legacy Foundation](#) fuel Briquettes, Richard Stanley

Mozambique

- [Juntos Gasifier Stove](#), Paul Anderson (July 2003)

Niger

- [Improved Stoves Project Photos](#) Bill Stein Peace Corps Volunteer 1990-1993

Rwanda

- World Bank [Improved Biomass Stoves \(Rwanda\)](#)
- World Bank Rondereza charcoal stove, in [Building on Local Knowledge](#), World Development Report 1998/99 Background Papers Knowledge for Africa

Senegal

- [Projets senegal-allemand combustibles domestiques \(PSACD\)](#)
- [Results of a Household Energy Survey in Western Sénégal The Town of Kaolack](#) (pdf) Ina Kersten GTZ
- [Furno Jamar](#) (Enterpriseworks)

South Africa

- [Gasifier Coal Stove](#) John Davies South Africa April 2003, October 2003
- [Prototype Briquette Gasifier Stove](#) Richard Stanley and Kobus Venter (October 2003)
- [A commercialization methodology for cookstove dissemination in Southern Africa](#) (Comm_SA, PDF, 32KB) Rina J King BSc(Eng), Margaret Pemberton-Pigott, Crispin Pemberton-Pigott, New Dawn (Pty) Ltd ARECOP February 2003
- [Mali Stove and Swazi Stove in Polekwane, Limpopo Tests](#) (December 2002) Crispin Pemberton-Pigott
- [Makoti Stove](#), Thabo Mokoena, sugar cane, bagasse, sawdust

Swaziland

- [VESTO Variable Energy Stove](#) February 2003
- [A commercialization methodology for cookstove dissemination in Southern Africa](#) (Comm_SA, PDF, 32KB) Rina J King BSc(Eng), Margaret Pemberton-Pigott, Crispin Pemberton-Pigott, New Dawn (Pty) Ltd ARECOP February 2003
- [Mali Stove and Swazi Stove in Polekwane, Limpopo Tests](#) (December 2002)
- [Basintuthu Stove Tests](#), New Dawn Engineering (September 2002)
- [New Dawn Engineering](#): Tsotso, Basinthutu, Shisa, Viro and Vesto Stoves Crispin Pemberton-Pigott

Uganda

- [Introduction of Rocket Stove Cooking Devices in Uganda](#), Peter Scott, Aprovecho, Kampala, September 2003 1.4 MB pdf
- [Rocket Stove for 100, 200, 300 liter pots and Bread oven](#) for GTZ Uganda, September 2003
- [Thresher Masher](#) Richard Stanley, Kampala, Uganda October 2003
- [Burning Behaviour of Holey Briquettes](#), Richard Stanley, Kampala, Uganda, (September 2003)
- [A Comparison of Wood-Burning Cookstoves for Uganda: Testing and Development](#) (pdf 400k), August 2002, Emma George, Ministry of Energy and Mineral Development, GTZ
- [Efficiency Tests on the Peko Po Stove in Uganda](#) Per Sieverts Nielson, Danish Technological University September 1996
- [Gender and Compliance with Technological Innovation for the Improved Charcoal Stove in Uganda](#) Ms. Joan Kyokutamba, African Energy Policy Research Network Pall Wendelbo; Nielsen, Per Sieverts 1998, Test of pyrolysis gasifier stoves in two &#xinstitutional" kitchens in Uganda. 10th European Conference on Biomass for Energy and Industry, Wurzburg. Biomass for Energy and Industry, CARMEN, Wurzburg, 1753-1756.
- Denmark/Ghana: [Per Nielsen's Home Page](#)

Zambia

- [Fuel Efficient Charcoal Stoves \(CARE Canada\) 2000](#)
- SEI [Stoves in Zambia, Pollution or Efficiency? \(1994\)](#)
- SEI EE&D [Zambia Charcoal Utilization Program](#)

Zimbabwe

- [Wood Burning Stoves of Zimbabwe](#) L Mika SIRDC

ASIA

- [Regional Training on Wood Gas Stove Development and Production](#), Bangkok, Thailand, March 19-21, 2003 ARECOP
- [Regional Workshop on Sustainable Improved Cookstove Dissemination with Special Emphasis on Commercialisation](#). Cebu, Philippines 15-18 February 2003 Organised by : Asia Regional Cookstove Program Secretariat (Indonesia) & APPROTECH Asia (Philippines)
- [Asian Regional Cookstove Development Program \(ARECOP\)](#)
- RWEDP Hulsher: Improved Cook Stoves Program [Some Lessons from Asia \(1998\)](#)
- www.rwedp.org/acrobat/p_stoves.pdf
- RWEDP Wood Energy News [Vol 14 1999](#)

Bangladesh

- [Shakti](#)
- Jonathan Rouse [The Improved Biomass Cookstove \(Bangladesh, India\)](#) The [Shielded Multi Lid](#)
- [Village Education Resource Center](#) (NIRAPAD UNICEF with ARECOP) Network for Improved Cookstoves

Cambodia

- [CFSP ICS Dissemination](#) (CFSP_ppr, PDF, 501KB) Iwan Baskoro, Mao Rotha, San You, CFSP ARECOP February 2003

China

- [Chinese Gasifier Stove](#) Kirk Smith
- [Wood Cooker from China](#)
- [Straw Gas Cooker](#) China Depot
- [Chinese Fuel Saving Stoves](#): A Compendium Field Document No.40, July 1993 RWEDP
- [Biomass Energy Use and Emission in China](#) ESCAP Virtual Conference FAO/UN

India

- [Community Briquette Stove](#) Ramesh K Nibhoria, Nishant Energy, Chandigarh, October 2003
- [Biomass Briquettes in India](#) including list of producers, Ramesh K Nibhoria, NISHANT BIOENERGY CONSULTANCY, Chandigarh October 2003
- [Appropriate Rural Technology Institute](#) (ARTI), Pune and ARTI [Field Research Station, Phaltan](#)
- Zenith Renewable Energy [Wood Stoves](#)
- A. Sampathrajan Tamil Nadu Agricultural University [Biomass Gas Stove](#)
- Jyoti Parikh: [EXPOSURE TO AIR POLLUTANTS FROM COMBUSTION OF COOKING FUELS: A CASE STUDY OF RURAL TAMIL NADU, INDIA](#)
- TERI [Emission Factors for Greenhouse Gases From Small Scale Combustion](#)
- TERI [Improved Cookstove Program in Northern India](#)
- TERI [Study of stoves used in silk reeling industry](#) Mande S P. 2000 Biomass and Bioenergy 19(2000): 51-61 pp (abs)
- [Adaptability: Village Level Trials of Improved Cookstoves](#) REPSVision Newsletter, Winrock India

Indonesia

- [Risk Taking in ICS Commercialization](#) (Dian_Desa, PDF, 176KB) Aryanto Sudjarwo, Dian Desa ARECOP February 2003

Laos

- [Improved Lao Bucket Stove](#) (ILBS) (Lao_Bucket, PDF, 47KB) Vanna Tipangna ,National University of Laos ARECOP Cebu Conference February 2003.

Myanmar

- [Woodfuel Production and Marketing in Myanmar](#), National Workshop, Forest Department, Yangon 16 - 19 March 1999, RWEDP Report #56 (Paru, SSIC stoves)

Nepal

- [The Beehive Charcoal Briquette Stove in the Khumbu Region](#), Nepal, Sjoerd Nienhuys ([1 800 kb pdf](#)) March 18, 2003
- [Towards the Framework for Commercialization of ICS Promotion in Nepal](#) (Frame_comm, PDF, 27KB) Moon Shrestha*, Rajan Thapa**, CRT/N Nepal. ARECOP February 2003
- [National Improved Cook Stove Dissemination in the middle hills of Nepal, Experiences, Opportunities and Lessons learnt](#) (ICS_Midhill, PDF, 40KB) Saurav K. Shrestha, AEPC, Nepal; Rajan Thapa, CRT/N, Nepal, Ms. Karuna Bajrachary, ESAP ARECOP February 2003
- [Government Policy and Strategies of Improved Cook Stove Dissemination in Nepal](#) (govt_pol, PDF, 25KB) Dr. M. B. Basnyat and S. K. Shrestha, Energy Officer, Alternative Energy Promotion Centre ARECOP February 2003
- [Centre for Rural Technology](#)
- [Improved Biomass Cookstoves](#) Center for Rural Technology Photos
- [Improved Cooking Stoves](#), Alternative Energy Promotion Centre
- [Mountain Forum](#) (2001) Week Three Postings on [Improved Cooking Stoves](#)
- [The Impact of Improved Cookstove Dissemination in Rural Nepal](#), Merina Pradhan (1996)
- [Lamjung Electricity Development Company](#) (LEDCO) Improved Cookstoves Program, Kathmandu
- [IV Improved Cooking Stoves](#) Ministry of Science and Technology
- [SOME VARIATIONS IN COOKING AND/OR HEATING STOVES](#) RECAST/CEDA, K. M. Sulpya and Dr. B. Bhandra.

Pakistan

- [Research Report on BACIP Wood Stoves for High Mountain Areas](#), Pakistan, Sjoerd Nienhuys March 2003

Sri Lanka

- [Historical Timeline from Subsidy to Commercialisation of Improved Cookstoves: The Path Leading to Sustainable Stove Development and Commercialisation Activities in Sri Lanka](#) (Hist, PDF, 30KB) R.M.Amarasekara and Karunatissa Atukorala., IDEA, Sri Lanka ARECOP February 2003

Thailand

- [A Study on Improved Institutional Biomass Stoves](#), Battacharya et al.
- AIT [Improved Biomass Briquetting System](#)
- [Study of Biomass as an Energy Source](#)
- [Workshop on Renewable Energy Systems \(Bangkok, 2000\)](#)

Philippines

- [Lo Trau Rice Hull Stove](#) (REAP, IRRI)
 - [Study on the Production of Briquettes from Bagasse \(pdf\)](#) Apolinario, M. A., Gatanela, D.V., Escarrila, L. T., Gaston, N. D. 21 Sugar and Sugar By-products Research Division,Sugar Regulatory Administration, Bacolod City with Alexis T. Belonio, Central Philippine University
 - [Rice Hull Biocoal](#), Alexis T Belonio, Central Philippines University
 - [IRRI Rice Hull Stove](#)
-

- REAP (Canada) [Mayon Turbo Rice Hull Stove](#)
- [Approtech Asia](#) RWEDP Improved Cook Stoves (ICS) Country Country Contact Philippines
- [Biomass Based Recycling and Recovery Technologies: A Review of GO'S and NGO'S Works in the Philippines](#) Jose S. Nicolas, Rural Enterprise Development Foundation, Inc., Los Baños, Laguna, Philippines Paper presented at the R'99 Congress (Recovery, Recycling, Re-integration), February 1.999
- www.environmental-expert.com/events/r2000/r2000.htm

Indonesia

- UNESCO [Improved Cookstove: Indonesia](#)

LATIN AMERICA

- [Trees Water and People](#): Guatemala, Honduras, El Salvador, Nicaragua, Mexico (Chiapas)
- [ETHOS Summer 2003 Internships](#): Prolena in Nicaragua, Honduras, Bolivia, Grupo Fenix in Nicaragua
- [Images: Traditional and Improved Stoves in Central America](#) Trees, Water and People (June 2003)
- [Mesoamerican Network on Gender in Sustainable Energy](#) (GENES)/ESMAP April - July 2002 ([5.4 MB pdf](#))

Argentina

- KUTRALDUM, Efficient Wood Stoves for the Patagonian Andes, Roberto Escardo

Bolivia

- [Ecological Stoves](#) David Whitfield V CEDESOL La Paz, Bolivia, presentation to Global Village Eenergy Partnership Latin America Santa Cruz, Bolivia, July 2003

Cuba

- [Ecosur Holey Briquette Press](#) Fernando Martirena (September 2003)
- [Waste to Energy Technologies Targeting the Poor. The Cuba Case Study July 2002](#)

El Salvador

- [FUELS: Thinking About Wood \(in El Salvador\)](#) Ken Goyer, March 2003
- [Using Pumice to Make Lightweight Ceramics in El Salvador](#) Damon Ogle, March 31, 2003

Guatemala

- [The Effect of Material Choice on the Combustion Chamber of a Rocket Cooking Stove](#): Adobe, Common Brick, Vernacular Insulative Ceramic, and Guatemalan Floor Tile (Baldosa) Dean Still and Brad van Appel January 1, 2002
- UC Berkely [Stove Intervention Study in the Guatemalan Highlands](#)
- [HELPS International](#), Guatemala
 - [HELPS Stove Factory in Rio Bravo](#), Guatemala, Don O'Neal September 2003
 - [HELPS Plancha Stove Jutiaupa Mod With Inverted Pyramid](#) Don O'Neal March 2003
 - Ron Larson's [Questions and Answers](#) March 2003
 - [Making Baldosa Tiles for HELPS Stoves in Guatemala](#) Don O'Neal Feb 3 2003
 - [Cast Stove and Mold. Don O'Neal Mar 2003](#)
- Estufa Plancha [Masons on a Mission](#), Patrick Manley [Guatemala Stove Project](#), Tom Clarke

Honduras

- [Visual Guide to Assembling the Justa Stove](#) Jim Wilmes, Trees Water and People and Aprovecho, February 2003
- Damon Ogle [Tiled Justa Stoves](#) at the AHDESA Project, Trees Water and People, March 2003

Mexico

- International Seminar on Bioenergy and Rural Sustainable Development [Small Scale Applications Working Group](#) Morelia, Michoacán, México, June 27, 2003
- [New Lorena Stove Design in Mexico](#), Dean Still, Jeremy Foster March 2003

Nicaragua

- The [Vertical Shaft Brick Kiln](#) (VSBK) in Nicaragua ([pdf 500k](#)), Martin Melendez, Grupo Sofonias Nicaragua (July 2003)
- PROLEÑA's [Ecostove](#)
- Winrock/Aprovecho [Wood Fired Cacao Dryer in Nicaragua](#)

Peru

- ADRA Peru [Fogones mejorados y Briquetas Orgánicas](#) Demetrio Roja and Richard Stanley (August 2003)
- [Rice Husk - an alternative fuel in Peru](#), Estela Assureira, Pontificia Universidad Católica del Perú in [ITDG Boiling Point 48](#) (November 2002)
- [Chasqui Adobe Stove in Cuzco](#), Chasqui Humanitarian, Victor Huaman, 2002
- [Legacy Foundation](#) fuel Briquettes, Richard Stanley

EUROPE

- [CookStove.Net](#)
- [Biomaster](#)
- Small and Medium Biomass Boilers and Stoves [OPET](#)

CANADA

- [Combustion Net - Pellet Fuels](#)

UNITED STATES OF AMERICA

- US EPA Emissions: [2000 Report](#), The Contribution of Combustion to Ambient Fine Particulate Emissions in the US
-