GERES Cambodia has been demonstrating the feasibility of large scale dissemination of locally made improved stoves for household cooking since 2000. At present around 100,000 New Lao Stoves are sold each year and emissions reductions from the project has recently been validated by DNV for sale in the voluntary carbon market. However, despite the problems associated with inefficient biomass use, dependence on wood energy remains high. Consequently, there is scope for introducing efficiency measures and technologies across the biomass energy sector. With the help of Planète Bois, a French organization, specialized in high performance wood burning equipments, GERES Cambodia has developed a new low cost design for use by Small and Medium Enterprises in Cambodia.
The stoves utilize post combustion technology which has been adapted to the conditions and demands of rural activities in Cambodia, in particular palm sugar production.

Social and economical context


Photo 1: Vattanak stove for Palm sugar

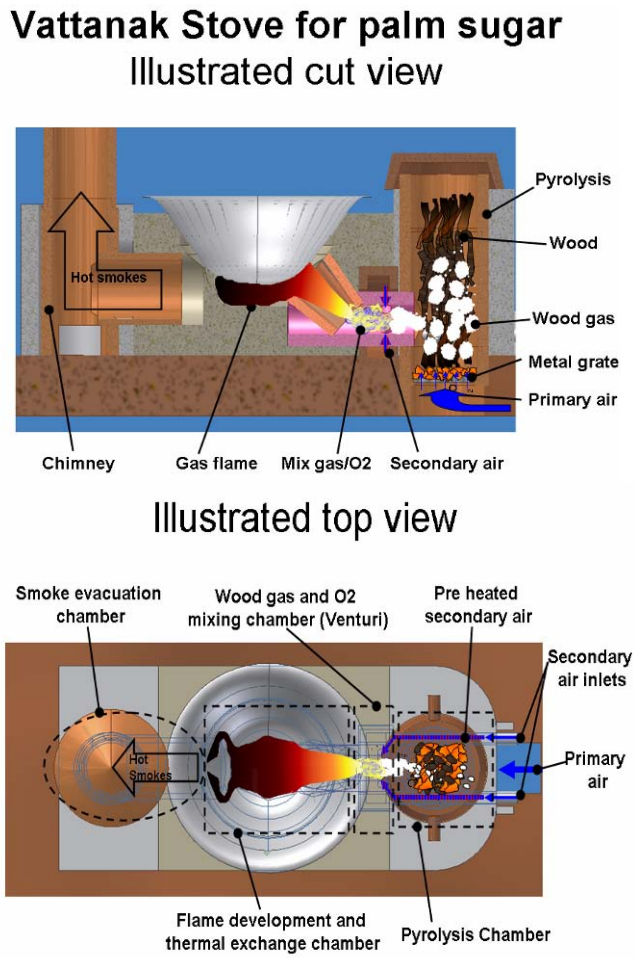
Palm sugar production consists of climbing the palm trees to collect the palm juice. After which the juice is heated in a wok using a stove to evaporated 85% of the water in the juice.
Palm sugar production in Cambodia, a traditional rural activity, is threatened by the wood scarcity/cost and the unpredictable quality of the end product, the palm sugar. It is estimated that 20 000 families are involved in this activity and their incomes are amongst the lowest in Cambodia. The UNDP (2005) estimated the poverty line at 0.5$ per day per person. Although a family earns around 0.5$ per day by producing sugar this is divided between the family members, which amounts to around US$ 0.15 a day.
Palm sugar is one of the few activities that can generate a cash income. In addition it is adapted to the rice growing season and therefore does not interfere with rice production.

The design

After laboratory and field testing the stove has been called “Chungkran Vattanak Skor” or ‘prosperous sugar stove’.

This post combustion stove is composed of 4 main elements:

- **The pyrolysis chamber** where the wood is gasified. The quantity of oxygen going into this chamber is just small enough to maintain heat generated by the embers to continue the gasification.
- **The venturi** where wood gas is mixed with oxygen. The relatively small size of this chamber increases the speed of the gas flow and improves its mixing with oxygen. The secondary air has been pre-heated thanks to the metal tubes going through the pyrolysis chamber.
- **The flaming chamber is** where the thermal exchange with the palm juice in the wok begins. The venturi is connected with a conical burner. The angle between these 2 ceramic parts generates turbulence to improve the mixing of gas and O_2. The conical shape of the burner helps the flame development.
- **The chimney** creates the necessary natural draft. The height of the chimney is of 3.5 m.



This stove has 2 operating phases. The first one consists of pre heating the internal parts of the stove. This phase takes around 20 minutes during which only primary air is supplied within the stove. Once it is hot enough, the stove can operate in post combustion mode; primary air is reduced and the secondary air is adjusted for quality combustion. This modification of air inlet is done with simple lids. The secondary air inlet can be full closed (pre-heating phase) and totally open (post combustion phase). The primary air can be fully open (pre-heating phase) and partially open (post combustion phase).

The standardization

The Vattanak stove is composed of pre fabricated ceramic parts. This system has important advantages:

- Good calibration of the 4 chambers of the stove
- Strong robustness to heat, thermal shock
- Decreases the masonry needed
- Enables a full technology transfer thanks to local and traditional pottery skills
- Enable local businesses approaches.

The mix used to produce the parts is composed of refractory clay and sandy clay. A production unit was set up in December 2006 able to produce 6 sets a month.

The Vattanak stove is composed of 17 ceramics elements:

ITEM	PART NAME	Qty	DESCRIPTION
4	Venturi	1	
5	Burner	1	
6	PY2	1	Element N°2 of the pyrolysis
7	Venturi ring	1	Ring bringing the O_2 in the venturi
8	Chimney base	1	
9	Smoke exit	1	
12	PY3	1	Element N°3 of the pyrolysis
17	PY1	1	Element N°1 of the pyrolysis
18	Ch	6	Chimney element
19	Ch top	1	Top of the chimney
20	Ch lid	1	Lid of the chimney
21	Py lid	1	Lid of the pyrolysis

Photo 2: Drawing of Vattanak stove showing how the ceramic parts are assembled

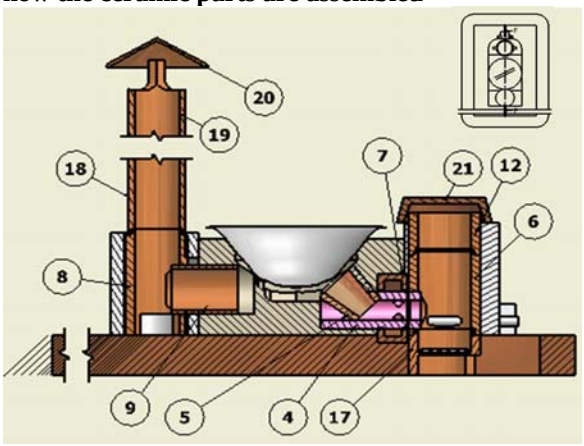


Photo 3: assembling test in the Production unit

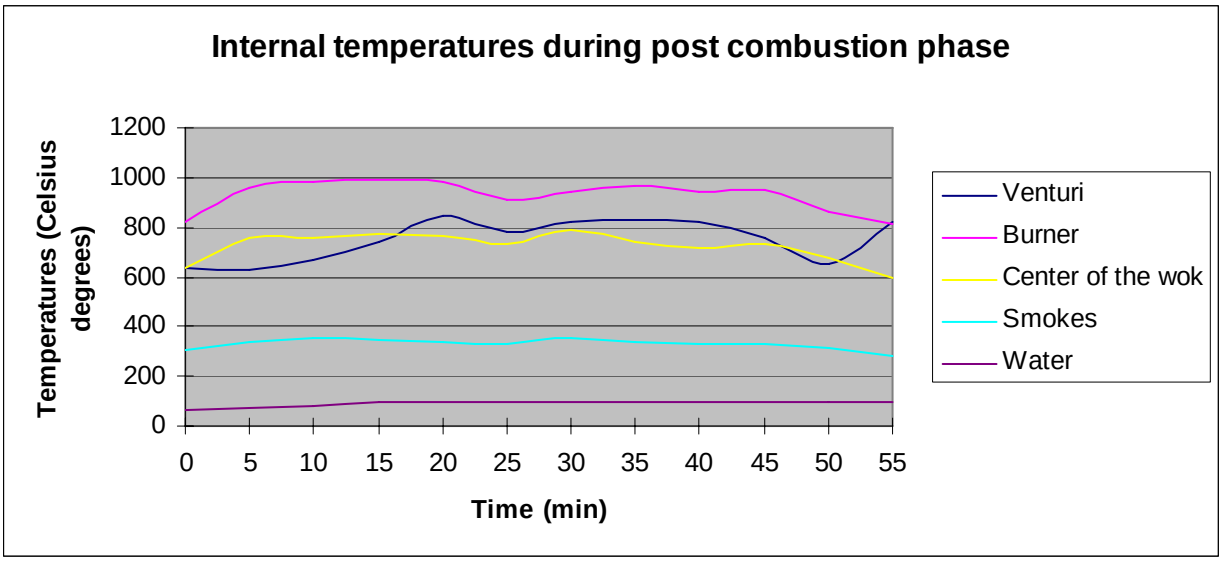
By just assembling this set and adding the plastering, we obtain one wood gas stove with calibrated pyrolysis, venturi, burner and chimney. The plastering can be traditional mix as clay, sandy clay and rice straw.
The production cost of one Vattanak set is of $ US 50. The estimated market price is of $ US 70.

The results

Fuel saving and low CO and unburnt components in the smokes

The stove was approved by palm sugar producers during field tests held between December 2006 and June 2007. The Vattanak Stove saves around 40% of wood so the producer can save 4 tons of wood or 6.6 tons of Co2 per year. At present we cannot greatly increase the heat exchange area for a standard family production unit; furthermore only the center part of the wok is to be heated to avoid sugar browning and lower grade sugar quality. Those first performance results will be improved in a second time with models with larger heat transfer zone(different production organization regrouping climbers..).

On average, the flame at the end of the burner is at around 900°C with low air excess. This produces fewer products of incomplete combustion (PICs) in particular low levels of carbon monoxide (CO).



Higher sugar quality

With the absence of smokes, a stable boiling power and a centralized thermal exchange, the end product is a very high quality product with all the natural aromas preserved.

Ergonomic environment

The smoke is extracted by the chimney, so the user doesn't inhale it. Also the insulation of the stove drastically decreases the heat around the stove giving a better working environment. Once fuelwood is added in the pyrolysis chamber it automatically burns, with regular power, for around 30 minutes without any need of intervention by the user.

The pilot users are very enthusiastic; they save large quantities of wood, increase the quality of their production and also enjoy better working conditions.

Coming developments:

Bring "Vattanak" stove to local business approach

Thanks to ESMAP funding, GERES Cambodia will start the pilot commercialization of the "Vattanak" Stove in the Kompong Chhnang province where the palm sugar production is well established. The objective is to bring the production unit to a financially independent status and to commercialize 35 units before March 2008 and also to implement and test in the field our commercialization strategy.

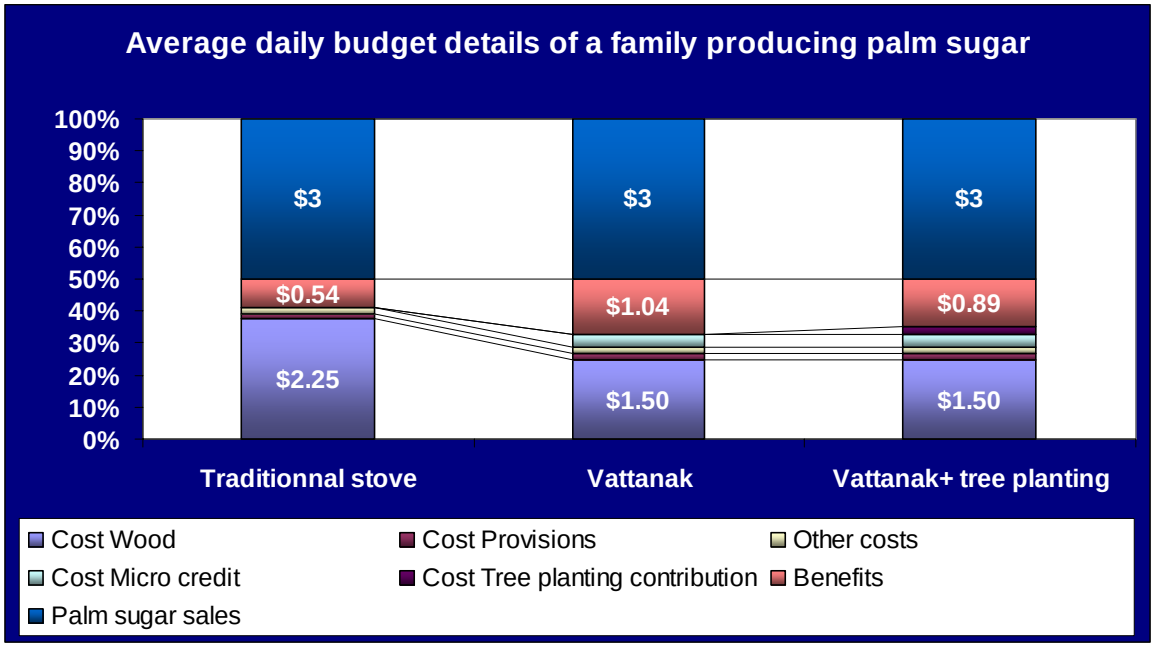
The Vattanak stove will be commercialized through local middlemen. The farmers will buy the set of ceramics and build themselves the stove following the construction manual. The middleman would provide the improved tools and technical support to ensure a good assembling.

Use energy efficiency to implement sustainable wood supply management and maintain, in rural areas, traditional lucrative activities.

GERES Cambodia is seeking funds to cofinance a 2 years project including Vattanak stove commercialization and forestry management.

Indeed, with the extra benefits offered by the "Vattanak" Stove, it is possible to set up a contribution to finance community tree planting. We estimated that a contribution by a community of 100 families of 0.15$ a day during 100 days per year can enable a tree planting of 16.8 hectares per year.

As shown on the graph, the contribution is not taking a big part of their daily incomes; they are still generating more income using the Vattanak stove than their traditional stoves (0.89 US$ compared to 0.54US $).



The objective is to demonstrate that by using low cost efficient stoves, a sustainable wood supply and an adapted marketing approach for a traditional quality product, we can enlarge income generation for some of Cambodia's poorest families and respect the local environment.

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The Renewable Energy and Solidarity Group (GERES), is a French NGO created in 1976 working on adapted technologies both in France and developing countries (West Africa, South Asia, South East Asia). GERES started to work in Cambodia in 1997 on fuel wood saving. In 2006, GERES Cambodia received an Ashden awards for the successful commercialization of a household cook stove called the *New Lao Stove*. GERES Cambodia is working on improved cook stoves, gasifier stoves, sustainable charcoal and wood vinegar production, and also climate change and Carbon finance.

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