

Health Impacts of Indoor Air Pollution

At-a-Glance

EAP CLEAN STOVE INITIATIVE KNOWLEDGE EXCHANGE SERIES

CHINA



Key Messages

- **More than half of China's population still relies on solid fuels (coal and biomass) for cooking and heating.** Most of these households are in rural areas and are likely to continue using solid fuels in the near future.
- **Household burning of solid fuels is a major health risk factor in China,** estimated to lead to more than half million premature deaths annually with women and children particularly affected.
- **China needs to build on its earlier successful stove programs and undertake more active interventions.** The World Bank is launching the China Clean Stove Initiative to help increase access to clean and efficient stoves through capacity building, policy development, and the support of selected government action plans.

Why is Indoor Air Pollution a Health Issue?

Indoor air pollution (IAP) caused by the burning of solid fuels in traditional stoves is one of the leading risk factors attributed to mortality and burden of disease. For about half of world's population, solid fuels such as wood, agricultural residues, dung, and coal are the primary sources for household cooking and heating needs. Indoor combustion of solid fuels using traditional stoves releases a large amount of particulate matter (PM) and gaseous pollutants, causing serious health consequences for exposed populations. IAP emission levels generated by solid fuels are often 20–100 times those of clean fuels like liquefied petroleum gases (LPG), as is shown in table 1, and often up to 20 times higher than the maximum recommended levels suggested by the World Health Organization (WHO) guidelines and national standards (WHO/UNDP 2009).

Smoke from cooking fuels accounts for an estimated 2 million worldwide premature deaths annually—more than the deaths from malaria and tuberculosis combined. (WHO/UNDP 2009). It is the ninth leading risk factor attributed to burden of disease and the tenth leading cause of global mortality.

Women and children in developing countries are particularly affected by the negative health outcomes associated with IAP from solid fuel use. Women and girls are disproportionately affected because of the amount of time spent cooking. Young children are especially vulnerable since they spend much time indoors to be close to their mothers who are often at cooking stoves.

A meta-analysis of global studies on the risk of pneumonia in children under 5 indicates that children who are exposed to smoke from solid fuels are more than 1.8 times more likely to contract pneumonia than those who are not (Smith et al. 2010). The analysis also shows that the increase in the risk for contracting the illnesses of acute lower respiratory infection (ALRI), chronic obstructive pulmonary disease (COPD), cataracts, lung cancer, and cardiovascular disease ranges widely—from less than 10 percent to more than double. On average, the chance of contracting one of these illnesses ranges from 78 percent for ALRI in children under 5 to more than 150 percent for COPD in women over 15 (WHO/UNDP 2009; WB 2011a).

Table 1. Household Emission Levels by Type of Fuel (per Meal)

	Biogas	LPG	Kerosene	Wood Residues	Crop	Dung
CO	0.1	1	3	19	60	64
PM	2.5	1	1.3	26	124	64

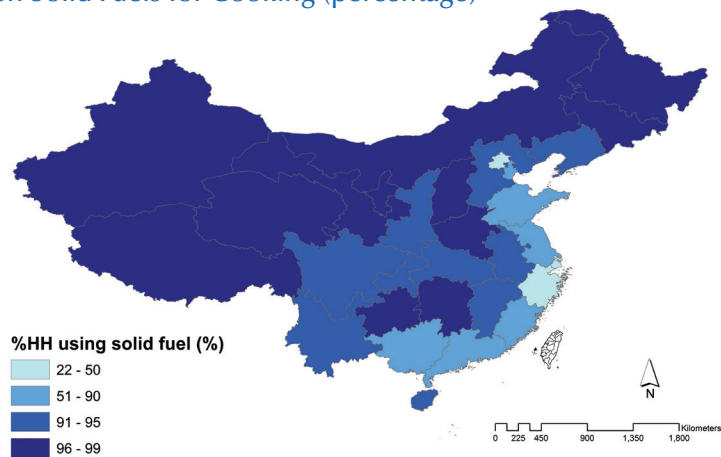
Note: Health-damaging pollutants per unit energy delivered: ratio of emissions to LPG. Data from K. Smith et al. 2000.
Source: Smith, Rogers, and Cowlin 2005.

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What is the Household Energy Use Situation in China?

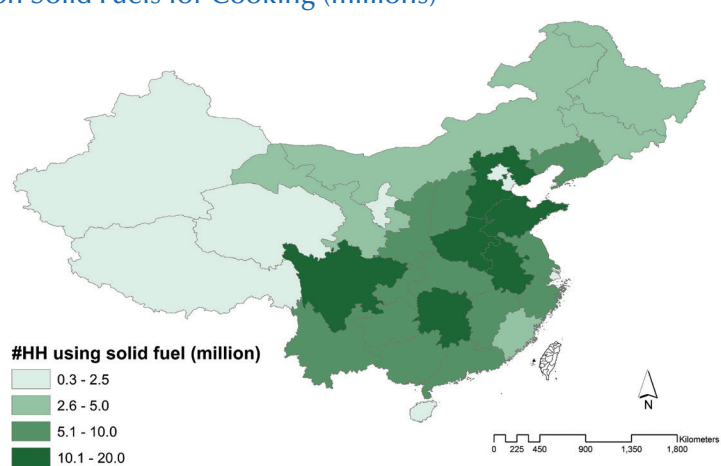
More than half of China’s population still relies on solid fuels for cooking and heating. Despite China’s impressive economic growth and accomplishments in poverty reduction, households have been slow to climb the *energy ladder* and transition from the use of coal and traditional fuels for cooking and heating to modern alternatives. Most of these households are in rural areas and it is likely that the use of solid fuels will continue even past 2030. Of the 263.8 million rural households in China, approximately 133.2 million rely primarily on wood and agricultural residues (60.2 percent) and an additional 57.6 million households use coal for their cooking fuel.

Figure 1. Percentage of Rural Households Relying Primarily on Solid Fuels for Cooking (percentage)



Source: National Agriculture Census 2006.

Figure 2. Number of Rural Households Relying Primarily on Solid Fuels for Cooking (millions)



Source: National Agriculture Census 2006.

Table 2. Top Five Provinces with the Largest Number of Rural Households Using Solid Cooking Fuels (millions)

Province	Biomass	Coal	Total
Henan	10	10	20
Sichuan	15	4	19
Shandong	14	5	19
Hunan	7	8	15
Hebei	7	7	14

Source: National Agriculture Census 2006.

Rural households in western and northern China predominantly depend on solid fuels (figure 1). Except for a few southeastern provinces, almost all rural households in China use solid fuels for cooking. The most concentrated areas of households solid fuel use for cooking are in central and eastern China because of the large populations and the access to these energy sources (figure 2).

The provinces of Henan, Sichuan, Shandong, Hunan, and Hebei have the most rural households using solid fuels for cooking. As table 2 illustrates, Henan Province has the largest number of rural households using solid fuel for cooking (20 million) and Sichuan Province has the largest number of rural household using biomass fuels (15 million).

What are the Health Impacts Caused by IAP in China?

The households burning of solid fuels represents a major health risk factor in China. It ranks sixth among all risk factors of ill health, only exceeded by alcohol abuse, high blood pressure, tobacco use, underweight, and occupational hazards (Smith et al. 2007). WHO/UNDP estimates that IAP from solid fuel use leads to over a half million premature deaths annually in China (table 3). It triples the COPD incidence and constitutes a major risk factor for acute lower respiratory tract infections (ALRI), causing deaths in young children in particular.

The combustion of locally-produced coal with high fluoride and arsenic content is a major cause of endemic fluorosis and arseniasis. According to data from 2000, 201 counties with total populations of approximately 33.678 million were affected by coal burning endemic fluorosis, and 8 counties with total populations of approximately .33 million were affected by coal-burning endemic arseniasis. The most affected areas of endemic fluorosis are in Guizhou and Shaanxi provinces (Jia, 2011).

Table 3. Annual Number of Premature Deaths Attributed to Air Pollution Caused by Cooking with Solid Fuels, 2007

Pneumonia— Children <5	Chronic Obstructive Lung Disease—Adults >30	Cancer—Adults >30	Total Premature Deaths	Total Premature Deaths per 1,000 People
9,100	505,900	33,900	548,900	0.42

Source: WHO and UNDP 2009.

What Can Be Done to Alleviate IAP?

IAP exposure can be reduced using a wide array of technological, housing, and behavioral interventions. Concentrations of indoor pollutants depend on a number of factors, including the stove-fuel combination (advanced clean stoves can reduce IAP levels by more than 50 percent); house design (e.g., size of structure, materials used in construction, arrangement of rooms, and quality of ventilation); and behavior regarding the use of stoves (for example, whether or not fuel is dried before it is combusted). In addition to pollution levels, exposure rates are affected by a number of factors, including amounts of time spent indoors, closeness to a cookstove, and cooking practices.

The most effective way to reduce IAP is by switching to clean fuels (electricity, natural gas, LPG, and biogas). This should be encouraged, but most rural households are still likely to continue using solid fuels in the near future. Modern clean fuels are usually more costly than solid fuels and they require more expensive stoves and a delivery infrastructure that is difficult for people in rural areas to obtain. By contrast, many forms of biomass are collected traditionally on a noncommercial basis in rural areas. Given these factors, large-scale fuel switching will not occur in rural areas until rural economies become substantially more developed.

In households where the use of solid fuels is likely to persist, the most effective remedy for IAP is the promotion of improved or advanced stoves that use solid fuels in a cleaner and more efficient way along with an awareness campaign. There is a pressing need to develop, promote, and deploy the new generation of more advanced and efficient stoves now commercially available that can significantly reduce fuel usage and emissions and thereby improve health outcomes. A key part of the promotion should be a campaign to raise awareness about the negative health and environmental impacts of traditional stoves, providing motivation for the behavioral changes needed for local people to adopt the new products (World Bank 2011a).

A Way Forward

China needs to build on its earlier stove programs and undertake more active and effective interventions that simultaneously address energy conservation, health, poverty, and environmental concerns. During the 1980s and 1990s, China instituted a very successful national improved stove program (NISP), implemented by the Ministry of Agriculture, which distributed 180 million improved stoves countrywide. The NISP was largely motivated by concerns about energy conservation, including the reduction of biomass use and its effects on land degradation and deforestation. The health dimensions of household energy use have only recently been identified as a driver for designing and marketing new stoves. The Ministry of Health (MOH) pioneered a program in the mid-1990s to promote “improved kitchens” in poorer regions of the country, providing improved stoves to households in targeted areas where fluorosis caused by burning high fluoride coal is endemic.

When the NISP program ended in late 1990s, the government expected the private sector to intensify stove commercialization and, to some degree, it has. The private sector currently produces more than 2 million efficient coal stoves and more than 600,000 high-efficiency low-emission biomass stoves. But the development and production of advanced biomass stoves has not kept pace with the challenge of promoting clean stoves in all households. At the current pace, it will take decades to reach this goal.

In addition to the positive health implications, scaling up access to clean and efficient stoves would be an important step toward reducing poverty, improving gender equality, and improving local and global environments. It is consistent with China’s strategy on promoting energy conservation and reducing carbon emissions as well as promoting green energy in villages. China should, therefore, build on its earlier successful stove programs and undertake more active interventions in a coordinated manner. In addition to existing programs that promote cleaner burning fuels (e.g., biogas), other options should be explored, including the creation of a new generation of innovative, cleaner-burning biomass stoves, the development of better marketing techniques to promote them, and the encouragement of private sector efforts to market and sell this new generation of more advanced biomass stoves.

EAP Clean Stove Initiative

China CSI is part of the East Asia and Pacific (EAP) Clean Stove Initiative, a follow-up to the Energy Flagship Report, *One Goal, Two Paths: Achieving Universal Access to Modern Energy in East Asia and Pacific* (1G2P). EAP CSI focuses on achieving access to modern cooking and heating solutions in East Asia and the Pacific, especially the scaling-up of access to advanced cooking and heating stoves for poor, primarily rural households that are likely to continue using solid fuels for cooking and heating even after 2030.

EAP CSI is a multi-country, multi-phase program with funding support from Australian Agency for International Development (AusAID). It includes four country-specific programs (China, Indonesia, Mongolia, and Laos) and a *Regional Energy Access Forum* to promote regional collaboration, learning, and knowledge-sharing about access to modern energy at the household level. EAP CSI takes a three-pronged approach focusing on (1) strengthening institutional capacity and creating an enabling policy and regulatory environment for scaling-up access to clean and efficient stoves; (2) supporting supply-side market and business development; and (3) stimulating demand for clean and efficient stoves.

Achieving universal access to modern energy services by 2030 is a goal set by the UN, which declared 2012 as the *Year of Sustainable Energy for All*. China, with a large population that lacks access to modern energy services, will have an critical role to play in achieving this global goal. To this end, the World Bank is working with the Department of Science and Education of Ministry of Agriculture to launch the *China Clean Stove Initiative* (CSI), to assist in scaling up access to clean and efficient cooking and heating solutions in China through capacity building, policy development and the support of selected government action plans.

Selected Sources for More Information

One Goal Two Paths: Achieving Universal Access to Modern Energy in East Asia and Pacific:

<http://elibrary.worldbank.org/content/book/9780821388372>

World Health Organization:

<http://www.who.int/indoorair/en/>

Global Alliance for Clean Cookstoves:

<http://cleancookstoves.org/>

China Alliance for Clean Stoves:

<http://cacs.chinaluju.com/>

Photo Credit

Courtesy of Chen Xiaofu, 2004.

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