SPECIAL FEATURE SEAR

MODERN ENERGY ACCESS AND HEALTH

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SEAR

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INTRODUCTION

Modern energy access is an important determinant of human health, as it plays a critical role in the capabilities of healthcare facilities and aids in the development of clean and safe household environments. But in the developing world, thousands of healthcare facilities and hundreds of millions of households lack access to modern energy services. And the situation will only get worse as the energy needs of communities and the health sectors in these countries are expected to increase dramatically in the years ahead.

This special feature begins with a look at energy access and health implications, along with energy access and reliability gaps, at two levels: electrification of healthcare facilities and household energy. It then tackles the barriers to better energy access and reliability, and concludes with opportunities and options—including decentralized renewable energy, hybrid solar PV/diesel, grid extension, energy-efficient medical equipment, a greater availability of clean energy sources and technologies (such as cleaner cookstoves and fuels).

The paper finds that addressing this unmet need in an efficient and timely matter will require decision-makers to better incorporate health considerations into energy policy, and vice-versa. The UN's 17 Sustainable Development Goals (SDGs) provide an opportunity to apply a nexus approach to energy and health—building on various linkages that energy and health have with sustainable development (including SDG 5 on gender equality, SDG 11 on sustainable urban environments, and SDG 13 on climate action).

ENERGY ACCESS AND HEALTH IMPLICATIONS

Electrification of healthcare facilities

Access to modern energy services plays a vital role in how healthcare facilities function, along with the quality, accessibility, and safety of essential health services (Table 1). Without reliable power, many of the most basic life-saving interventions cannot be undertaken safely, or at all.

Energy access matters greatly to maternal and child health, as women and children often bear the brunt of inadequate primary healthcare services (Lale et al., 2007; Taghreed et al, 2005)—with over 289,000 women globally dying from pregnancy- and childbirth-related complications every year (WHO Factsheet, 2014). Anecdotal evidence suggests that interventions providing minimal lighting and appliance operating services can help to avert many of these life-threatening complications affecting mothers and newborns during pregnancy (Mills, 2012). When better lighting and power is introduced, health workers report fewer delays in providing life-saving care, more timely blood transfusions, and more successful child deliveries, along with improved morale of the patient and health service provider (Ibid). In Uganda, the availability of power can be a key factor in attracting women to deliver in health facilities, as opposed to at home (Mbonye & Asimwe, 2010).

Another important facet of energy provision relates to the ability to refrigerate vaccines, blood, and other medicines. Many diseases (such as pneumonia and measles) can be prevented through immunizations, yet they still kill approximately 1.7 million children each year (GAVI, 2012), mainly in developing countries. A considerable share of vaccines delivered to these countries is ruined due to poor cold chain services (WHO, UNICEF, & World Bank, 2009). In health centers, access to reliable electricity is essential for ensuring the integrity of conditions needed to store vaccines, blood, and other necessary medicines requiring refrigeration.

Energy—and in particular electricity—is required for the operation of basic amenities, including lighting, ventilation, communications and computer systems. It is also required for the safe management of medical waste (such as non-incineration methods), as well as for the operation of essential medical devices (including emergency surgical, laboratory and diagnostic equipment). Access to clean and hot water in healthcare facilities is also generally dependent on access to energy for water pumping and water purification systems.

In addition, there are clear links between access to energy in healthcare facilities and the availability of information and communication technology (ICT) services. ICT is a critical enabler of wider "telemedicine" and "e-health" strategies, which are aimed at allowing health workers in remote areas to consult with better-trained nurses or doctors elsewhere on the appropriate treatment of urgent conditions or the management of health issues for which specialized expertise is lacking. The increasing global

TABLE 1 Key energy-dependent devices/equipment in healthcare facilities

PURPOSE/SERVICE	ENABLING ENERGY SERVICE/EQUIPMENT
General amenities/ infrastructure	
Basic amenities and equipment	Lighting—clinical/theatre, ward, offices/administrative
	ICT—mobile phone charger, VHF radio, office appliances (computer, printer, internet router, etc.)
	Sterilization equipment (dry heat sterilizer or autoclave)
	Refrigerators, electric fans
	Cooking, water heating, space heating
Potable water, cleaning and sanitation	Water pumping (when gravity-fed water not available), purification
Health-care waste management	Waste autoclave, grinder
Service-specific medical services	
Cold chain	Vaccine refrigerator
Maternity and child health	Suction apparatus, incubator, fetal heart monitor, ultrasound
HIV diagnostic capacity	ELISA test equipment (washer, reader, incubator)
Laboratory and diagnostic equipment	Centrifuge, hematology mixer, microscope, blood storage, blood chemistry analyzer, blood glucose meter, X-ray, ECG, CT scan, peak respiratory flow meter
Surgical equipment	Suction apparatus, anesthesia machine
Outpatient services	Portable X-ray, oxygen concentrator

Source: WHO and the World Bank (2014). Access to Modern Energy Services for Health Facilities in Resource-Constrained Settings, and Practical Action, Poor people's energy outlook 2013.

ubiquity of mobile phones and other similar devices presents an opportunity to improve health outcomes—by using mobile technologies for education and awareness, diagnostic and treatment support, supply chain management, remote data collection and surveillance, remote monitoring, and healthcare worker communication and training. Efficient management of patient records and referrals, as well as collection and reporting of health statistics, is also greatly facilitated when computer-based.

An initial review of the literature suggests that access to energy in health also has some cross-cutting impacts—for example, on health clinic hours of operation, health service costs and retention of health workers. In rural locations far from national grids, where it may be difficult to attract and retain trained medical staff, reliable electricity can provide highly valued services such as lighting, cooling, entertainment, IT, and communications in staff quarters (WHO & World Bank, 2014).

Household energy

For households, a lack of access to clean energy and technologies for cooking, heating, and lighting leads to household air pollution at levels that can significantly impact health. These concentrations can be 100 times or more than the emission rates targets set forth in the WHO guidelines for indoor air quality: household fuel combustion (WHO, 2014a). Exposure to household air pollution is estimated to have contributed to about 4.3 million premature deaths globally in 2012 (WHO & GHO, 2015). There is a wide range of negative health outcomes that have been epidemiologically linked to household air pollution exposure from cooking with solid fuels able 2). Cooking with solid fuels in a traditional cookstove is also a major source of ambient air pollution, contributing to as much as 37 percent of ambient air pollution in South and South East Asia in 2010 (Smith, K. R., Bruce, N., Balakrishnan, K., Adair-Rohani, H., et al., 2014).

Women and children in low- and middle-income countries (LMICs) are disproportionately affected by lack of access to clean fuels and technologies for household energy generation. Societal norms typically call for women to be the primary cook of the household, with their children often close to them or carried on their back during cooking. In addition to being exposed to higher levels of household air pollution from household energy use (Burnett, R. T., et al., 2014), women and children must travel long distances to gather fuel. In several countries, children spend at least 15 hours a week collecting fuel wood; in some countries, they spend more than 30 hours per week (WHO, 2016). Gathering fuel wood can subject women and children to an increased risk of injury and violence. It also displaces valuable time that they could spend in education, income-generating activities, or rest and leisure. Unsustainable harvesting of wood for cooking or charcoal production leads to deforestation in certain areas (Smith & Haigler, 2008). Inefficient burning of solid fuels emits fine particulates, black carbon, and other short-lived climate pollutants, and thus contributes to climate change.

TABLE 2 Common diseases linked to household air pollution exposure

NONCOMMUNICABLE DISEASE	GLOBAL DEATHS CAUSED BY HAP IN 2012	BREAKDOWN OF DEATHS ATTRIBUTABLE TO HAP, BY DISEASE IN 2012
Chronic Obstructive Pulmonary Disease	905,856	21.3%
Lung Cancer	271,041	6.4%
Stroke	1,458,412	34.2%
Ischemic Heart Disease	1,095,014	25.7%
Lower respiratory infections	531,190	12.5%

Source: WHO Regions (2012). Household air pollution burden of disease.
Note: HAP stands for household air pollution

ENERGY ACCESS AND RELIABILITY GAPS

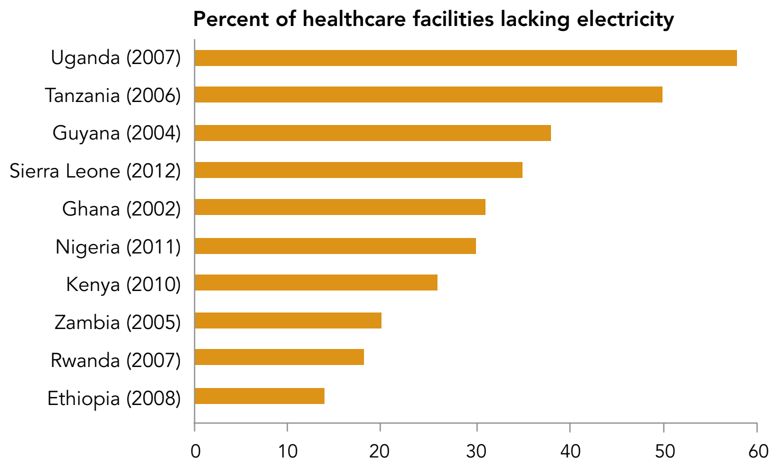
Electrification of healthcare facilities

Despite the critical role energy plays in enabling health services, there is a dearth of power in health facilities in developing countries, according to existing (albeit sparse) data. For example, a recent analysis of available data on access to energy in healthcare facilities[1] in 11 sub-Saharan countries shows that on average more than 25 percent of the health facilities lack access to electricity (Adair-Rohani et al., 2013). The situation is particularly problematic in primary healthcare facilities, especially those serving rural and remote populations, the study notes, with access for rural clinics in some of these countries dropping below 25 percent—although the problem is not limited to Africa. Another study (WHO and World Bank, 2014) shows that some developing countries (like Uganda and Tanzania) report that as many as 50 percent or more health facilities lack access to electricity (Figure 1).

Ensuring a reliable supply of energy is another challenge, particularly as one moves up from primary care facilities to district and referral hospital levels. Even when health facilities are connected to the grid, many suffer frequent power outages. On average, only 28 percent of all facilities with electricity access (Adair-Rohani *et al.*, 2013) report reliable access to electricity, with Sierra Leone as low as 14 percent. This matters greatly, given that power quality disturbances such as surges and frequency fluctuations can damage or destroy medical devices. WHO estimates that nearly 70 percent of medical devices used in developing countries fail (WHO, 2010), with poor power quality a major contributing factor.

The source of power used in healthcare facilities in developing countries varies significantly, with multiple sources often being drawn on at a single facility (including grid power, diesel generators, and renewable energy systems). In Uganda, 15 percent of hospitals and 2 percent of other facilities use a combination of grid-connected and solar sources; in Sierra Leone, up to 36 percent of all healthcare facilities use power from a solar energy source, compared to 25 percent using a generator and only 13 percent using grid electricity (Adair-Rohani et al., 2013). Adding further complexity, different energy sources are used for different purposes, ranging from primary power to back-up power for only a few hours a day or for emergency services. Other energy sources used in healthcare facilities may include kerosene or gas to power vaccine refrigerators.

FIGURE 1 High electricity deficits for healthcare facilities



Source: Adair-Rohani et al., 2013

Household energy

At the household level, the share of the population without access to clean cooking fuels varies greatly by region—with the majority of individuals using polluting fuels for cooking in sub-Saharan Africa and South Asia (WHO, 2016). Several LMICs in Asia are expected to see an increase in clean energy access by 2030, while the situation will worsen in Sub-Saharan Africa, where the number of people without clean cooking facilities is expected to rise by about 20 percent (IEA, 2012).

The specific metric used by WHO to evaluate progress toward SDG 7 is the "percentage of population with primary reliance on clean fuels and technologies at the household level" (WHO, 2015). The categories of "clean" and "polluting" fuels and technologies were added in 2015 (WHO, 2014a), setting a scientific basis for interventions and serving as a step up from the previous evaluation of household energy, which only considered the share of the population using "solid fuels."

The 2015 Report of the Global Tracking Framework shows that the annual growth of global access to non-solid fuels from 2010–12 was –0.1 percent, similar to that of 2000–10. This is significantly below the target energy access growth rate of 1.7 percent to reach the SDG of universal energy access by 2030. If the current rate of household energy access continues, it is projected that by 2030, only 72 percent of the global population will have access to modern energy services for clean cooking (IEA & World Bank, 2015). As of 2012, primary access to non-solid fuels among the global population rose slightly to 59 percent from 58 percent in 2010, with about 125 million people (mostly in urban areas) gaining first-time access (Ibid). Other survey data confirm that the type of fuel used varies drastically by urban and rural settings, with about 20 percent of urban households using primarily solid fuels in traditional cookstoves, well below the 80 percent in rural areas (WHO, 2016a).

BARRIERS TO BETTER ENERGY ACCESS AND RELIABILITY

Electrification of health facilities

There are several barriers to electrifying health facilities. The key barriers fall into the following categories:

Weak enabling environments. Increasing electrification in health facilities relies on a strong national enabling framework—including policies, regulations, and technical standards—which is lacking in many countries. Nonetheless, in many health sectors, energy access is not prioritized within efforts to strengthen health systems that are aimed at better planning and better service delivery. Although import duties and subsidies for fossil fuel power can make it difficult for off-grid technologies to compete, they remain in place in many countries. Enhanced inter-sectorial dialogue is necessary in order to ensure that health sector energy needs are reflected in wider national energy planning processes.

Lack of awareness and information. Little attention has been given to the central role that energy access plays in influencing the quality, availability, and safety of primary and essential maternal and child health services. Rather, energy is largely treated merely as a facility, operations, and infrastructure issue. Healthcare and other actors need to be made more aware of the interconnectedness of these linkages and equipped with information, tools, and guidance on how to monitor them and identify gaps.

Insufficient human capacity and institutional support structures. Health care facilities often lack adequate capacity to manage and service power systems. Health clinic administrators need to be equipped with the tools and knowledge to improve their systems in order to ensure sustainable financial and operational maintenance of energy systems and implement good practices in obtaining and using electronic medical devices (WHO & World Bank, 2014).

Affordability and lack of financing options. Even though the cost of power solutions has decreased, affordability remains a barrier to the adoption of power by healthcare facilities—especially public health facilities in developing countries that rely on scarce government funding to support their operations. Governments and donors have begun providing capital for health facility electrification, but a lack of operating and maintenance funds can impair the long-term sustainability of power systems, often rendering the equipment unusable. More innovative financing instruments are needed.

Weak local energy sector and service infrastructure. Many countries lack an off-grid sector to meet the energy needs of health facilities, starting with the design and installation of systems in the field. Common problems relating to system design and installations are: lack of data, poor system sizing, and poor installation (McCarney et al., 2013). Designers and field technicians must receive regular training and information to create a supply of qualified energy providers, and they should be taught best practices of energy use in medical facilities. Reliable supply chains are important not only for the installation of equipment but also for ensuring effective maintenance.

Lack of maintenance. Off-grid technologies often fail prematurely due to lack of maintenance, leading to the perception that renewable technologies are too unreliable to serve the needs of communities. Maintenance challenges include: failure to properly care for the systems (such as regular cleaning and topping up battery cells with distilled water); lack of local qualified technicians; lack of funding for spare parts; and unclear ownership. To achieve long-term operational sustainability, it is critical to step up maintenance plans and capacity building, and adopt innovative technologies like remote-monitoring systems.

Rural health clinics in particular face many of these challenges, along with other challenges specific to their settings. For example, in many areas in sub-Saharan Africa and south Asia, rural electrification rates cannot keep up with population growth and the power demands that come with it. Additionally, rural healthcare facilities and the communities they serve are often very remote and characterized by limited surrounding infrastructure and low energy demand. As a result, they are less attractive to traditional energy service providers (such as utilities) and lack capital to fund energy systems. Plus, a lack of institutional capacity and low numbers of trained individuals to perform maintenance make the issue worse, as they lead to systems that provide unreliable power with frequent power outages, even where clinics are connected to a grid.

Household energy

At the household level, several barriers stand out, which vary in importance depending on the location and predominant cooking technology in place:

User acceptability. Individuals experience difficulty adjusting to an improved cookstove for multiple reasons, including the convenience and durability of the cookstove (Ruiz-Mercado, I., et al., 2011). There are also lifestyle barriers, as cooking is embedded in the culture of households. Also, households may prefer the taste of food cooked on traditional cookstoves. Thus, behavior change communication must be incorporated into interventions and the cook's preferences incorporated into the design of new stove technologies.

Lack of information and gender norms. Households lack information on how the use of dirty fuels and technologies for cooking, heating, and lighting can harm health. In other cases, even knowledgeable women may not receive permission from their husbands to purchase a clean stove (IFC, 2014): A willingness to pay often must come from both the male and female head of household.

Undervaluation of fuel and time saving. A saving on fuel amount (and therefore cost to the household) is one of the most appreciated aspects of an improved cookstove by participants (WHO, 2016b), although this is often not incorporated in the decision-making process. Thus, stove developers must consider time associated with fuel processing and/or cleaning the stove or chimney when trying to decrease fuel consumption.

Socio-economic status. Those with the lowest income levels are generally experiencing the worst health and time burdens associated with cooking with polluting fuels and technologies. These households are commonly susceptible to multiple other health problems, with few resources to deal with them. Clean energy access serves as a crucial component that can lift families out of poverty by increasing the availability and affordability of resources that can improve health, such as clean cooking stoves and fuels.

Lack of financing options. While the cost of a cookstove may be subsidized to an affordable price, or a cookstove may be provided to participants free of charge for use during an intervention study, households may not be able to afford fuel and/or maintenance costs over time and revert back to using their traditional stove. Therefore, costs associated with repairs and fuel prices post-intervention need to be accounted for to make the clean stoves and fuels financially competitive with traditional cookstoves.

Supply and distribution. Efficient supply chains can lower the costs of producing a clean cooking technology, directly impacting affordability for the user. In addition to the initial production of an improved cookstove, the market must be sustained by offering replacement parts and services to users. Stove entrepreneurs must develop a flexible business plan that can handle an initial low demand of stoves among the target population (WHO, 2016b).

These barriers often result in "stove-fuel stacking"—that is, individuals primarily using their clean-fueled stove but also using their traditional stoves and other polluting fuels for cooking, heating, and lighting. To maximize the health benefit of a clean cooking technology, complete termination of the traditional cookstove and polluting fuels must occur (Johnson & Chiang, 2015, WHO 2014a).

OPPORTUNITIES AND OPTIONS

Electrification of healthcare facilities

The international community's adoption of the SDGs opens a major opportunity for the health sector to improve access to, and the quality, of health services—especially for maternal, newborn, and child health services. What is needed is a more comprehensive and systems-based approach, centered on a holistic evaluation of needs, including gender—rather than a piecemeal approach that can lead to inefficiencies in design, unmet needs, and, often, early system failure. Moreover, the need to act is pressing, given that the energy needs of the health sectors in LMICs are expected to increase dramatically. For example, the need for cold storage space for vaccines is expected to rise eightfold or more in coming decades (PATH & WHO, 2008), and the growing need to prevent or fight non-communicable diseases requires complex interventions that will drive additional energy requirements (WHO & World Bank, 2014). Possible solutions include the following:

Decentralized renewable energy. This approach can be a first step toward enhanced energy provision, either by providing backup for grid-connected facilities where existing supply is unstable or erratic, or as a primary energy source for rural health facilities that are far from the grid and not prioritized for connection in the near future. In the case of solar PV, module prices have dropped considerably over the past five years, battery storage capacity has increased and is set to improve further in the coming years, and remote monitoring capabilities are making it easier to more effectively manage the energy requirements of multiple facilities. Also, while the up-front capital cost of a solar system may be higher than that of a diesel generator, the cost over the system's life is generally less thanks to lower operating costs—reflecting the lack of need to purchase diesel fuel (USAID, Powering Health Data). This option can be particularly relevant in rural and remote areas, where the ability to source diesel can be difficult, extremely costly, and may not be adequately covered by health clinic budgets.

Hybrid solar PV/diesel. This combination may be appropriate where (i) load requirements are too high for solar PV alone, and the battery capacity is not large enough to cope with the associated load; or (ii) there are strong seasonal variations in the solar insolation. It may also be effective when uninterrupted power is needed for an operating room, and large loads are required for heating or cooling devices and x-ray machines—with the solar system providing the main source of power and the diesel generator ensuring that back-up power is available. In these situations, "triaging" power requirements is critical, based on clear priorities and directives regarding power usage.

Grid extension. This approach is attractive if the grid is close enough to justify the extension and connection costs. However, a grid connection alone does not ensure access to reliable power, as many developing countries (particularly those in sub-Saharan Africa and South Asia) suffer from chronic power shortages owing to inadequate generation capacity. Thus, health facilities are often forced to invest in backup power sources or cope with inadequate supply

Energy-efficient medical equipment. For procedures such as ultrasounds or blood oxygen measurements, new portable low-energy direct-current medical devices can be operated from solar PV panels and work well in energy-constrained environments. LED-illuminated microscopes and vaccine refrigerators are able to store solar energy in freezer packs in place of batteries, thereby avoiding extra costs for battery maintenance and replacement.

Governments, donors, and, where possible, the private sector should consider prioritizing health facility electrification as a key development issue in order to improve the delivery of energy-dependent health services and to help reduce the vulnerability of communities. Coordination across both the energy and health sectors is necessary so that the needs of health facilities are met in a sustainable and long-lasting manner. Deployment should always account for the lifetime of the solution set, and mechanisms should be set in place for appropriate long-term maintenance and parts replacement. Additionally, the improving ability to provide certain diagnostics capabilities using cell phone apps and other mobile-en-abled technology should be explored to help ensure the most effective utilization of limited power availability in the clinic setting.

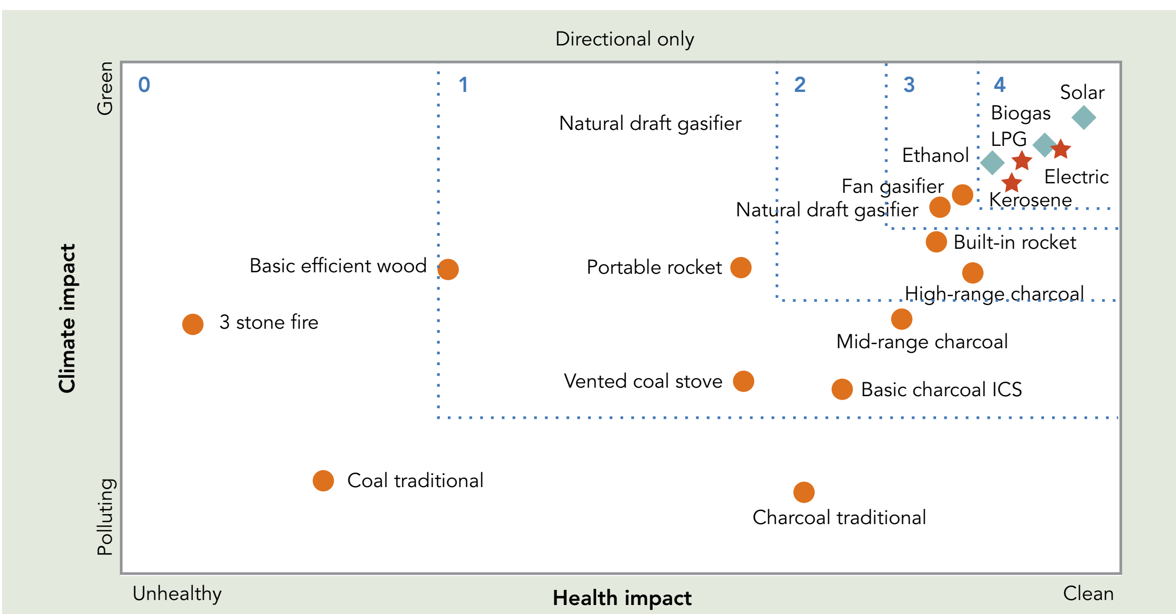
Household energy

At the household level, the key is pursuing policies, programs, and interventions that increase the availability of clean energy sources and technologies. For cookstove producers, markets are being analyzed at the regional level to allow for a diversity of technologies that can satisfy the needs of individuals with different cultural and gender norms. Local clean cookstove businesses are the most likely to be aware of local community needs and local market barriers.

Once a stove has been designed, innovative monitoring and evaluation (M&E) is required to ensure acceptable product performance. To that end, investments are being made to establish globally accepted standards for evaluating cookstove technology. Besides the new WHO guidelines for indoor air quality: household fuel combustion (2014a), global standards are being developed by the International Organization for Standardization (ISO). So far, the ISO has issued International Workshop Agreement (IWA) guidelines, which rate cookstove performance on four factors—efficiency, indoor emissions, total emissions, and safety—across 5 tiers (0 being lowest-performing and 4 being highest-performing), with boundaries defined by quantitative values determined by laboratory testing. For example, shifting to better performing stoves and fuels can dramatically lower the risk for childhood pneumonia. The ISO is currently assessing whether the IWA tiers of performance will be used in the final standard.

At the same time, policymakers must also consider health and climate co-benefits in cookstove M&E, as the most environmentally sustainable cookstoves and fuels may not maximize health benefits: There are varying concentrations of greenhouse gases and short-lived climate pollutants emitted from different cooking technologies, which results in cooking technologies having different climate-altering impacts (Ramanathan, V., & Carmichael, G., 2008). For that reason, the same IWA tiers for evaluating health are also available for assessing climate impact. For example, as Figure 3 shows, while a charcoal stove may score higher on health impact than a Tier 1 advanced biomass, portable 'rocket' stove, a charcoal stove remains in Tier 0 because it scores very poorly on climate impact.

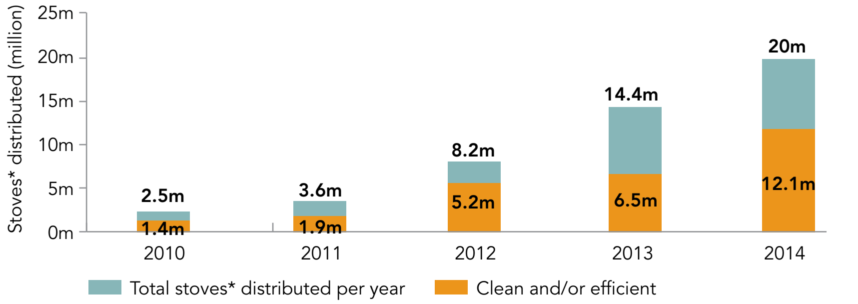
FIGURE 3 Picking the best stove for both health and the climate



Source: Putti, V.R., Tsan, M., Mehta, S., Kammila, S. 2015. The State of the Global Clean and Improved Cooking Sector.

Note: The four ISO tiers are evaluated according to stove efficiency/fuel use, total emissions, indoor emissions, and safety, with Tier 0 being the lowest performing, and Tier 4 being the highest performing.

FIGURE 4 Trends in uptake of clean and/or efficient cookstoves and fuels
(Number of cookstoves distributed to households in LMICs from 2010–2014)



**Household stove equivalents estimated from fuel volumes, starting in 2014

Source: 2014 Results Report. Global Alliance for Clean Cookstoves

How much progress is being made in scaling up clean cooking technologies and fuels? The latest Results Report from the Global Alliance for Clean Cookstoves (Alliance, 2015) shows that over 12 million clean and/or efficient cooking technologies were distributed in 2014— almost double that of 2013 (Figure 4). Over half of the cleaner cooking technologies distributed in 2014 were estimated to have a Tier 2, 3, or 4 rating for indoor emissions or fuel efficiency, a tenfold increase from 2013. Likewise, reported clean fuel production increased 100-fold, and reported fuel distribution increased 200-fold between 2013 and 2014.

Since the Alliance's formation in 2010, more than 50 million stoves and fuels have been distributed, which sets the Alliance and its partners on track to reach their goal of 100 million households adopting clean and efficient cookstoves and fuels by 2020. The Alliance's Clean Cooking Catalog—san online global database of cookstoves, fuels, specifications, prices, manufacturers, and third-party validated performance testing—provides public information on the characteristics and relative performance of various stove and fuel innovations, reflecting the increased technologic innovation that has occurred in the household cooking sector.

To continue scaling up clean technologies, interventions and policies will need to consider contextual factors involved with energy purchasing at the household level. Household energy research is now focused on examining different male and female behaviors and decisions regarding fuels and cooking technologies and how these perspectives influence purchase decisions (Pachauri & Rao, 2013; WHO, 2016a). For example, a recent study in Bangladesh found that women had a stronger desire for improved cookstoves than men, but lacked the authority to make the decision to purchase one (Miller & Mobarak, 2013).

CONCLUSION

The tremendous health improvements that can result from universal energy access should not be overlooked. Achieving universal energy access can improve human health by strengthening the capabilities of healthcare facilities and enhancing the safety of household environments. Such health gains will be realized when health considerations are incorporated into the planning and implementation of energy investments, and vice versa. Encouragingly, a growing number of organizations—including the WHO, Global Alliance for Clean Cookstoves, Sustainable Energy for All, and United Nations Foundation—are working with governments to raise awareness about the inextricable links between energy and health. As these organizations move to identify and diminish research gaps, develop country-capacity for implementation, and overcome barriers associated with uptake and sustained energy use at the community and household level, they can simultaneously catalyze action needed to effectively and efficiently address multiple SDG goals.

NOTE

1. The analysis included all health facilities in each country and grouped them as "hospital" and "other facilities".

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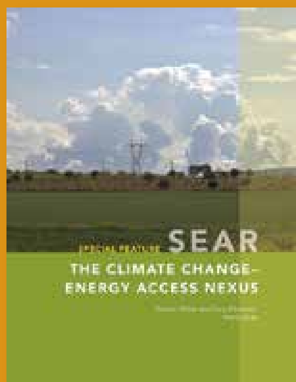

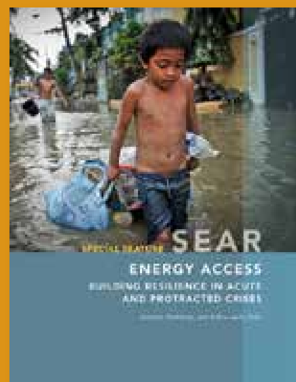

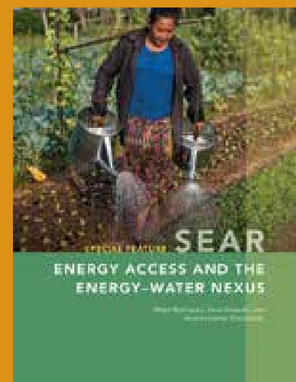

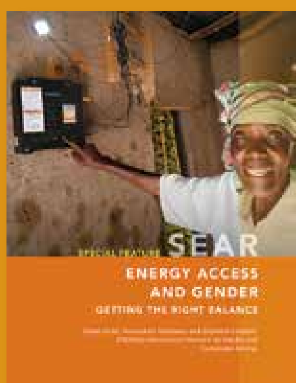

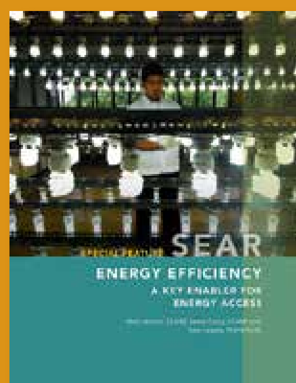

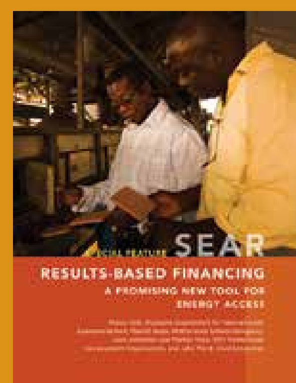

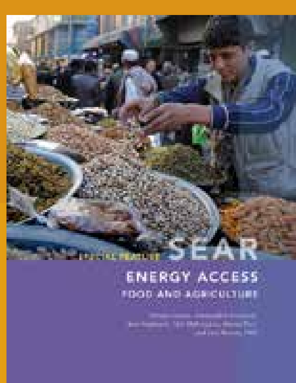

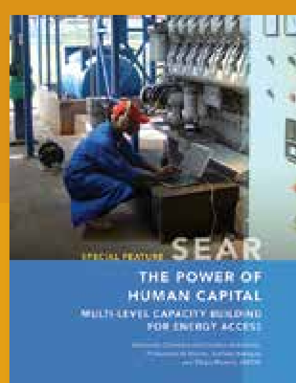

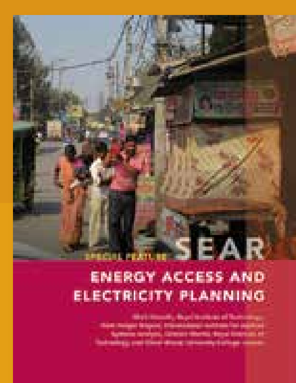

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