

by James E. Houck and Paul Tiegs

In many areas of the world, improved biomass cookstoves and wood heaters are desperately needed. That expertise resides in the hearth and barbecue industries.

## A Global Opportunity

**F**orget your perceptions of wood-fueled heater and cookstove use based on experience in developed countries, such as North America or Western Europe.

Forget the advances in technology that are responsible for low emission, efficient units.

Forget that environmental and health issues have been, by in large, addressed with modern appliances and state-of-the-art installation.

Forget the economics and demographics of wood heating and cooking that have been so well studied in North America for business development and governmental energy utilization interests.

For the overwhelming majority of the world it is a totally different story, and it should be a story of interest to the North American hearth product and barbecue industries.

### Cookstoves in Developing Nations

The magnitude of the use of biomass fuels for cooking in developing nations, with associated environmental, health and socioeconomic issues, is staggering. So much so that it has caught the attention of a number of governmental agencies, international aid groups, the World Bank, and various scientific researchers. The magnitude and pervasiveness of cooking

with solid fuels were succinctly explained in an introduction to a 1995 Scientific American article on the subject.

“Half of the world’s population of nearly six billion people prepare their food and heat their homes with coal and the traditional fuels of dung, crop residues, wood and charcoal. The procurement and consumption of these fuels define the character of everyday life in many developing countries.”

More recently, in 1999, the estimated number of people who use biomass (wood, dung or crop residues) for cooking worldwide was 3.5 billion, dwarfing the mere 42,000 homes that were equipped with a wood cookstove in the U.S. during the same year.

The litany of issues associated with low technology, inefficient biomass cookstoves include: deforestation, soil erosion, unnecessarily high fuel costs, global warming, deleterious indoor air quality, poor outside ambient air quality, visibility degradation and respiratory disease. The World Bank has declared indoor air quality (primarily degraded due to cooking) as one of the five major environmental problems facing the world.

Horribly, more than five million children under the age of five die each year of pneumonia, with a key causality being poor indoor air quality.

To address the environmental, health and economic issues, there have been a number of large scale programs, dur-



ing the 1980s and 1990s, to develop and distribute improved cookstoves, such as in China, India, Kenya and Central America, as well as many other developing nations. The effort has become so well known among international energy, environmental and health experts that the term “improved cookstoves” has even acquired its own acronym (ICS), and a series of models/types have been widely recognized. They include the Jiko stove of Kenya (more than one million distributed), the Chula cookstoves of India (more than 12 million currently in homes), and a number of Central American models (Lorena stove, Rocket stove, Estufa Justa and Ecostove).

By far the largest ICS program has been instituted by China, which has installed more than 150 million units.

The sponsors associated with ICS programs have included the World Resources Institute, UNICEF, Peace Corps, United States Agency for International Development (USAID), Food and Agriculture Organization (FAO) of the United Nations, Volunteers in Technical Assistance (VITA), and the World Bank. Numerous country-specific governmental agencies and development banks throughout Asia, Africa, Central America and the Caribbean also have been involved in sponsoring or subsidizing ICS programs.

Notable research organizations involved in the study or development of ICS have included the East-West Center of the University of Hawaii, Aprovecho Research Center (Oregon), Stockholm Environment Institute, Center for Renewable Energy and Sustainable Technology (CREST, Washington, D.C.), and the Indian Appropriate Rural Technology Institute (ARTI).

But what is an ICS? More to the point, what is the “improved” part of the ICS acronym? While the various models offer a range of improvements, unfortunately, many improved cookstoves are only improved over a hole in the ground, a three rock open fire, or a very rudimentary metal skin cookstove. Many do not include the

### Traditional Three Rock Cookstove 8% of Energy Absorbed by water and food



technology necessary to control the air supply or to optimize secondary combustion that has become so commonplace with U.S. EPA-certified wood heating stoves sold in the U.S.

Moreover, many either do not have a chimney associated with them or have not been designed to optimize draft. Con-

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sequently, while ICS are more efficient and cleaner burning than the more rudimentary cooking set-ups, many further improvements are possible.

It is outside the scope of this article to detail the design characteristics to make an “improved” improved cookstove. Comprehensive technical manuals on the

subject have been published with various testing protocols to judge efficiencies and performance<sup>1</sup>.

Those familiar with stoves know that the keys to the design of a good cookstove involve the application of heat transfer, combustion and fluid flow principles in order to attain complete combustion of the fuel with a minimum amount of excess air, maximum heat transfer from the flame and the flue gases to the cooking vessel, and a minimum loss of heat to the surroundings. This can be accomplished by optimizing and/or incorporating various subsystems in the stoves. These are: fire-

box/combustion chambers and stove walls, grate, air/fuel inlet, flue/chimney, baffles, dampers and connecting tunnels.

Beyond the fundamental engineering principles taken into consideration in the design of an improved cookstove, the following key points are worth emphasizing: Heating stoves, with which most of us are familiar, are fundamentally different in design and purpose from cookstoves. Simply put, a heating stove is designed to transfer heat to a room. A cooking stove is designed to transfer heat to food, not to a room.

Social factors cannot be ignored. Different cultures have different cooking practices. Different cooking tasks include boiling, frying, baking, grilling, steaming and pressure cooking. Different stove designs are required for optimal performance of these different cooking tasks. For example, in some cases the optimum scenario is very rapid transfer of heat to a small area, e.g., boiling water in a pot in the tropics. In other cases, such as for baking needs, heating a large thermal mass is desirable.

Biomass fuel types will influence stove design. Depending on whether wet wood, dry wood, crop residues, dung or charcoal will be primarily burnt, different stove design parameters would be appropriate.

Due to economics, ICS are generally built in developing countries, often coor-

minated by experts and with international development or aid agencies and/or governmental agencies providing subsidies. A case in point is the Ecostove manufacturing plant located in Managua, Nicaragua, that has the current capacity to manufacture some 500 stoves per month. It has been assisted with USAID, World Bank and UN grants; its vice president, Rogerio Miranda, is the director of an affiliated research organization and, again, due to economics, local materials are utilized.

Some ICS, such as the Ecostove, are factory-built; others, such as some Indian Chula models or Chinese ICS, are site-built. In either case, the formula appears to be governmental or international subsidies, local construction and professional expertise.

### Wood Heaters in Central and Eastern Europe and the Commonwealth of Independent States

While variable with regions, the use of wood for space heating in Central and Eastern Europe (CEE) and the Commonwealth of Independent States (CIS) is well established, commensurate with their generally cold climates and available forest resources. The opportunity for the additional application of wood heaters for space heating in lieu of other energy sources has recently increased.

Traditionally, the energy sectors of the CEE and CIS countries were vertically-integrated public monopolies. With a shift from centrally planned to market-based economies, the traditional structures of the energy sector have become increasingly unsustainable. The fact that many public power facilities were not well maintained has compounded the current problem. Many countries have started or are contemplating structural reforms. Future uncertainty and current shortages of low-cost energy have increased the interest in more energy independence such as provided by wood heaters.

A common heating scenario in urban settings within the CEE and CIS coun-



tries is district heating. As with other parts of the energy sector, the privatization of households and industries has caused considerable problems for centrally controlled district heating systems. This, coupled with the fact that, for a number of metropolitan areas, there is now less control of urban sprawl outside the boundaries served by heating districts has further increased interest in independent space heating options.

Environmental awareness also may play a role in increasing interest in new

bad maintenance and the lack of installation of environmental controls during the Communist era.

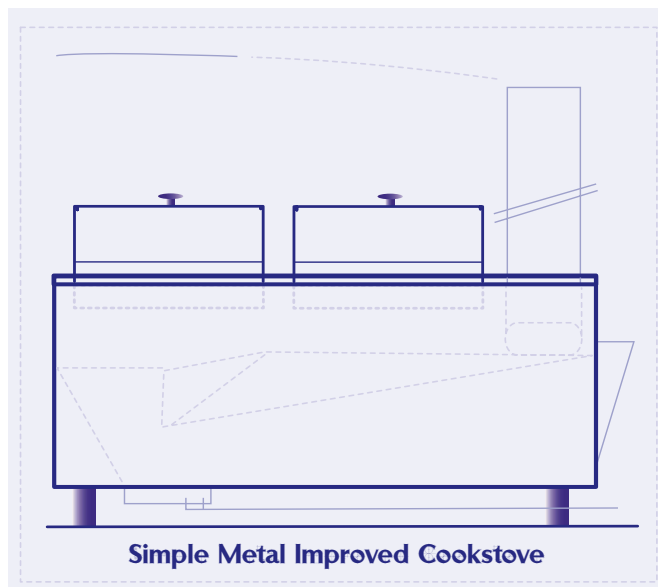
There appear to be no large scale (or a least well publicized) current projects to expand the use of wood heaters to help conserve other forms of energy (e.g., electricity or natural gas) or reduce air emissions from homes with existing wood heaters. There are, however, a number of multilateral financial institutions active in the energy and environmental arenas in CEE. These include: the European Bank for Reconstruction and Development (EBRD), the Euro-

pean Investment Bank (EIB), World Bank Group (WB), Nordic Environment Finance Corporation, Nordic Investment Bank, EC Energy Programmes and the Project Preparation Committee (PPC).

The Multilateral Development Banks (MDB) play a significant role in advising CEE countries in the development of their energy sectors and are large-scale and long-term lenders. For example, the WB, EIB and EBRD alone, from 1989 through 1996, have approved loans totaling \$25.4 billion (US) in CEE countries. The role of some other types of multilateral financial institutions include coordinating funding between governments, private industry and banks, and assisting CEE countries in achieving membership in the European Union. In all cases, energy and environmental projects make up a significant fraction of the institutions' activities.

For example, two recent World Bank projects were the loans to Poland for \$43.6 million (US) to reduce pollution from coal-fired space heating boilers, and to Ukraine for \$18.3 million (US) to improve energy efficiency in buildings.

There appear to be two avenues to increase wood heater use in CEE and CIS countries. One is an institutional approach, in many ways analogous to the Hearth, Patio & Barbecue Association's wood stove change-out pro-

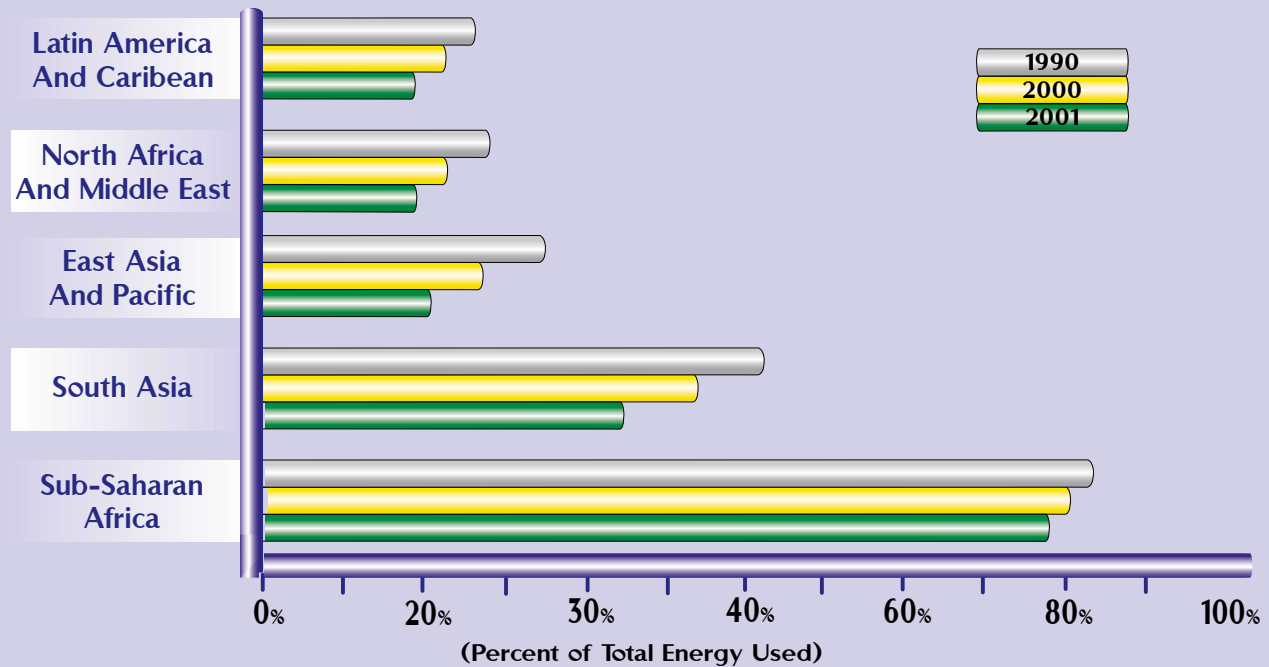


Simple Metal Improved Cookstove

technology, environmentally sound wood heaters. Most of the CEE countries have promulgated new environmental standards. This in part is a response to the very poor air quality in many regions produced by low quality coal and oil,

## Biomass Use, While Declining, Will Remain High

Current and Projected Use of Biomass by Region, Selected Years



Source: The World Bank, Rural Energy and Development: Improving Energy Supplies for Two Billion People (The World Bank, Washington, D.C., 1996)

grams that have been successful in the U.S. In this scenario, governmental agencies or developmental institutions subsidize the program. The other scenario is simply to capitalize on the expanded free market atmosphere in CEE and CIS countries in concert with the increased number of privately-owned residences with occupants facing uncertain energy availability. In either scenario, high technology, efficient, low-emission wood heater designs developed in North America fit the need.

### The Opportunity


So what is the opportunity for a North American company to get involved in the international manufacture or sale of wood heaters or cookstoves, and to be able to make an acceptable profit while at the same time improving the human condition? Certainly the numbers are there.

In regards to cookstoves in the more impoverished nations, 75 percent of the 3.5 billion people who cook with biomass still use a three-stone or a simple mud/stone enclosure. Even most of the 200 million or more improved cookstoves that are in use are primitive compared to the technology employed in state-of-the-art wood heaters developed in North America and Western Europe.

The numbers are also there in regards to wood heaters in CEE and CIS. The combined population of the CEE and CIS countries is large – 415 million (1998) and, while variable with regions, substantial forest resources are available for fuel. The Russian Federation alone has 767 million hectares of woodland and forest which is, for comparison, equivalent to approximately 84 percent of the total land area of the United States.

Clearly, large numbers with low production costs is the

key paradigm for success. Local manufacture, local labor and local materials would be essential. Historically, subsidies by international aid or development organizations and/or governments has been available for cookstove programs in developing nations and for various energy related projects in CEE and CIS countries.

Importantly, this does not appear to be an ephemeral opportunity as trends in biomass utilization, energy infrastructures, population growth and concerns with environmental issues suggest that, if anything, the need for efficient, environmentally sound, biomass-fueled cookstoves and heaters will increase in the future. 

*About the authors: Dr. James E. Houck is president of OMNI Consulting Services and is a research scientist with over 20 years experience. Mr. Paul Tiegs is the president of OMNI- Test Laboratories and a professional engineer with over 25 years of experience. OMNI Consulting Services specializes in energy and environmental issues associated with residential heating. OMNI-Test Laboratories specializes in safety, efficiency and environmental testing of home heating appliances and fuels. Information and related studies can be obtained at [www.omni-test.com](http://www.omni-test.com).*

Two excellent comprehensive technical manuals are: "Biomass Stoves, Engineering Design, Development, and Dissemination," 1987, by S.F. Baldwin, Volunteers in Technical Assistance, Arlington, Virginia, and "Improved Solid Biomass Burning Cookstoves: A Development Manual," 1993, Food and Agriculture Organization of the United Nations, Bangkok, Thailand.