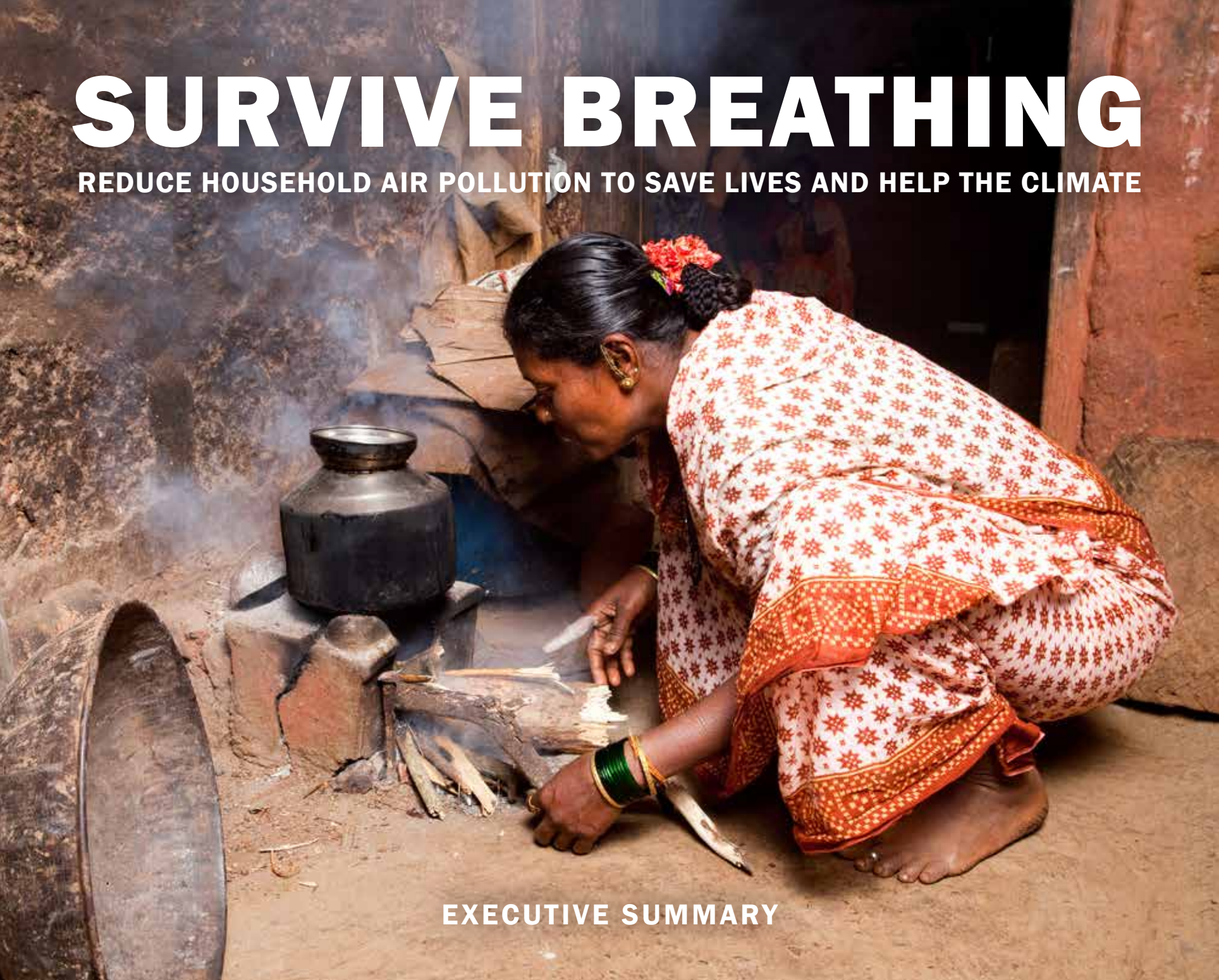


SURVIVE BREATHING

REDUCE HOUSEHOLD AIR POLLUTION TO SAVE LIVES AND HELP THE CLIMATE



EXECUTIVE SUMMARY

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Preface

In the early 21st century, nearly 3 billion people still lack reliable, affordable and sustainable access to modern energy services. They have to rely on various forms of solid fuel – animal dung, crop residues and waste, wood, coal and charcoal – to heat and light their homes and cook their food. Most of these people live in low- and middle-income countries.

Women and young children are most at risk because of the amount of time they spend indoors. As the 2014 World Health Organization (WHO) *Guidelines for indoor air quality: household fuel combustion* state, “clean air in and around the home is essential to a healthy life.”

Due to incomplete combustion, cooking fires and kerosene lighting produce black carbon, or soot, in the form of tiny particulate matter. These small particles penetrate deep into the lungs and have great potential to damage human health. Household air pollution causes over 4 million deaths per year, mainly through stroke, cardiovascular diseases, and lung cancer. Millions more fall ill and are unable to work causing loss of income and family hardship.

Ensuring access to sustainable, modern energy services for all will bring substantial health and development benefits. It will also benefit the climate since the same indoor cooking fires and kerosene lighting produce black carbon and other pollutants that contribute to global warming.

In order to make progress on the health front, a number of things must happen: People need access to modern cooking solutions, including cleaner household fuels and electricity. As well, cookstoves must be designed to reduce emissions – indoors and





outdoors. There is need to invest in alternative clean forms of energy to enable their large scale deployment. Above all, we need to invest in empowering people, especially women, to make those shifts themselves to cleaner means of cooking and to cleaner energy.

Reducing black carbon and other Short-Lived Climate Pollutants (SLCPs) is the focus of the Climate and Clean Air Coalition (CCAC). More than 100 countries and non-state parties are now part of the CCAC and are working towards this common goal. Norway was an early partner in the CCAC and has provided both leadership and financial support. As an Arctic nation with a strong commitment to improving the health and well-being of people around the developing world, Norway is fully cognisant of the role black carbon and other SLCPs play in the health-development-climate equation. We have stepped up our funding to reduce emissions of SLCPs, and we contribute to the global effort of promoting adoption of clean cookstoves and fuels.



Borge Brende
Minister of Foreign Affairs
Norway

The cost of inaction in this field is immense, in terms of both lives lost and economic losses. The cost of inaction greatly exceeds the cost of acting. We simply cannot afford not to act, and action needs to be taken now.

The report provides an overview of the science and our knowledge of household air pollution and its effects on human health, development and climate change. It examines some of the key initiatives to reduce household air pollution and provides a framework for decision makers that help them implement effective strategies.

The intention of this report is to bring together existing information on household air pollution, its effects on human health, and what can be – and is being – done about it. We trust this report amplifies the messages about the importance of dealing with household air pollution and its causes. Finally, we hope it will lay the foundation for further work in this area and support crucial activities required to provide three billion of the world's most vulnerable people clean air to breathe.



Achim Steiner
Executive Director
UNEP

Executive summary

“Universal access [to electricity and cleaner cooking fuels and stoves] is necessary to alleviate poverty, enhance economic prosperity, promote social development, and improve human health and well-being.”

2012 Global Energy Assessment¹

“Get rid of the smoke and people survive. It’s as simple as that.... People should not be dying from breathing.”

Borge Brende, Norwegian Minister of Foreign Affairs²

Household air pollution (HAP) caused by the inefficient burning of solid fuels such as wood, charcoal, dung, and crop waste on open fires and traditional stoves is a well known contributor to the global burden of disease. There is also a growing global recognition that the sources of household air pollution are major contributors to local and regional environmental degradation and global climate change.

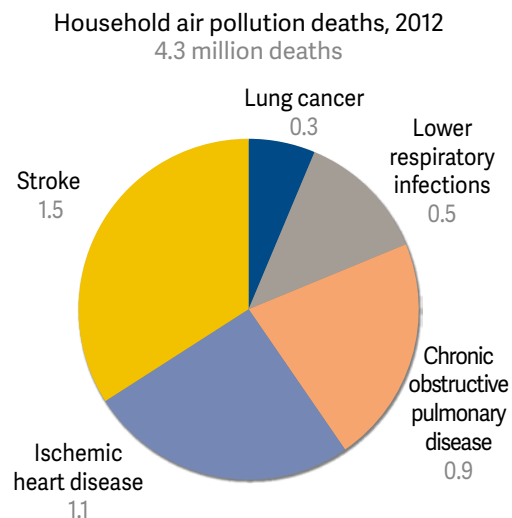


Figure 1: Causes of death attributed to household air pollution (HAP) in 2012. Data from the World Health Organization.³



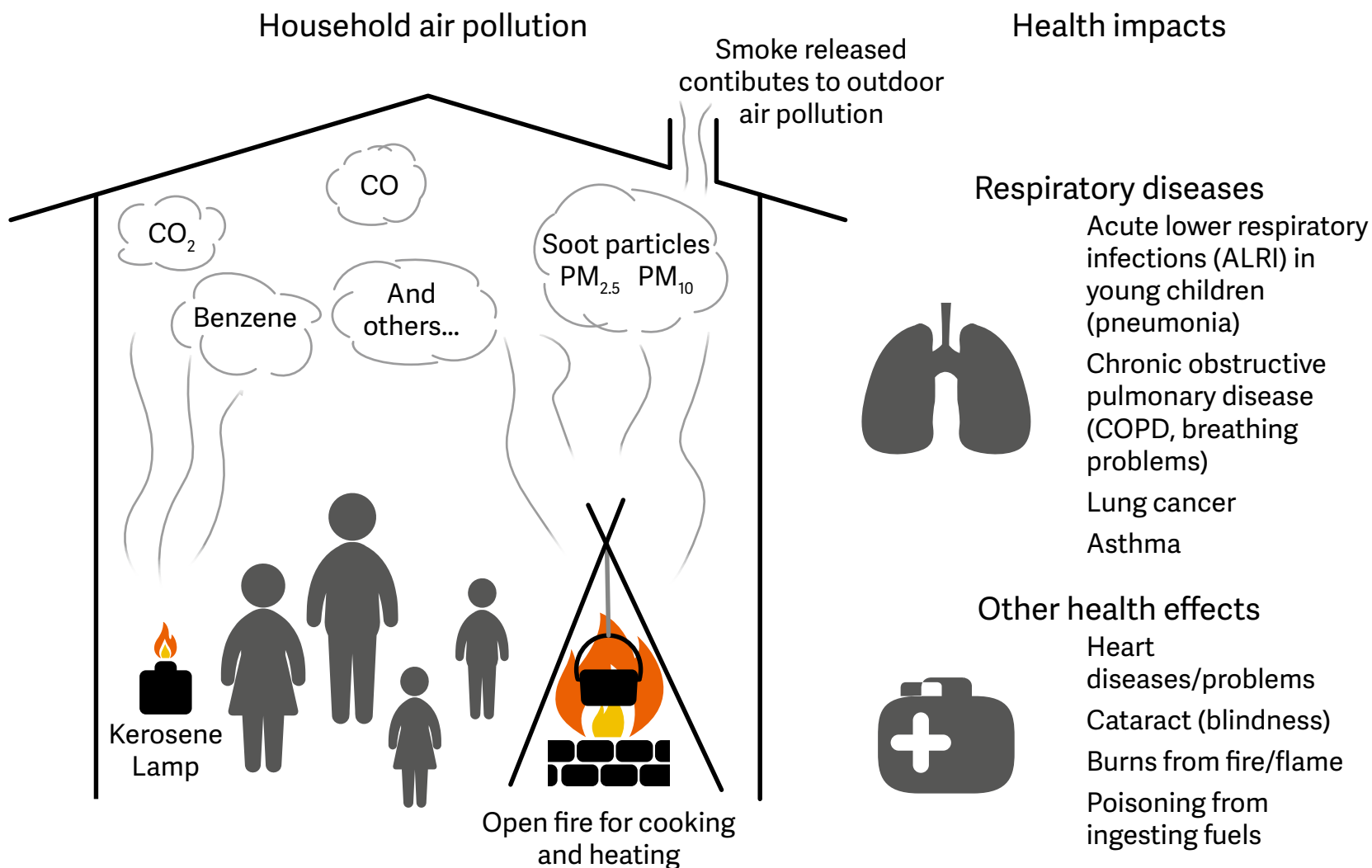


Figure 2: Nearly 3 billion people continue to rely on biomass for cooking. This exposes them to a number of dangerous pollutants that have been linked to lower respiratory infections, chronic obstructive pulmonary disease, cancer and a host of other child and adult health problems. These include low birth weight, perinatal mortality, asthma, middle ear infection, tuberculosis, nasopharyngeal cancer, cataracts, blindness, and cardiovascular disease.

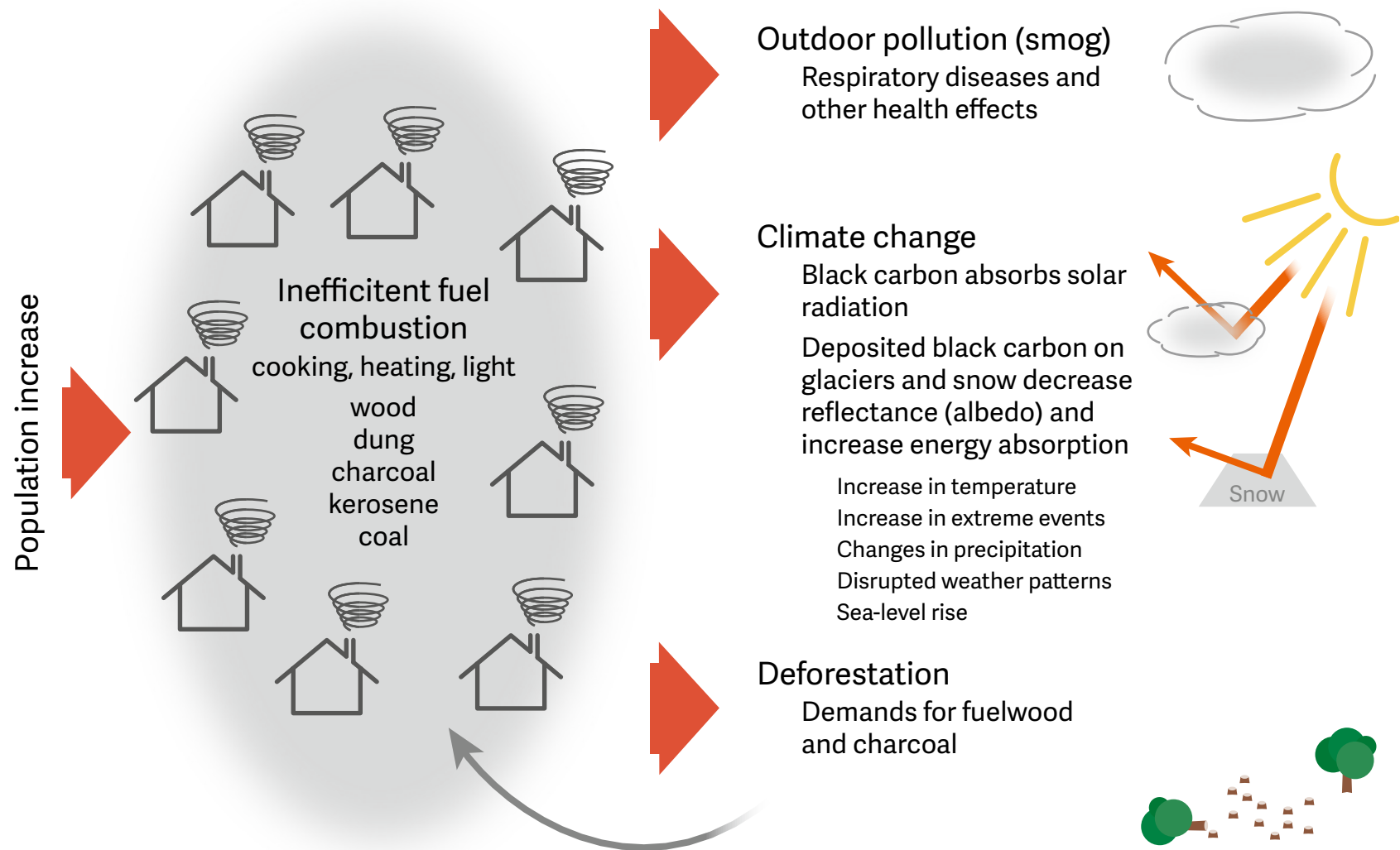


Figure 3: As the population in some parts of the world increases, so does the use of inefficient fuels for cooking and lighting. This creates household air pollution that threatens the lives and health of millions. It also contributes to climate change and deforestation.

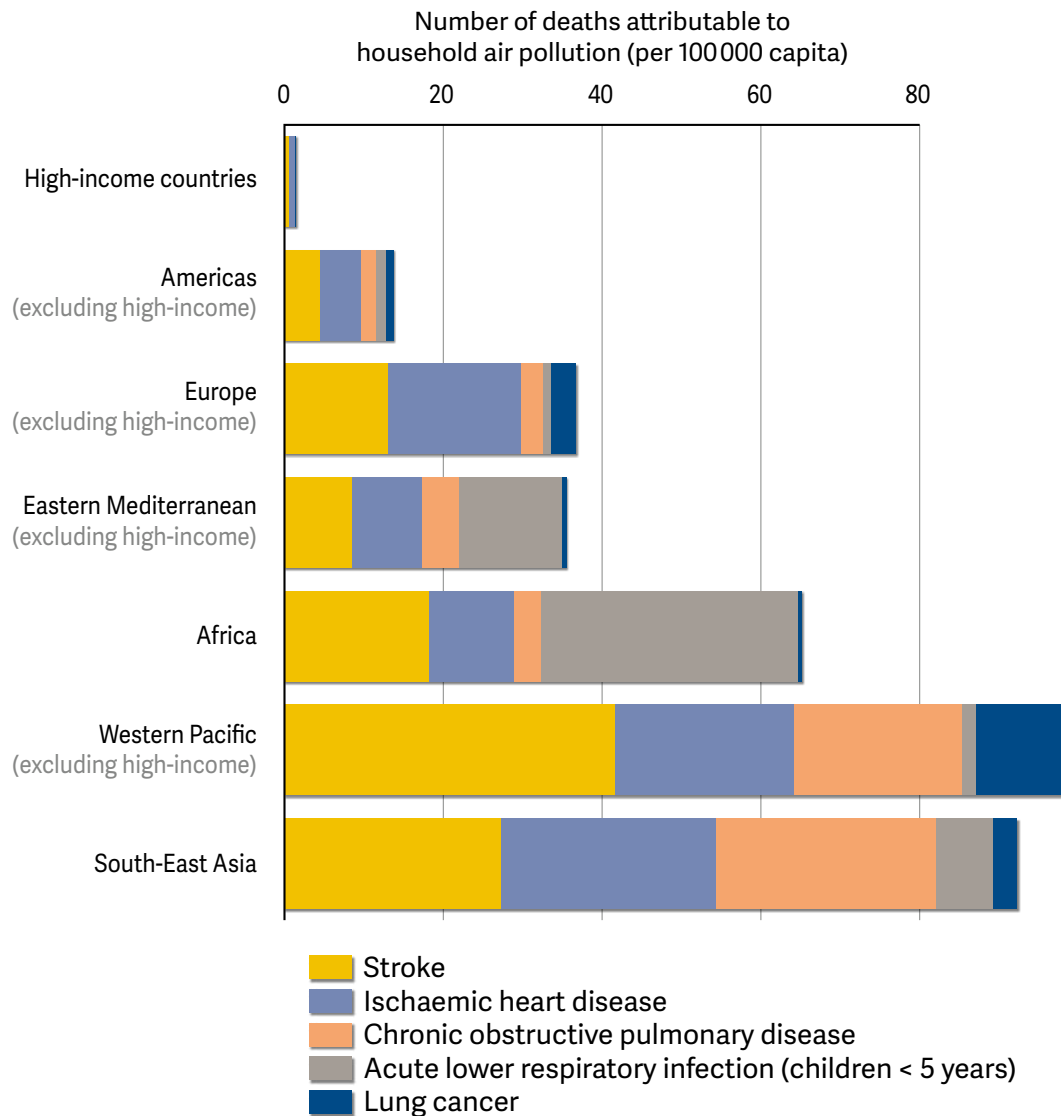


Figure 4: Deaths caused by household air pollution, organized by World Health Organization regions (2012).⁴ Of the 4.3 million deaths attributable to HAP, almost all are in low and middle-income countries.

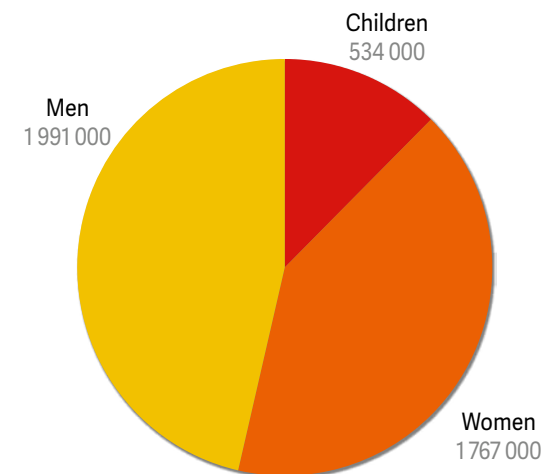
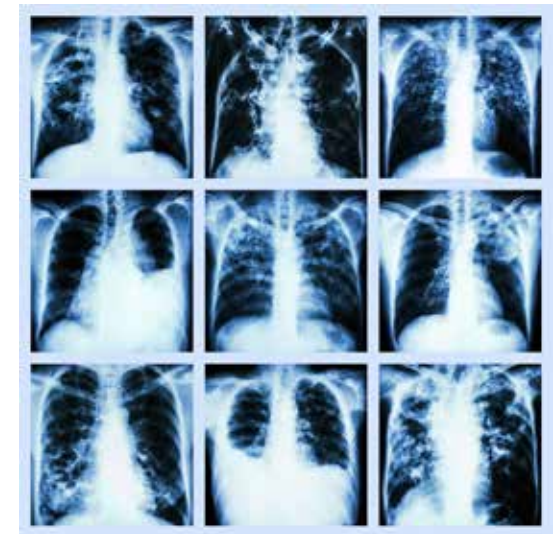


Figure 5: HAP burden of deaths, by category 2012.⁵ While women tend to be more exposed to household air pollution than men because they are much more involved in daily cooking activities, the absolute burden is larger in men because they are more affected by other diseases.

Once a significant problem, household air pollution in the developed world has been largely solved, due to fuel switching and use of modern, more efficient technologies. Today the vast majority of the impacts attributable to this source are concentrated in low- and middle-income countries, primarily among the poorest and most vulnerable members of society with the least capacity to adapt.

Reducing emissions from these sources of HAP is an important near-term strategy capable of providing multiple benefits for human and environmental health, sustainable development and climate mitigation.

Billions still rely on biomass

Approximately three billion of the estimated seven billion people on earth still rely on solid fuels on open fires or traditional stoves for cooking and heating. They are concentrated largely in the developing world, primarily in Africa and South Asia. Of these, 2.4 billion use biomass fuels and the remainder, primarily in China, use unprocessed or raw coal. In some countries and particularly within sub-Saharan Africa, more than 95% of the population uses solid fuels for cooking. Almost all of these people either lack or have unreliable access to electricity, and so rely on candles or kerosene lamps to provide lighting, which also significantly contributes to HAP.

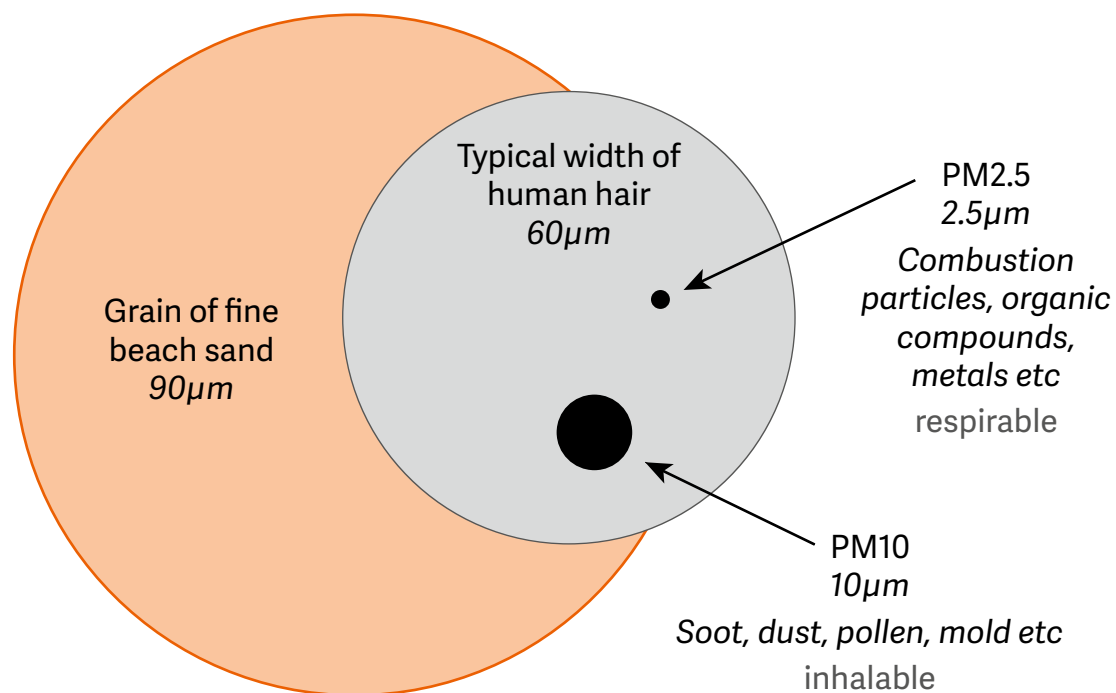


Figure 6: PM_{2.5} and PM₁₀ are both much smaller than the diameter of a human hair. Both are dangerous to inhale. PM_{2.5} is of most concern given its ability to penetrate deep into the human lungs and bloodstreams and is dangerous in any concentration.





Household Air Pollution a major health threat

The connection between household air pollution and health is well documented. Every year an estimated 4.3 million people die globally due to illnesses caused by HAP. Depending upon the type of fuel used, these pollutants can contain a number of components which seriously affect human health including fine particulate matter (PM), carbon monoxide, nitrous oxides, sulphur oxides (mainly from coal), formaldehyde, and other toxic compounds. The most health damaging of these pollutants are fine particles known as PM_{2.5} (particulate matter less than 2.5 micrometers).

Exposure to household air pollution has been linked to acute lower respiratory infections,⁶ chronic obstructive pulmonary disease,⁷ cancer⁸ and a host of other health problems. These include asthma, middle ear infection, tuberculosis, nasopharyngeal cancer, cataracts, blindness, and cardiovascular disease.⁹

According to the World Health Organization, the highest numbers of annual deaths from HAP occur in South-East Asia and the Western Pacific regions, which account for 1.69 million and 1.62 million annual deaths, respectively. Another nearly 600,000 deaths occur in Africa and 200,000 in the Eastern Mediterranean each year.

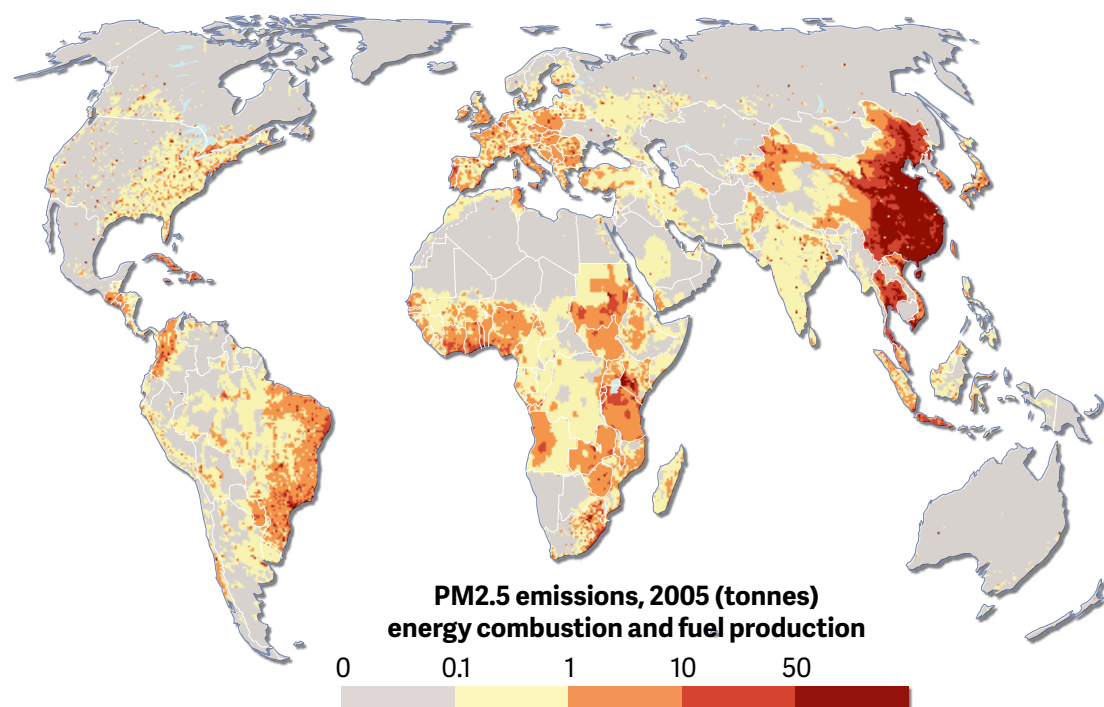


Figure 7: PM_{2.5} emissions from energy production, manufacturing and fuel production, 2005. Data modeled by the EDGAR-HTAP project.¹⁰ Small particles contribute to ambient air pollution (smog). The biggest contributor to PM_{2.5} emissions in areas like North America, Europe and China is the burning of coal.

Household air pollutants in the form of particulate matter (PM_{2.5}) are especially dangerous for children and have been linked to low-birth weight and neonatal death. While women and children are most at risk for disease from HAP, the absolute burden of deaths is greater among men because they have higher underlying instances of HAP related diseases than women and children.

Negative socio-economic effects

In addition to direct effects for human health, HAP also imposes significant negative socioeconomic impacts on the families and communities that depend upon these inefficient fuels and devices.

There is a direct correlation between the level of solid fuel use and income. Simply put, the poorest

and most vulnerable members of society are often the most dependent upon solid fuels to supply their basic cooking, heating, and lighting needs. The poor also typically have the least access to, and ability to pay for, healthcare to manage the impacts of long term exposure to HAP, which leads to high instances of chronic poor-health among the poorest members of society. People in poor

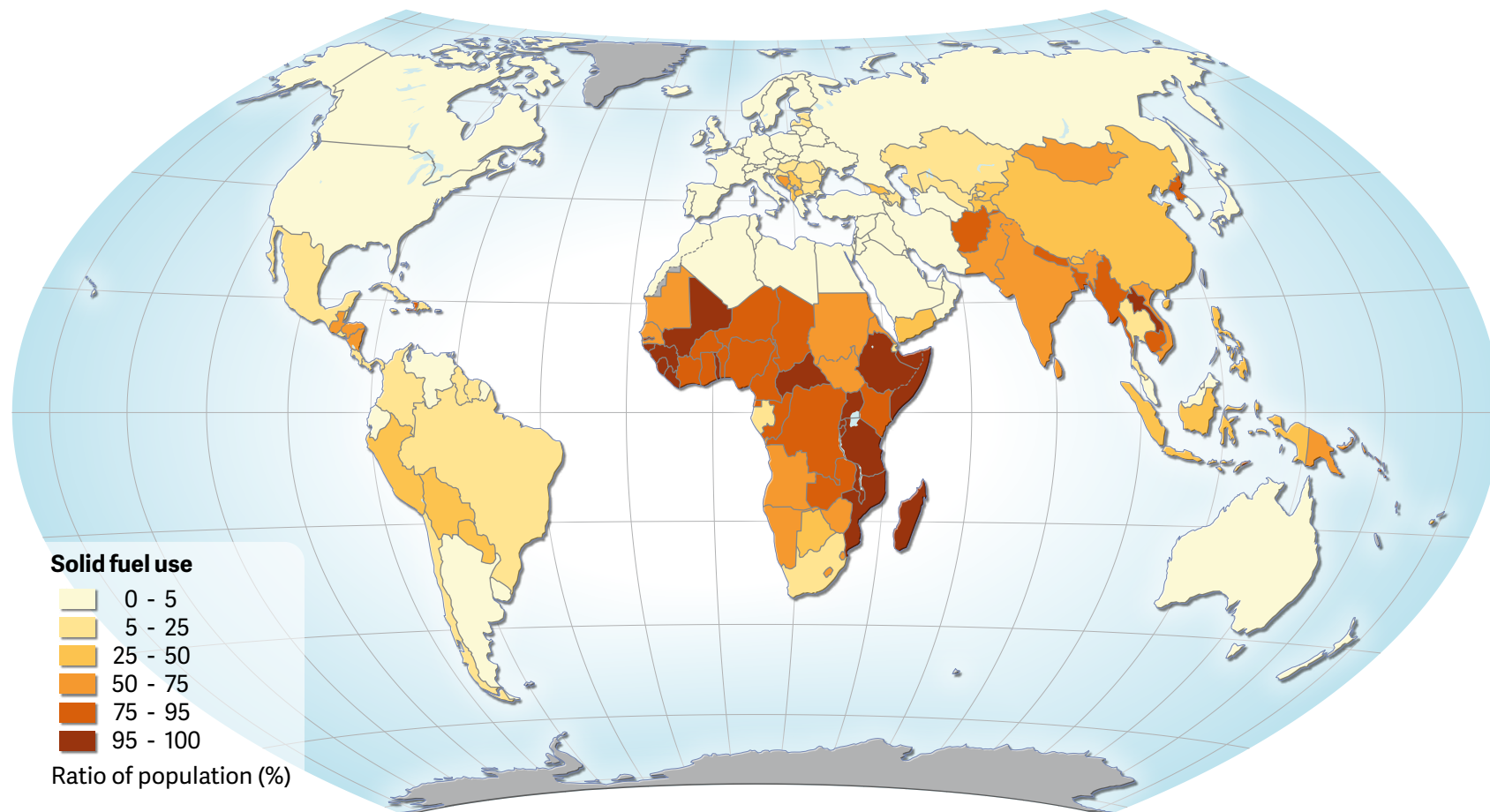


Figure 8: Population using solid fuels (%), 2012.¹¹ The use of solid fuels for cooking and heating continues in developed countries but is concentrated in the developing world, primarily in Africa and South Asia. These fuels are often the main source of household energy in these regions.

health miss more days of work and are less likely to be able to sustain strenuous work, which limits opportunities for employment, or if employed, to earn sufficient wages.

It is not unusual to find that the rural poor in least developed countries do not purchase solid fuels – they collect them from available resources. While

traditional fuel such as wood, agricultural residues and dung can be gathered locally considerable time can be spent collecting fuel. This limits time available to engage in income-generating activities or, in the case of children, to focus on education. Since women and children are often primarily responsible for fuel collection, this places them at greater risk of injury or gender-based violence.

For these reasons, the degree to which women are able to participate in the labour market is very much associated with transition to other modern fuel sources especially because there is less time to collect and use solid fuel. In addition, overall household energy use is reduced because less time is spent at home.¹² Household income is also an important factor in the transition to modern energy sources, though it is





not always as well correlated with reductions in overall household biomass energy use.

Household Air Pollution a significant driver of environmental degradation and climate change

Reliance on solid fuels also has significant negative impacts on the health of ecosystems. While clearing land for commercial agriculture is the dominant direct cause of deforestation globally, the collection of fuelwood and the production of charcoal from mature forests are major drivers of forest degradation in many parts of the world, particularly in Africa.

The use of solid fuels for cooking and heating also contributes to the growing threat of climate change.

The incomplete combustion of fossil fuels and biomass emits a number of different particles which can warm the climate, the most important of which is known as black carbon. Black carbon is a component of PM air pollution and is a significant human-caused contributor to global warming. The burning of solid fuels can also emit other gases that affect the climate, such as carbon monoxide (CO) and nitrous oxides.

Black carbon along with methane (CH₄), tropospheric (ground-level) ozone (O₃), and many hydrofluorocarbons (HFCs), are known as short-lived climate pollutants (SLCP) due to their relatively short lifetime in the atmosphere.

As noted, the WHO estimates that approximately seven million people die prematurely every year due to PM_{2.5} air pollution (both indoor and outdoor), of which black carbon is a component. The burning of solid fuels for cooking and heating is responsible for an estimated 21% of global black carbon emissions. Ground-level ozone – which is formed from many of the gases emitted through the burning of solid fuels – is estimated to cause an additional 200,000 deaths every year. Ground-level ozone also harms plants and ecosystems, and is estimated to reduce crop yields of the four major staple grains: between 4–15% for wheat, 6–16% for soybeans, 3–4% for rice and 2–6% for corn, resulting in a combined economic loss of between \$11–26 billion annually.¹³



Cut emissions to save lives, protect the environment, and slow climate change

According to studies organized by the United Nations Environment Programme, the World Meteorological Organization and others, rapidly reducing global emissions of all four SLCPs can save 2.4 million lives every year from improved outdoor air quality, many more from improved indoor air quality, and cut the rate of global warming in half by the middle of this century. These benefits can be achieved through the global deployment of sixteen measures, based on existing technologies, including three focussed specifically on the burning of solid fuel for cooking and heating:



1. Replace unprocessed coal with coal briquettes in cooking and heating stoves;
2. Replace current wood-burning stoves and boilers with pellets made from recycled wood waste or sawdust, and;
3. Replace traditional cookstoves with models that burn more efficiently, such as fan-assisted stoves, or replace current biofuel cookstoves with stoves using biogas or LPG.

In some respects, the solutions are straightforward. Many different clean cookstoves are widely available, relatively cheap, and capable of combusting solid fuels more efficiently than traditional methods. There are also cookstoves

using a wide range of alternative and accessible fuels: biogas cookers, solar cookers, and through mini-grids, electric cooking solutions are able to reach people in rural areas. In several countries a number of programmes to distribute improved cookstoves have been successfully adopted. Technologies to replace kerosene fuel lamps, such as LED lighting paired with a solar cell and battery, are also available and affordable.

The right to clean air and energy

Access to safe and sustainable energy is increasingly recognized as a human right and essential for the safety, well being and productivity of all people. It is also essential for social and economic development.

The constitution of the WHO states, “the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being.”¹⁴ This stance is widely accepted and “is fundamentally a moral one, rooted in the belief that the only way to lessen the burden of disease that disproportionately affects society’s poorest is to build systems of service delivery targeting those marginalized.”¹⁵

States have a duty to protect their citizens’ right to health and one way to do this is to protect the right to clean air. “The state should ensure that all citizens have access to clean indoor air and that targets are set and monitored so that the state can be held accountable for the realization of this right.”¹⁶

But the right to clean air is impinged by the millions of tonnes of pollutants we spew into the atmosphere every year. Large portions of these pollutants are greenhouse gases which are responsible for global warming.

Dealing with air pollution and climate change has a moral underpinning that cannot be ignored.

“The Universal Declaration of Human Rights ... speaks movingly of the inalienable human right to ‘freedom, justice and peace’. Today, climate change poses the greatest long-term danger to these core values, and to the cause of human development.

So if we care about peace and security, if we demand development, and if we are passionate about human rights, then we have but one option: we must make climate change our highest international priority, and we must demand that our leaders deliver on this issue.”¹⁷

Pulling down barriers

While technical solutions to HAP are available, major efforts to reduce it, such as introducing clean





cooking solutions, have historically met with mixed results often due to challenges presented by non-technical barriers. These barriers can include issues of affordability and suitability of alternatives for local conditions and uses, lack of consumer knowledge, consumer preferences, availability and price of alternative fuels, gender issues, and conflicting price subsidies, policies, and programmes.

Countries and communities interested in addressing HAP should begin with the understanding that the barriers to its reduction and the use of solid fuels are multi-dimensional. A successful HAP programme must foster a fundamental and permanent change in the way that millions of families cook their food and light and heat their homes. The most successful programmes aimed at reducing household solid fuel use look at all aspects of the issue and try to involve all relevant stakeholders to address it in a comprehensive and sustainable way.

A significant amount of research is available to guide action in this area. The World Health Organization, the Climate and Clean Air Coalition, the Global Alliance for Clean Cookstoves, the German Society for International Cooperation (GIZ), among others, have proposed solutions based on the growing body of scientific evidence about the danger of household air pollution. Much of the needed action must come at the national level through the implementation of focused and achievable policies. The next section provides a number of recommendations drawn from these resources and analyses of previous interventions.

Recommendations

Develop a holistic strategy, possibly through the development of a National Action Plan, to catalyze action and address HAP in a holistic and sustainable manner. A National HAP Action Plan is a tool to support the identification and deployment of key stakeholders, projects, best practices and ways to quickly and effectively reduce household air pollution and solid fuel use. While general measures might have been identified that are aimed at reducing household air pollution, nations can benefit from developing individual solutions tailored to fit their situations. Specialized national plans allow countries to tackle the causes of continued use of inefficient solid fuels for household cooking, heating,

and lighting while, at the same time, maximizing benefits for public health, ecosystems, and the climate.

Optimizing policies, actions, and technologies to efficiently and rapidly provide simultaneous multiple benefits will require the cooperation of relevant stakeholders at every level of government, as well as scientists, industry leaders, civil servants, non-governmental organizations, international organizations, and citizens. Coordinating and managing such a diverse group can occur most effectively at a national level. A unified approach is vital. Instead of independent actions focused

on individual problems, united efforts based on a well-designed integrated programme can address household air pollution far more efficiently.

The GACC has produced a methodology for developing *Country Action Plans* for clean cookstoves and has developed country toolkits with templates for market intelligence, sector coordination, awareness raising, and sharing best practices. During Phase I of the Alliance's Business Plan they worked closely with six priority countries – Bangladesh, China, Ghana, Kenya, Nigeria, and Uganda – to promote a market for clean cookstoves and fuels. (For more information go to: www.cleancookstoves.org.) Even where a country does not wish to develop a full National HAP Action Plan, it can benefit from working through the methodology to ensure that any action to address HAP is as holistic and sustainable as possible.

In 2013 the government of Nepal announced an ambitious mission to achieve “Clean Cooking Solutions for All by 2017.” Multiple rounds of discussions with various bodies recognized the need for a coordinated national alliance to achieve the 2017 target. On July 10, 2013, a task force comprised of the Alternative Energy Promotion Centre (AEPIC), private sector companies, and development partners declared the establishment of the Nepal Alliance for Clean Cookstoves (NACC), and affiliated with the Global Alliance for Clean Cookstoves. The NACC's establishment – with its stated aim of acting as a centralized, national resource for facilitation and information sharing of product improvement, financing, understanding of market dynamics, enhancing of demand and creating of an enabling environment – is the first step towards solving the long-standing problem of cookstove-induced



HAP in Nepal. (For more information go to: www.nepalcookstoves.org.)

Pay special consideration to user behaviour, needs, and preferences. In order for households to gain from the health benefits of reduced household air pollution, users must permanently adopt, and properly use and maintain new cookstoves and other devices. Even when new technologies are highly subsidized or given free of charge, experience has shown that this does not guarantee sustained adoption.

Any intervention must be well researched, including not only the implications for health and climate, but also behavioral and cultural factors that influence choice and decision-making, as well as the economic situation of people and communities. An example of behaviour change includes drying fuel before use to improve combustion and decrease smoke production and keeping young children away from smoke to reduce exposure. (Such changes in user behaviour are unlikely to bring about reductions as large as those expected from a fuel switch or the installation of a hood or chimney. However, they should be seen as important supporting measures for other interventions).

It is also important to consider how needs for heating and cooking will affect the use of clean fuel technologies. The same fuels and technologies are often used for cooking are used for space heating. In some cases households that have adopted cleaner cooking solutions still rely on open fires and other rudimentary technology for space heating. That is because the clean fuel alternatives and technologies typically do not provide the same warmth as more traditional fuels and technologies.

Part of Phase II of the GACC's Strategic Roadmap includes working to better understand the cookstoves fuel needs of consumers, and to leverage this understanding to launch targeted awareness-raising campaigns to drive demand for cleaner cooking solutions.¹⁸

Establish and utilize testing methodologies to ensure alternative technologies and fuels meet the objectives of the programme. Technological alternatives to traditional methods of burning solid fuels for cooking and heating vary significantly in terms of their effectiveness at reducing health and/or climate damaging emissions. In addition to ensuring that the alternatives meet the needs of the users, as discussed above, HAP interventions must ensure that the technologies and fuels also produce the desired public health and climate benefits.

Without being certified using a clear testing methodology, some interventions may produce results opposite to the goals of the HAP programme. For example, some clean cookstoves reduce overall PM_{2.5} emissions, when compared to traditional cooking methods, while at the same time increasing total BC emissions, thus reducing the burden on health but increasing climate impacts.

While there are currently no universally agreed standards for determining whether a cookstove produces the desired reductions in HAP, improvements in health outcomes, or reduced climate impacts, the GACC and WHO are leading an ISO process to promote consensus standards for cookstoves.

The WHO has also recommended maximum emissions rates for PM and CO in its 2014 Indoor air quality guidelines: household fuel combustion.

Recommendations from the 2014 WHO indoor air quality guidelines: household fuel combustion

Recommendation 1

Emissions from household fuel combustion should not exceed WHO-recommended targets for PM_{2.5} and Carbon Monoxide (CO).

Recommendation 2

Governments and their implementing partners should develop strategies to accelerate efforts to meet the emission rate targets of these air quality guidelines.

Recommendation 3

Unprocessed coal should not be used as a household fuel.

Recommendation 4

The household use of kerosene is discouraged while further research into its health impacts is conducted.

Good practice recommendation

Governments and other agencies should develop and implement policy on climate change mitigation, which consider action on household energy and carry out relevant assessments to maximize health and climate gains.

From Frequently Asked Questions
WHO guidelines for indoor air quality: household fuel combustion
November 2014¹⁹



In 2015, the Climate and Clean Air Coalition's *Household Cooking and Domestic Heating Initiative* supported the development of a pioneering new methodology to measure the emissions of black carbon and other short-lived climate pollutants from cookstoves and reductions from the deployment of clean technologies.

The GACC maintains a global database of information on current cookstove technologies and fuel performance information known as the *Clean Cooking Catalogue*. The catalogue provides performance information for stove technologies based upon the ISO's International Workshop Agreement (IWA) provided by manufacturers and third-party test facilities. (For more information go to: <http://catalogue.cleancookstoves.org>.)

While new test methodologies continue to be developed, technologies under consideration will need to be tested in labs to determine if they meet the standards. Technologies will also need to be tested under real-world conditions for sustained periods to determine if they are suitable and effective for a particular community or environment.

Conduct analyses of the costs and benefits of technical and policy options to reduce HAP. It is always important to assess costs and benefits of interventions that seek to improve people's health and environment, given that funding is almost always limited and policy makers need information on how best to allocate funds between competing projects, programmes, or sectors. However, it's also important to remember that different types of analyses will be important to different audiences. For example many countries use the Value of a Statistical Life (VSL) methodology to quantify the health benefits of a particular policy and compare that to the economic cost of implementation. This type of analysis can be extremely useful to help policy-makers prioritize or justify different policies, but is less useful to

consumers for which the upfront cost of the technology and recurring fuel costs are more important indicators of affordability. Conducting such cost benefit analyses from multiple perspectives can allow those planning HAP programmes to optimize technology and policy interventions to benefit all stakeholders.

Include gender as an element of analysis when considering effective technologies and policies for addressing HAP. Globally, women generally experience the highest exposure to HAP due to traditional roles as caretakers of the home. This means that women will be the most direct beneficiaries of reduced HAP, but also that they will be the most likely to users of any new technologies or policies. Steps to reduce barriers to female participation in paid employment and/or gender-inclusive rural employment schemes may play a big role in household energy transitions and health improvements.

The Nigerian Rural Women Energy Security (RUWES) project aims to catalyze adoption of household clean cooking and heating technologies by targeting under-served rural women who typically live off of the electrical grid, are energy poor, and have the highest incidences of health related issues from harmful energy practices. The RUWES Project partners with women's organizations, women's cooperatives, and technology providers to establish well equipped Skills Acquisition Centres to serve as training and assembly workshops for the RUWES Project. The centres provide local entrepreneurs with the skills and the ability to assemble solar lanterns and clean cookstoves. They also provide training and support to conduct equipment repairs and maintenance, and manage sales and distribution of RUWES clean energy products. Once trained, the women-entrepreneurs are equipped with a RUWES business starter-kit and provided ongoing training and support in bookkeeping, profit and loss accounting, sales and marketing of clean energy technologies to support their clean energy businesses.

"Nigeria set a target to provide 20 million clean cookstoves by 2020 through its National Clean Cooking Scheme, born out of the CCAC. I founded the RUWES Initiative in Nigeria to bring change to the underserved rural woman who is usually energy poor and has highest incidence of health related issues from cooking, lighting and heating. WHO estimates that cooking with firewood kills almost 100,000 women in Nigeria every year. This is a national emergency, and RUWES will step forward to lead the call to action. Women should not be dying from cooking. RUWES is also involved in the kerosene lantern exchange program as well as a chain-training scheme, where one trained woman – an assembler of solar lanterns and cookstoves – must train ten women to be eligible for a 2nd-tier business starter kit. The programme is expected to create 2 million jobs."

Bahijjahtu Abubakar, the Head of the Renewable Energy Programme in the Federal Ministry of Environment, and former co-chair of the CCAC

The Safe Access to Fuel and Energy (SAFE) project is hosted by the Global Alliance for Clean Cookstoves. It seeks to *"reduce exposure to violence, contribute to the protection of and ease the burden on those populations collecting wood in humanitarian settings worldwide, through solutions which will promote safe access to appropriate energy and reduce environmental impacts while ensuring accountability."* The SAFE project maintains a web-based resource library and project map database with content to enable researchers and implementers to easily access the latest research literature and tools. (For more information go to: <http://www.safefuelandenergy.org/resources/index.cfm?all=1>.)

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