SCI
SOLAR COOKERS INTERNATIONAL

WHITE PAPER

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Solar Cookers International's Role

Solar Cookers International (SCI) improves human and environmental health by supporting the expansion of effective carbon-free solar cooking in world regions of greatest need. SCI leads through advocacy, research, and strengthening the capacity of the global solar cooking movement.

SCI promotes best practices by producing evidence-based materials and publications to grow the scale and amplify the capacity of the global solar cooking movement. SCI commissioned this white paper to look at why solar cooking is needed, where the greatest urgency exists for solar cooker adoption and where the solar cooker has been employed to great success.

As of December 2019, SCI has identified 3.9+ million solar cookers around the globe. These cookers mean:

- Over 14 million people are directly impacted by solar cooking
- Over 5.6 million tonnes of CO_2 emissions are prevented in one year; this is equal to taking almost 1 million cars off the road
- Almost 30 million tonnes of CO_2 emissions are prevented over the lifetime of these solar cookers. These emissions are the equivalent to not driving over 73 billion miles or not burning over 32 billion pounds of coal
- Over $1.25 billion dollars are saved globally over the cookers' lifespans by preventing CO_2 emissions

As this is a rapidly evolving sector, many of the statistics in this paper represent a snapshot in time. Please visit the SCI website at www.solarcookers.org and the world's largest online database of solar cooking information, managed by Solar Cookers International, www.solarcooking.org, for more up to date information.

Introduction

When a tribeswoman in Ghana cooks her family's meal using a solar cooker, she is taking part in a long evolution that reaches back into prehistory – where the clean and free energy of the sun was tapped for *the betterment of humanity.*

Today the solar cooker is being employed on all continents and has become a vital tool in protecting the health of those without access to clean cooking and the environment.

In the 21st century that world is changing rapidly**,** with more humans rising out of poverty than ever before. Yes, today there are around 2.8 billion that do not have access to clean cooking. Half of those that live in developing countries do not have access to clean cooking.

Access to clean cooking has become an urgent worldwide health and safety issue. It has also arisen to be an environmental one involving the world's forests and climate.

These are problems that can be solved by employment of the solar cooker, which mines an energy source that is clean, free and available to all.

Many families, especially in the developing world, cook with biofuels like firewood, dung or charcoal. The maladies that arise from cooking with biofuel indoors are many, and some life threatening.

The need to gather wood for cooking puts women and children in danger and the gathering of that fuel has hastened deforestation of already imperiled forests.

Today, the solar cooker is being employed in all continents and can be found from the high mountain yurts of Tibet to adobe homes in rural Nicaragua.

Despite this worldwide presence, urgency exists for deeper penetration and adoption of the solar cooker, especially in areas where little to no electricity access exists, like refugee camps, and where the populations of the poor are growing – as is the case in Sub-Saharan Africa.

Cooking Wood & Charcoal Indoors: a silent and smoldering killer

A sweeping global study published by *The Lancet Commission on Pollution and Health* recently found that pollution is the largest environmental cause of disease and premature death in the world.

The study found that pollution accounts for three times more deaths in 2015 than AIDS, tuberculosis and malaria combined.

A subset of that pollution is indoor pollution, from cooking. The issue is not a small one. More than half of the body's intake during a lifetime is air inhaled in the home.[i]

Nearly half of the world's population relies on biofuels such as wood, charcoal or dung for cooking and heating, much of that in the home.

Worldwide about 2.8 billion rely on solid fuels for cooking indoors.[ii]

Although the percentage of the world's population that uses biofuels is now lower than at any time since records have been kept, the absolute number of people using solid fuels throughout the world continues to rise - because of population growth, and poverty.

Poverty is further compounded by ongoing wars that give rise to growing refugee and migrant populations. These populations are typically housed in areas with no access to clean, sustainable cooking options.

Trapped pollutants from wood, charcoal and dung fires produce about the same pollution per hour as what is produced by a thousand cigarettes burning.[iii]

The health threats that result from exposure to such pollutants include acute infections of the lower respiratory tract - including pneumonia, especially in young children. Pneumonia is the chief killer of children worldwide.[iv]

Indoor pollutants eventually become ambient pollutants. By 2020 the developing countries will likely account for half of global greenhouse gas emissions. This underscores the urgency for the adoption and the continuation of solar cooking and clean cookstoves in the developing world.[v]

The Solar Cooker: An opportunity awaiting

A considerable lack of access to clean sustainable cooking can be found among those that live in the Asia-Pacific and Africa regions. In the Asia-Pacific region only 51 percent of the population had access to clean cooking in 2014.[vi]

In Africa (excluding North Africa) only 12% have access to clean cooking. The problem is most glaring in Africa because the African population expands by 25 million annually, but access to clean cooking only increases by 4 million annually.[vii]

A recent household survey identified 20 high impact countries for access to clean cooking. One of those is China, which saw 100% electrification, but where only 57% percent had access to clean cooking in 2014.[viii]

But the greatest urgency for the solar cooker can be found in growing refugee populations where access to the most basic amenities are not easily had, especially clean, sustainable cooking options.

Africa

In Sub Saharan Africa there are still more people without electricity today than there were in 2000, despite the fact electrification efforts have been outpacing population growth since 2014.

Almost 80% of the population still cooks with solid biomass, a share that has declined by just three percentage points since 2000. This is taking place in a region with some of the best solar radiation in the world.

Population growth means that, despite this small percentage decline, the number of people still cooking with solid biomass has increased by 240 million to reach around 780 million.[ix]

Kenya - where adaptation is key

When the sun goes down in Kenya, adaptation is key.

In this East African country, which borders the Indian Ocean, people are extending the usability of the solar cooker by using insulated baskets to cook or heat food after sunset. In Busia County, in western Kenya, as many as 1,500 households have turned to solar thermal cooking, mostly over the last four years, according to Kenya's Ministry of Energy.

Other families have adopted more efficient charcoal or firewood stoves. The nonprofit Farmers with a Vision (FWA), a local community organization based in Bumala Township, has driven the adoption effort.

Over the last four years FWA has sold thousands of solar cookers and energy saving charcoal and wood stoves and established a platform to promote use of solar energy appliances.

In Kenya, as in many other regions in Africa, the challenges to adopting solar cookers are financial ones. Sixty percent of solar cooker buyers default on loans for equipment.

The solar cooker technologies cost, on average, between $25 - $60 USD. Their use leads to a decline in the harvesting and use of firewood and paraffin.

To strengthen its business plan, FWA, offers a range of solar cooking boxes, parabolic reflector cookers, solar thermos systems and other devices, including improved combustion cookstoves for biomass fuels.

Roughly 14 clean cooking devices are sold each month and virtually all the homes in a certain neighborhood now use solar or other cookstoves instead of other fuels.[x]

Mali – successful private and public partnership

In 2014, Solar Cooking KoZon granted Togo Tilé, a Mali-based solar cooking business, an initial subsidy of EUR 13,300 with a goal of it establishing financial sustainability. Two years later, it was an established business with 30 staff members and five points of sales nationwide.

The Mali government then provided funding to expand operations under The Program for Support to Economic Growth and Promotion of Employment stimulated by the Private Sector (PACEPEP). PACEPEP is a new generation of development program of the Government of the Kingdom of Denmark, whose convention was signed with the Republic of Mali in December 2013.

The production of solar cooking products successfully continues. Togo Tilé sells heat-retention cookers, solar boxes, water pasteurization indicators, parabolic solar cookers, CooKits, and solar lighters, with 80 employees. [xi] Use of over 4,600 solar cookers in Mali has been identified as of July 2019.[xii]

Uganda - women empowered

Solar Cooking projects in Uganda began with the involvement of the Solar Connect Association (SCA) in 1994 - which had funding support from Foundation Lord Michealham and World Wildlife Fund, Switzerland (which got involved because of biodiversity issues).

Between 1994 and 2014 the SCA distributed 50,000 solar cookers in Uganda, South Sudan eastern Congo and Burundi.

The SCA is transitioning from an NGO to a social enterprise effort. To date it employs 64 women accounting for nearly three quarters of staff. These marketers sell solar cookers to villagers, and many are workers on the production floor.

The SCA has expanded from the Mbarara district to five other districts near Kampala City.

At first cardboard and plywood cookers were the only cookers available. Parabolic solar cookers and CooKits are now part of the mix in Uganda. The SCA has tapped a largely unemployed workforce to produce durable plywood solar cookers and cardboard box solar cookers. These have been distributed in the districts of Masaka, Soroti, Tororo and Kampala.

Roughly 80 parabolic cookers are built every year. This has led to over 10,000 solar cookers currently in use in homes throughout Uganda.

The Solar Connect Association said it works to mitigate climate change issues while improving the lives of rural people. It also sees a benefit with the biodiversity issue by stopping the destruction of herbal trees and plants that are rampantly cut for firewood and charcoal production.

Before the solar cookers were used, bumper crops typically rotted. Afterwards, the populace used solar energy to solar dry the food for storage.

Importantly, solar cookers are also used to pasteurize water, which is critical to reduce waterborne disease. There is a strong parallel between incidence of bacterial and viral disease and incidence of biomass fuels used for cooking. Pasteurization of water has led to a curtailment of waterborne diseases in Uganda.

The effort has also led to the generation of small-scale jobs including metal work, carpentry and canning. Productivity is increased all around as women can work in the fields while the sun is cooking their food. The cookers mean that girls no longer devote time to perilous treks to source firewood. Instead they are in schools learning.

A factor in the SCA's success is devising an educational campaign tailored to village life and the illiterate population. Local actors were used to describe and promote the use of solar cookers.

As of June 2017, the SCA has been selling 280 solar cookers monthly. This has allowed the effort to be self-sustaining.[xiii]

Ghana – a great need

In Ghana 73 percent of the population still relies on biomass for cooking. A 2019 study shows household air pollution is the seventh leading cause of premature death among Ghanaians. Household air pollution is caused by cooking fuels used in most Ghanaian households – such as firewood and charcoal. The use of biomass for cooking indoors has led to an estimated 10,000 Ghanaians dying annually from household air pollution. [xiv]

This makes Ghana an urgent destination for the solar cooker in Africa.

Malawi – accelerating deforestation

Malawi is one of the poorest countries in the world where 98% of families cook using firewood and charcoal. [xv] Households consume 84% of the total primary energy. This, with increasing population growth, is exerting significant pressure on the country's forest resources, leading to forest degradation and deforestation at a rate of 2.6% per year. Less than 7% of the 14 million people are connected to the national grid. [xvi]

Present efforts to move towards cleaner cooking include the use of the Chitetezo Mbaula clay stove. There are more than 200,000 clay stoves in use in Malawi. However, this cookstove still demands the harvesting of firewood, albeit at a much lower rate than is need for a traditional three stone fire.

Senegal – droughts and a UN program for change

The West African droughts of the 1970s and 1980s have brought sustainable cooking issues to the fore in Senegal. The droughts caused the populace to rely on wood for cooking, and this has led to rapid deforestation in the country.

The promotion of clean cooking in Senegal has fallen to the United Nations Framework Convention on Climate Change (UNFCC) whose activity in Senegal includes supporting the Mekhe Solar Cooker Project. This project has seen 105 women trained on how to build solar cookers. [xvii] The Mehke project instructs women on how to manufacture the solar cookers and how to train them to train others on their production. It has also identified 30 traditional recipes that can be easily prepared using the solar cooker. [xviii]

Madagascar – changing mindsets

In this island nation of 26 million most of its rural population remains disconnected from electricity networks. The Association for the Development of Solar Energy's (ADES) solar and efficient stoves program in Madagascar seeks to change minds about solar cooking. The ADES project got started in southwest Madagascar but soon became popular and is now implemented throughout the island.

Giving people alternatives to wood fuel is key to saving the biodiversity of this jungle island. It is estimated that emissions from 12,000 tons of firewood and 13,800 tons of charcoal can be saved annually if cleaner cooking methods, including clean, sustainable solar cooking, is adopted. [xix]

Manufacturing of climate-friendly solar and efficient cookers in Madagascar is currently underway. There are seven stove production and distribution centres, which produced and sold over 64,000 stoves by the end of 2014. 760,000 tons of wood have not been burnt as a result. [xx]

Madagascar was issued over 287,000 credits in 2017 by the Gold Standard for the Global Goals. The Gold Standard was established in 2003 by World Wildlife Fund and other international NGOs to allow governments and firms to offset their carbon dioxide and other greenhouse gas emissions through new investment in clean technology projects. The offsets must provide climate and sustainable development benefits. Every project certified by The Gold Standard must monitor, report and verify carbon savings and sustainable development benefits for local communities. For more information on solar and efficient stoves in Madagascar, see the Gold Standard website. [xxi]

Americas

Nicaragua - where men gather wood

While most fuel-gathering tasks fall to women and children, particularly girls, these roles vary culturally. In Central America men typically gather firewood, spending on average 10 hours per week while women take charge of the cooking spending on average 4 hours per day in the kitchen breathing toxic fumes. [xxii]

In Central America indoor air pollution has been associated with 37,000 premature deaths every year and ranked one of the top five causes of death and illness every year in Guatemala, Honduras and Nicaragua. [xxiii]

According to data gathered by Solar Cookers International from solar cooks and solar cooker distributors, there are over 1,735 solar cookers in use in Managua, Nicaragua as of July 2019. [xxiv]

Asia

China – solar cooking colossus

When it comes to the number of solar cookers successfully employed there is no match for China. The country now has roughly 2.2 million solar cookers. [xxv]

The story of solar cookers in China has been one of steady growth since the 1980's – some of it dramatic. In 2009, China led the world with over 1.4 million solar thermal cookers. A year later, stock totaled 1.6 million units. [xxvi]

Today, a large swath of China's population has access to electricity or natural gas for cooking that did not have that option a decade ago. This has come about with a dramatic reduction in poverty levels – as much as 94% in rural China. [xxvii]

However, a World Bank analysis indicates that more than half of China's population still relies on solid fuels for cooking and heating. [xxviii]

Most of these households are in rural areas and will likely continue using solid fuels to meet their cooking and heating needs in the foreseeable future.

China is rich in solar energy resources. Most provinces in China have abundant annual solar radiation except for East Sichuan and Guizhou provinces. Except for a few provinces in the Southeast, nearly all the rural households in each province use solid fuels for cooking, especially in West and North China. Switching to electricity or natural gas on a large scale will not occur in these rural areas unless those region's economies

become substantially developed. By 2030, an estimated 280 million people in China will still rely on solid fuels for cooking and heating. [xxix]

Adoption of solar cooking in China is often a multi-partnership affair.

One example is the Heqing Solar Cooker Projects 1 and 2. This multi country partnership includes China, the Netherlands, Sweden and Spain and is now in its 6th iteration.

The project enables rural residents to substitute solar energy for coal in daily cooking and water boiling by distributing 98,000 solar cookers in poor rural areas of China.

In a one-year period in 2013 the Heqing 1 project accounted for the saving of 151,466 tons of carbon emissions by way of placing 49,000 solar cookers, mostly in people's backyards. [xxx]

Manufacturers and types in China

Chinese solar cooker manufacturing typically is found in two forms: specialized and local. Most of China's solar cooker stock are made of cast iron, glass-fiber reinforced concrete, and composite material, and sold over a wide geographic area.

China has more than 20 enterprises that produce solar cookers distributed throughout Gansu, Ningxia, Qinghai, Sichuan, Jiangsu, and Shandong. The first four provinces are noted for their high levels of solar cooker stock. In addition, most companies are either private or joint-ownership types, with annual sales of more than 200,000 units.

The case of solar energy illustrates the importance of availability as a driver of household fuel selection. The large number of solar cookers used in Gansu is due, in large part, to the province's rich solar resources, combined with a severe shortage of biomass and conventional energy sources owing to harsh natural conditions. Over the years, farmers have had to dig up vegetation and roots and cut trees to compensate for the fuel deficit. [xxi]

The price range is 400 – 500 RMB per cooker (roughly $50 - $75 USD).

Local manufacturers, mainly in Gansu, Ningxia, and Qinghai, generally make thick cement shell stoves with a waste glass lens as reflective material. These products are popular among residents due to the lower production costs and sales price (about 200 – 300 RMB per cooker) and are regarded as high quality.

Suitable promotion areas for solar cookers are mainly concentrated in Gansu, Qinghai, Ningxia, Tibet, Sichuan, and Yunnan Tibetan areas, where solar energy resources are rich and biomass sourcing scarce.

Overcoming Barriers

The application of solar cookers can ease China's energy shortage and improve the environment. To effectively promote solar cookers, a World Bank study suggests that

various strategies be used. These include the integration and promotion of solar cookers with poverty-reduction planning. These strategies offset the difficulty of commercialization due to affordability issues and producers' low expectations of profitability.

That study also suggests that households in middle-income regions rich in solar resources be encouraged to purchase solar cookers through diversified financing methods such as consignment and installment with improved after-sales services.

The Tibetan Plateau – sky and sun

Tibet China is home to the Himalayas and the highest peaks in the world. It is also home to the best solar radiation intensity capacity in China, and the best global solar potential outside of Saharan Africa.

The sun shines between 275-330 days a year in Tibet, with the best solar energy found in the west and north. [xxxii]

In Tibet, there is a reliance on biomass energy for cooking – primarily yak dung. A survey of household fuel consumption in the Tibet autonomous region found families spend a large part of their income and time obtaining fuel. At altitudes above 3700 meters the daily fuel is one to two bags of yak dung collected most days by women -- in three to nine-hour forays throughout the dry season. At lower altitudes very poor women carried wood from distant mountain valleys walking up to 10 hours a day during collecting season. [xxxiii]

Sourcing of biomass has also led to rapid deforestation and land desertification.

Access to clean energy in a region where electricity access is scarce is the goal of China's One Solar Cooker and One Biomass Stove Program, initiated by China's Ministry of Agriculture in 2007.

The program is designed to solve the household energy problems of herdsmen and farmers living in the Tibet Autonomous Region as well as the neighboring provinces of Sichuan, Qinghai, Gansu, Yunnan.

Under the program, rural households in targeted areas receive one energy-efficient biomass stove and one solar cooker.

In just four years, the program successfully promoted 79,833 biomass stoves, and 244,474 solar cookers. [xxxiv]

There are now more than 260,000 solar cookstoves in Tibet. [xxxv]

As a result, rural sanitary conditions have improved, the incomes of herdsmen and farmers have risen, and overall quality of life for ethnic minorities is improving, helping to build a more stable and prosperous region.

A recent survey showed that most residents were aware of adverse health impacts of burning yak dung indoors, and that approximately 2/3 of those residents had already installed chimney stoves to mitigate indoor air pollution. However, measurements revealed that, without adequate ventilation, installing a chimney was not likely to ensure good indoor air quality. [xxxvi]

Public sector organizations have been key in solar cooker adoption in Tibet through organizations like the Tibetan Energy Research Center (TERC), which has been working on box and concentrator solar cookers.

Culture affects the adoption of new technologies, as this work in Tibet illustrates. During the nascent stage of solar cooker adoption programs, farmers and herdsmen were hesitant to use the stoves, as they saw the devices as stealing from the sun. However, TERC persisted in its education program which has led to the adoption of 260,000 solar cookers in Tibet. In turn, this has translated into the reduction of one ton of firewood use each year and the intended environmental benefit. [xxxvii]

Nepal – vanishing forests

Nepal was a country known for its large lush forests – but that is no longer the case. Barely 29% of Nepal's forest cover remains. The reason: roughly 87% of the Nepal's domestic energy is produced by firewood.

The result is a shortage of fuel wood in many parts of the country. For many, this means that harvesting wood occurs further from home, an increasingly time-consuming burden. This job typically falls to women and children. On average, 4-6 hours a day is spent on collection of firewood for cooking fires.

Replacing biomass with solar thermal energy for cooking can help stem the deforestation and drastically reduce travel times to gather firewood.

There are currently 2,225 solar dryers and cookers in Nepal. [xxxviii]

Pakistan – plenty of sun, plenty of deforestation

In Pakistan the Council of Renewable Energy Technology (PCRET) in Islamabad develops, acquires, and disseminates solar cookers. The project aims to provide 125,000 solar cookers for cooking and pasteurizing of water in remote areas in all four of Pakistan's provinces. The proposed project is a key objective of PCRET.

At present SCI has identified approximately 21,000 solar cookers in use in Pakistan. This is based on input from solar cooks and solar cooker distributors.

Solar cookers are a logical cooking tool in the country because, on average, 5 kilowatt hours of solar energy is collected on each square meter area in most parts of Pakistan, where solar radiation can be as high as 2500-3000 hours, per year.

Solar cookers are also seen as a key tool for clean cooking in rural communities, especially for those that live along the coastal belt and in Sindh and Balochistan provinces.

PCRET has found that acceptance to using the parabolic solar cooker can be high if proper training is given to rural women in Pakistan. [xxxix]

The use of solar cookers would also help stem the deforestation in Pakistan. Experts have predicted that the forests of Pakistan will disappear within the next 50 years if deforestation continues at current rates. Pakistan loses 42,000 hectares or 2.1 percent of its forests every year. [xl]

India – community solar cooking

India has a long history with solar cooking and the idea of solar cooker is as ancient as Indian roots. It is not rare to find references to solar cooking in old Indian literature. The first documented reference of solar cooking construction in India dates to 1878 when an army officer in Bombay constructed the first solar cooker. [xli]

In the 21st century the solar cooker has evolved into a decidedly community affair – and these are typically massive endeavors.

In India the use of the large-size sun-tracking solar cooker helps mitigate the use of firewood, animal dung cake and agricultural waste in rural areas, and Liquified Petroleum Gas (LPG), kerosene and coal in urban districts.

A 2012 study by the Government of India, found that in urban India 68% used LPG and 14% firewood and chips. The opposite is true in rural areas where 67% use firewood and chips and 15% LPG. [xlii] Whole conservation of firewood helps preserve the region's

forests. Removing the need to use animal dung cakes for cooking allows farmers to use it more freely as fertilizer, which could help improve yield of agricultural products.

At present, there are more than 800,000 solar cookers being employed in India. Most are of the box solar cooker type. Roughly 3,000 parabolic solar cookers are also in use in India. [xliii]

Approximately 130 community kitchens use the Scheffler Cooker in India. These include residential schools, living communities such as ashrams and pilgrimage sites.

In general, solar cooking activity is of the institutional solar steam cooking system variety. These systems can cook from 500 to 50,000 meals per day using solar generated steam. [xliv]

In some cases, the systems are integrated with existing biomass boiler systems to ensure continued cooking, regardless of whether the sun is shining or not. Well-integrated solar systems with back up energy systems, such as biomass or biogas greatly improve the use of solar cooking systems. In India, the largest scale solar thermal application for cooking is Shirdi Saibaba temple in Shirdi, Maharashtra. It is here where a large array of solar reflectors is used to cook 50,000 meals daily.

The temple's dining halls are some of the largest in India. The solar steam cooking system is comprised of 73 rooftop - mounted Scheffler reflectors of sixteen square meters each. [xlv]

Investment in solar steam cooking system on Shirdi's scale costs nearly $300,000 USD. Government subsidies have helped reduce the temple's cash contribution to $170,000 USD.

Use of the cookers has resulted in the reduction of roughly 100,000 kilograms of LPG each year, and an annual savings of approximately $45,000 USD. The system is designed to pay for itself in three to four years and expected to last 15 years.

Another project of note, India One, is the Mount Abu cooker, one of the largest community solar cooker projects in the world. Since 2017, the 1-megawatt solar thermal Mount Abu cooker, located in Rajasthan, has provided for 38,500 meals per day while catering to the power and heat needs of a township of 25,000 people. It started out as a modular solar steam cooking system of 24 Scheffler dishes (7.5m² each) serving 2,000 meals/day. The solar parabolic reflector dishes produce steam that serves as a heat source to cook vegetables and rice. Project One is sponsored by the Ministry of New and Renewable Energy Sources (MNRE) and co-sponsored with the German government. [xlvi]
In Tilonia, Rajasthan, the region's Barefoot College has been creating a new paradigm for solar cooking. In 2003, the college created the Society of Women Barefoot Solar

Cooker Engineers. It became one the first associations of illiterate and semi-literate women to build, install and maintain parabolic solar cookers in their homes.

The parabolic solar cookers are made from 300 mirrors that reflect the sun's rays onto the bottom of a cooking pot to cook food quickly and sustainably. The cooker has allowed women, who once spent long hours searching for firewood, to refocus their time on other productive activities. It also limits deforestation and pollution. [xlvii]

Ever since 2003, 13 rural women have been trained in production techniques to fabricate solar cookers. A total of 70 solar cookers have been produced.

In 2017, ten solar cookers have been sold to engineering institutes and other organizations. It takes 20 working days for the women to build one cooker. As of this year the solar cookers have been installed in Rajasthan, Delhi and Hyderabad.

The project has continued to evolve with women designing a solar coffee roaster using the Scheffler dish design. [xlviii]

Research has shown that large size sun-tracking solar cookers have an estimated life of 15 years in India and the typical payback period for solar cookers is under 2 years. This suggests that solar cookers are economically viable tool for families in India. [xlix]

Lastly, the solar cooker is an instrument of great appeal, even among young populations. This was elegantly proven in early 2017 when 7,438 students from 59 private and civic schools participated in "Suryakumbh" a solar cooking festival in Bhayander.

The Guinness Book of World Records confirmed that the event had set the world record for the "Largest Solar Oven Cooking Class". [l]

Refugees

Refugee migration is a growing global issue with deep economic, social, and public health implications. There are now more refugees and displaced people around the world than at any time since the Second World War. [li]

Wherever there is mass displacement of populations it is a surety that access to clean cooking becomes difficult or nonexistent, and glaring health issues result.

The number of displaced people reached an unprecedented level in 2015. The United Nations High Commissioner for Refugees (UNHCR) estimates that 65.3 million people were forcibly displaced worldwide as a result of persecution, conflict, generalized violence, or human rights violations in 2015.

Among displaced people, of the 8.7 million people living in refugee camps, only 3% have access to clean cooking solutions.

Many displaced people are generally left to source their own fuels and the means to prepare their food, and usually resort to solid fuels and three stone fires or inefficient, polluting cookstoves. [lii] These solid fuels impact cooks' health, economy and environment.

For many refugees cooking means cooking with firewood. This is not only a pollution issue it is also an economical one for refugees.

In the world's largest refugee settlement - the 83,277 household Dadaab settlement in Kenya, residents spent an estimated $6.2 million on firewood in 2015. This accounts for approximately 24 per cent of their overall household income. [liii]

The Moving Energy Initiative estimates the unsafe cooking practices lead to the premature deaths of some 20,000 refugees every year. [liv]

Dependence on polluting fuels has wider social, health and environmental impacts for displaced people. Women and girls often collect fuel from outside the camp and become vulnerable to attack. The arrival of displaced people often leads to the clearing of trees for fuel and shelter. Further, the time devoted to fuel collection by children takes them away from school.

Solar technologies for household and community-scale cooking can be important energy access solutions. Demand for fossil fuels and biomass fuels grows at an unsustainable pace. Solar thermal energy can scale as demand for clean sustainable fuel grows.

A recycled cardboard box solar cooker - an ingenious method that uses materials from a kitchen-set box package that contains a complete cooking set with forks, knifes and pots, is one such solution. Portable solar cookers made from cardboard packaging, is another solution, in which the solar cooker cooks' food for people living in developing countries or in refugee camps where lack of fossil fuels and wood is a daily problem. Amongst the various solar cooker choices, the parabolic solar cooker can reach even higher temperatures. [lv]

Gaza refugees

A severe electricity shortage exists in Gaza. This has put residents of Gaza under great stress.

Typically, residents of Gaza get only three hours of electricity daily. Water is scarce, and fuel supplies at hospitals carefully rationed. The region is also home to one of the highest unemployment rates in the world - 41 percent.

In Gaza, the non-governmental organization American Near East Refugee Aid (ANERA) is distributing solar cookers as part of a food security project. In the summer of 2017 ANERA distributed solar cookers to 160 families in Gaza. [lvi]

The locally made solar cookers are the innovative design of a Palestinian agronomist who built one to avoid having to buy gas canisters or deal with never-ending power outages.

ANERA added the solar cookers in Gaza to a household gardens initiative to enhance the availability of nutritious meals, reduce the dependency on fuel, and further support the economy by using stoves produced right in Gaza.

The locally made solar cookers are part of a larger plan of a food security program at ANERA that includes the building of a greenhouse, drip irrigation system, compost and planting of vegetables. [lvii]

CONCLUSION

The benefits of solar cooking and the variability of the models used have proven an important health and environment tool for many communities worldwide.

The solar cooker is a scalable tool; with its simplicity one of its greatest attributes. Outside of initial delivery and some maintenance/repair, the solar cooker does not require additional infrastructure (pipelines, transmission towers, storage or delivery trucks).

Reducing the need to transport LPG or biomass energy is one of the greatest arguments for the solar cooker as a greenhouse gas reduction tool since, in many countries, the highest contributor of pollution to the environment comes from the transportation sector.

Solar thermal cooking technology is an ideal solution to numerous global challenges. Solar cooking allows people to breathe cleaner air, reduces carbon dioxide emissions, conquers waterborne diseases, preserves habitats, increases safety and opportunities for women and children and protects biodiversity.

Since human health, quality of life, and environments are affected by cooking fuel choices, solar cooking offers a solution to the difficult choices many families make every day: whether to buy fuel, or to buy food and meet other family needs. The sun's free energy is a viable solution for all who live where the sun shines.

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