Cleaner stoves for developing countries, thanks to heat-powered fan design

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Paul Montgomery, a graduate student at Pennsylvania State University, is helping design a better cook stove for people in developing countries.

At an upcoming meeting of the 2nd Pan-American/Iberian Meeting on Acoustics in Cancun, Mexico, he will present a simple heat-powered fan that could help to make these stoves more efficient and combat the serious health problems associated with cooking in unventilated spaces.

How important is this? In a speech in September 2010 U.S. Secretary of State Hillary Clinton made a speech in which she underscored the impact of simple stoves on living standards in many parts of the world. More than 3 billion people use open fire cooking to eat daily, she said. But such cooking is very energy inefficient; finding fuel itself is a laborious; the combustion contributes disproportionately to greenhouse warming; and, worst of all, the fumes (often gathering in unventilated rooms) produce air that often exceeds EPA guidelines for healthful air by a factor of 200.

The fumes kill an estimated 1.9 million people a year, according to the United Nations. The World Health Organization cites this smoke as one of the five greatest killers in developing countries. Ms. Clinton's speech launched a worldwide effort called the Global Alliance for Clean Cookstoves.

Some moderate-sized devices generate combined heat and power, or CHP. The smallest of these highly-efficient machines can make, for

example, 2 kilowatts of heat and 1 kilowatt of electricity. But even this is too much for a person in a rural area to use and too expensive, so Montgomery is trying to make a simple appliance that is 100 times smaller still.

His device, still at the experimental stage, captures some of the stove's waste heat and converts the heat into sound waves in a simple thermo-acoustic engine. Then the acoustic energy is converted into a tiny bit of electricity in an electro-acoustic transducer. The electricity in turn can partly charge a battery (delivering well-needed lighting after dark) and operate a fan directed at the combustion of the stove's biofuel, making the whole process more energy efficient.

The more efficient combustion, the less biomass must be burned to cook and the less smoke produced.

"Although a thermo-acoustic cogeneration cook stove would produce only on the order of ten watts of electrical power," he says, "there are probably two billion biomass-fueled cook stoves in use worldwide that might benefit from nano-CHP technology."

The target price for the device that attaches to the stove is $25, says Montgomery, who will report on his ongoing engineering research in Cancun.

More information: Montgomery has written a lay-language paper explaining his research in greater detail, available online: http://www.acoustics.org/press/160th/montgomery.html
The talk "Low-cost thermoacoustic co-generator for biomass burning cook stoves" will be at 4:00 p.m. on Tuesday, November 16.

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