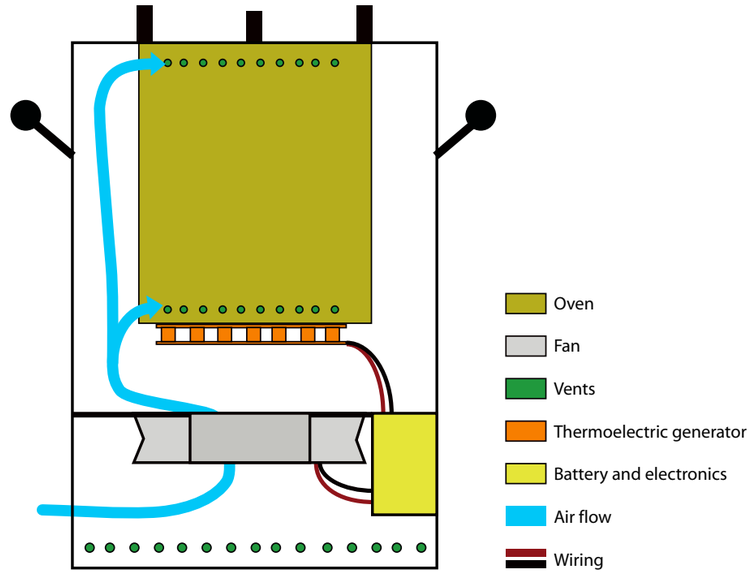
Satisfying a burning need

A revolutionary woodstove design will improve cooking conditions in developing countries. By burning more efficiently, the stove reduces the demands on the existing energy supply chain. It also cuts the smoke and toxic emissions that cause 1.6 million[i] deaths a year. The stove could benefit up to 300 million families in the world's poorest regions.

By David Hegarty
Photography/illustration: Philips, Storm Scott

The woodstove being used in a field trial



Schematic diagram of the woodstove

The secret to the efficiency of the stove is a long-life, brushless fan that forces a controllable flow of air through the stove from below. To start the oven, the cook lights the fuel (typically wood or charcoal) and then switches on the fan, which runs on a rechargeable battery. The fan improves the fuel to air ratio, helping the stove reach cooking temperature in as little as a fifth of the time taken by a traditional, three-stone fire. Once lit, the flow of air ensures a higher burning temperature.

Philips Research carefully chose the materials used to build the stove for low thermal mass and high isolation. Low thermal mass means the stove absorbs less energy, so it reaches cooking temperature faster. High isolation ensures the stove loses less of its heat to the surroundings, so more of the heat is available for cooking. The regulated airflow makes the heat output more stable and controllable. This is more convenient for cooking. Working with current cooking vessels, this achieves an energy efficiency of up to 50%, which is comparable to cooking with gas.

As the oven gets up to temperature, a thermoelectric generator slowly takes over from the battery to power the fan. When the oven is at its final temperature, the generator also recharges the starter battery.

> "We made some good choices early in the project, before we really knew how important they were."
>
> Paul van der Sluis, woodstove project leader, Philips Research

A new challenge for old technology

Though the technology in the stove has been viable for the last ten years or so, getting such a stove to work is not a trivial matter. A few teams have already tried to get this principle to work, but none have yet fully succeeded. As Paul van der Sluis, project leader for the woodstove at Philips Research, explains, "We made some good choices early in the project, before we really knew how important they were."

The main problem is with the electrical efficiency of the system. The generator is

[i] World Health Organization, 2004

made up of P-type and N-type alloys of bismuth and tellurium, sandwiched between ceramic plates. When a temperature difference is maintained across this sandwich electrical power is generated. This power is used to run the fan.

For all of this to work in the woodstove, there has to be a large enough difference in temperature between the hot side of the thermoelectric generator (facing to the burning wood), and the cold side of the thermoelectric generator (facing the outside). To achieve this, the fan also has to cool the cold side of the generator. Obviously, it has to use less energy for both fanning the flames and cooling than the generator produces. This was the greatest problem the research team had to solve.

Improving quality of life

The airflow through the burning wood gasifies it and these gases are burnt with preheated secondary air. This results in cleaner burning and more efficient use of the fuel. A field trial in India in late 2005 showed that, when used properly, the woodstove typically reduces fuel consumption to a third of that used by traditional, three-stone fires. This alone contributes to a better use of the available resources, and could slow deforestation. But perhaps more significant is the advantage to the people using the stove. Apart from faster and more convenient cooking, the greater energy efficiency means the stove needs less fuel. This saves the cost or the time taken to gather fuel. It also burns the fuel completely and inside a portable container, which saves the time and effort of cleaning up afterwards.

While there is some room in the design to further increase the efficiency of burning, there is a more important goal. By optimizing the airflow to burn the fuel as cleanly as possible, the woodstove reduces indoor air pollution. "The World Health Organization has identified indoor air pollution as a major risk to the health of women and children in the world's poorest countries," says Paul van der Sluis. The World Energy Assessment[ii] estimated the smoke from indoor wood or dung fires for cooking was the equivalent of smoking two packets of cigarettes a day. These people still have to cook, and "it was this that first prompted us to explore sophisticated, sustainable technology that was still affordable and practicable for a great many of the world's poor," he adds. The woodstove reduces pollution from smoke to a tenth, and organic volatile emissions to one-hundredth of the level of traditional, three-stone cooking fires. Aprovecho, an independent testing facility, has found the woodstove to be the cleanest burning stove they ever tested.

New markets

Philips Domestic Appliances and Personal Care will start a commercial pilot in India. The results of the first pilot should help decide how Philips can best partner with other companies and organizations to make, distribute and market the woodstove successfully. PW

[ii] The World Energy Assessment is a joint publication of UNDP, the UN Department for Economic & Social Affairs and the World Energy Council.

Paul van der Sluis • Philips Research • **paul.van.der.sluis@philips.com**

Extra info **www.research.philips.com/password** • woodstove

The woodstove has been tested extensively in field trials.