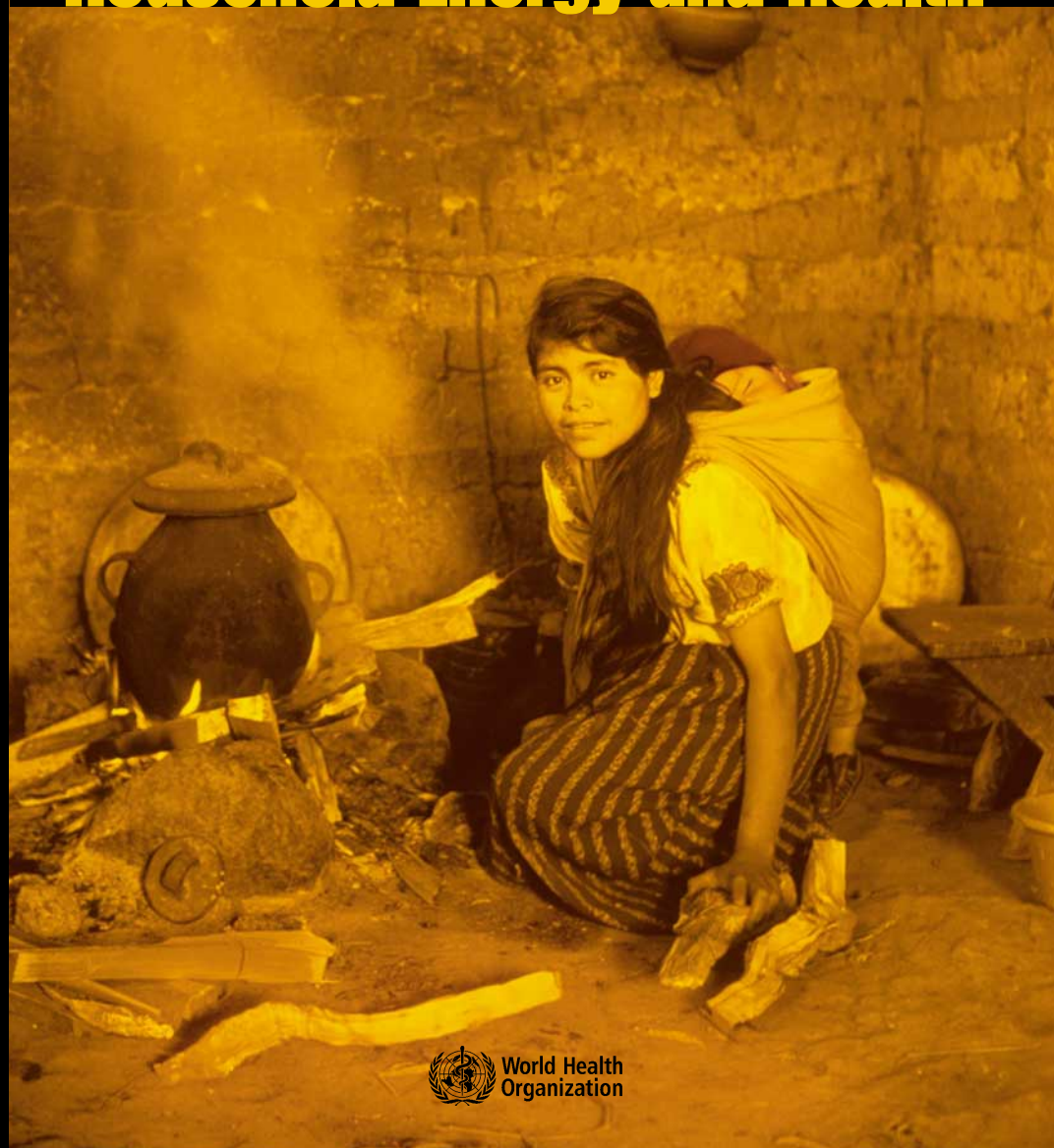
World Health Organization

Fuel for Life

Household Energy and Health



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Foreword

Energy is essential to meet our most basic needs: cooking, boiling water, lighting and heating. It is also a prerequisite for good health – a reality that has been largely ignored by the world community.

More than three billion people still burn wood, dung, coal and other traditional fuels inside their homes. The resulting indoor air pollution is responsible for more than 1.5 million deaths a year – mostly of young children and their mothers. Millions more suffer every day with difficulty in breathing, stinging eyes and chronic respiratory disease. Moreover, indoor air pollution and inefficient household energy practices are a significant obstacle to the achievement of the Millennium Development Goals.

Fuel for life, food for thought. With this publication we draw attention to a serious neglected public health problem. Effective solutions exist and the economic case for taking practical solutions to scale is just as strong as the humanitarian case. Making cleaner fuels and improved stoves available to millions of poor people in developing countries will reduce child mortality and improve women's health. In addition to the health gains, household energy programmes can help lift families out of poverty and accelerate development progress.

We hope that *Fuel for life* will inspire and prompt vigorous action to close the household energy gap.

Dr LEE Jong-wook
Director-General
World Health Organization

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section 1

Household Energy, Indoor Air Pollution and Health

Household energy: three billion left behind

"The health of the people is really the foundation upon which all their happiness and all their powers as a state depend."

Benjamin Disraeli,
British statesman and writer (1804–1881)

Cooking as an enjoyable pastime and passion for a privileged minority – on an electric range or a gas stove in a stylish kitchen in New York, Paris or Tokyo. Cooking as a chore and threat to the lives of the great majority – on an open fire in a shabby hut in rural Africa, south Asia or Latin America.

Worldwide, more than three billion people depend on solid fuels, including biomass (wood, dung and agricultural residues) and coal, to meet their most basic energy needs: cooking, boiling water and heating (Figure 1). Opening the door to their homes makes for a hazy welcome: thick grey smoke fills the air, making breathing unbearable and bringing tears to the eyes. The inefficient burning of solid fuels on an open fire or traditional stove indoors creates a dangerous cocktail of hundreds of pollutants, primarily carbon monoxide and small particles, but also nitrogen oxides, benzene, butadiene, formaldehyde, polyaromatic hydrocarbons and many other health-damaging chemicals. Day in day out, and for hours at a time, women and their small children breathe in amounts of smoke equivalent to consuming two packs of cigarettes per day. Where coal is used, additional contaminants such as sulfur, arsenic and fluorine may also be present in the air.

Yet, these families are faced with an impossible dilemma: don't cook with solid fuels, or don't eat a cooked meal. Being poor condemns half of humanity to dependence on polluting household energy practices. With increasing prosperity, cleaner, more efficient and more convenient fuels are replacing, step-by-step, traditional biomass fuels and coal. Climbing up the energy ladder tends to occur gradually as most low- and middle-income households use a combination of fuels to meet their cooking needs (Figure 2).

The problem of indoor air pollution has been around since the Stone Age, yet international development agendas still fail to recognize that missing out on clean energy equals missing out on life.

Figure 1: Energy poverty in people's homes
Percentage of population using solid fuels (Millennium Development Goal indicator 29), 2003 or latest available data

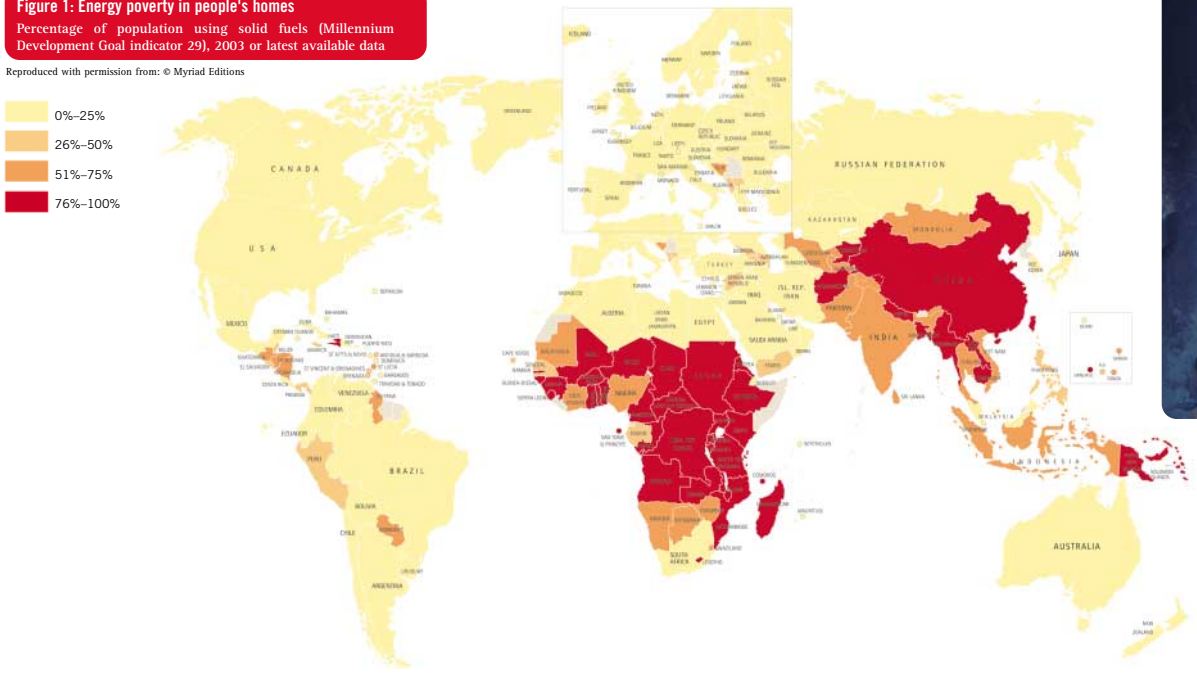
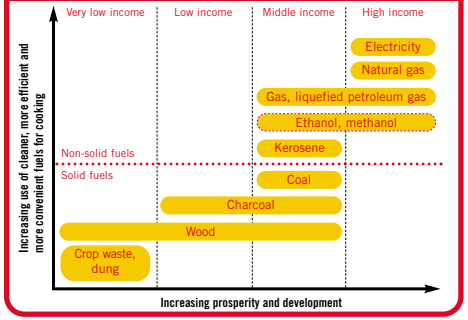


Figure 2: The energy ladder: household energy and development inextricably linked



Health at the heart of the matter

Black soot covers the walls of the dwelling. It is the pollutants in this black soot, as well as many invisible pollutants in the air, that women and children breathe in for many hours every day. Small particles (with a diameter of up to 10 microns (PM_{10})) are the most widely used indicator of the health hazard of indoor air pollution. Fine particles (with a diameter of up to 2.5 microns ($PM_{2.5}$)) are able to penetrate deep into the lungs and appear to have the greatest health-damaging potential. It is known that these particles can cause inflammation of the airways and lungs and impair the immune response, yet the precise mechanism by which exposure to indoor air pollution translates into disease is still unknown.

Burning solid fuels produces extremely high levels of indoor air pollution: typical 24-hour levels of PM_{10} in biomass-using homes in Africa, Asia or Latin America range from 300 to 3000 micrograms per cubic metre (μg/m³). Peaks during cooking may be as high as 10 000 μg/m³. By comparison, the United States Environmental Protection Agency has set the standard for annual mean PM_{10} levels in *outdoor* air at 50 μg/m³; the annual mean PM_{10} limit agreed by the European Union is 40 μg/m³. As cooking takes place every day of the year, most people using solid fuels are exposed to levels of small particles many times higher than accepted annual limits for outdoor air pollution (Figure 3). The more time people spend in these highly polluted environments, the more dramatic the consequences for health. Women and children, indoors and in the vicinity of the hearth for many hours a day, are most at risk from harmful indoor air pollution.

Since the mid-1980s, epidemiological studies have been investigating the impacts of exposure to indoor air pollution on health. The results of these studies have recently been reviewed by WHO (Table 1). Inhaling indoor smoke doubles the risk of pneumonia and other acute infections of the lower respiratory tract among children under five years of age. Women exposed to indoor smoke are three times more likely to suffer from chronic obstructive pulmonary disease (COPD), such as chronic bronchitis or emphysema, than women who cook with electricity, gas or other cleaner fuels. And coal use doubles the risk of lung cancer, particularly among women.

Moreover, some studies have linked exposure to indoor smoke to asthma; cataracts; tuberculosis; adverse pregnancy outcomes, in particular low birth weight; ischaemic heart disease; interstitial lung disease, and nasopharyngeal and laryngeal cancers. New research is needed to shed light on how exposure to indoor smoke contributes to this long list of health problems (see also Box 1).

Figure 3: Smoky streets, smoky homes
Typical 24-hour mean levels of small particles (PM_{10}) in micrograms per cubic metre (μg/m³), early 2000s

USEPA, US Environmental Protection Agency.

Table 1: Health impacts of indoor air pollution

Health outcome	Evidence[1]	Population	Relative risk[2]	Relative risk (95% confidence interval)[3]	
Acute infections of the lower respiratory tract	Strong	Children aged 0–4 years	2.3	1.9–2.7	SUFFICIENT
Chronic obstructive pulmonary disease	Strong	Women aged ≥ 30 years	3.2	2.3–4.8	SUFFICIENT
	Moderate I	Men aged ≥ 30 years	1.8	1.0–3.2	SUFFICIENT
Lung cancer (coal)	Strong	Women aged ≥ 30 years	1.9	1.1–3.5	SUFFICIENT
	Moderate I	Men aged ≥ 30 years	1.5	1.0–2.5	SUFFICIENT
Lung cancer (biomass)	Moderate II	Women aged ≥ 30 years	1.5	1.0–2.1	INSUFFICIENT
Asthma	Moderate II	Children aged 5–14 years	1.6	1.0–2.5	INSUFFICIENT
	Moderate II	Adults aged ≥ 15 years	1.2	1.0–1.5	INSUFFICIENT
Cataracts	Moderate II	Adults aged ≥ 15 years	1.3	1.0–1.7	INSUFFICIENT
Tuberculosis	Moderate II	Adults aged ≥ 15 years	1.5	1.0–2.4	INSUFFICIENT

[1] *Strong evidence: Many studies of solid fuel use in developing countries, supported by evidence from studies of active and passive smoking, urban air pollution and biochemical or laboratory studies.*
Moderate evidence: At least three studies of solid fuel use in developing countries, supported by evidence from studies on active smoking and on animals.
Moderate I: strong evidence for specific age/sex groups. Moderate II: limited evidence.
[2] *The relative risk indicates how many times more likely the disease is to occur in people exposed to indoor air pollution than in unexposed people.*
[3] *The confidence interval represents an uncertainty range. Wide intervals indicate lower precision; narrow intervals indicate greater precision.*

Box 1: Better household energy practices to mitigate the HIV/AIDS crisis?

Winning the battle against HIV/AIDS calls for effective prevention and treatment. But it also requires that people maintain their energy levels and physical fitness. Household energy plays a crucial role in keeping patients and their caregivers going: It is indispensable for cooking safe, nutritious meals and for boiling water to ensure its safety for drinking. It is essential for preparing hot compresses, heating water for bathing and sterilizing utensils for patients. And it provides warmth for those who are ill and suffering.

In Africa, wood tends to be scarce where collected and expensive where purchased. The incomplete combustion of biomass fuels indoors produces dense smoke, a major contributor to respiratory problems – even more so among immunocompromised HIV/AIDS patients. Therefore, more efficient, cleaner household energy practices can help families affected by HIV/AIDS as well as those not affected by the disease to live a healthier life.

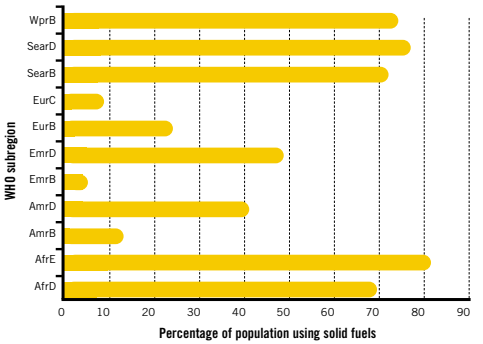
Adapted from:
Gebert N. *Mainstreaming HIV/AIDS: Participation or exclusion? Actors in the context of HIV/AIDS and project-induced measures (GTZ) for the optimized utilization of subsistence resources.* German Technical Cooperation Programme for Biomass Energy Conservation in Southern Africa (GTZ ProBEC), in press. Available at: http://www.probec.org

he kitchen

"Are we to decide the importance of issues by asking how fashionable or glamorous they are? Or by asking how seriously they affect how many?"

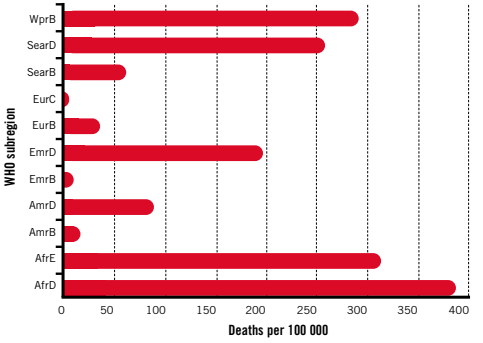
Nelson Mandela,
South African statesman and winner
of the Nobel Prize for Peace (1918–)

Figure 4: Widespread solid fuel use ...
Percentage of population using solid fuels, by WHO subregion[1], 2003 or latest available data



[1] *WHO distinguishes between the following geographical regions: African Region (Afr); Region of the Americas (Amr); Eastern Mediterranean Region (Emr); European Region (Eur); South-East Asia Region (Sear); Western Pacific Region (Wpr). WHO also differentiates between the following mortality strata: very low child, very low adult (A); low child, low adult (B); low child, high adult (C); high child, high adult (D); high child, very high adult (E).*

Figure 5: ... translates into respiratory deaths
Deaths attributable to indoor air pollution per 100 000 population, by WHO subregion[1], 2002



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