

Solar Cookers: Achieving Sustainable Solutions to Global Challenges

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Abstract

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. Solar Cookers International (SCI) connects collaborators in over 135 countries, with a mission to improve human and environmental health by supporting the expansion of effective carbon-free solar cooking in world regions of greatest need through advocacy, research, and strengthening the capacity of the global solar cooking movement.

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1. Introduction

Solar thermal cooking technology is an ideal solution to numerous global challenges. Solar cooking allows people to breathe cleaner air, reduces carbon dioxide and black carbon 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 makes solar cooking a viable clean and sustainable cooking solution for all who live where the sun shines.

A solar cooker is a device which uses the energy of direct sunlight to heat, cook food or pasteurize water. The three most common types of solar cookers are box ovens, parabolic concentrators, and reflective-panel cookers. Solar cookers use only solar energy for fuel, and hence have no ongoing costs, environmentally or economically.

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SCI has identified more than 3.3 million solar cookers worldwide, and estimates that those solar cookers have directly, positively impacted over 11.8 million people. Based on post solar cooker distribution survey data from SCI collaborator Friends of The Old (FOTO), it is estimated that one solar cooker can save one ton of wood in a year. Using the California Air Resources Board Greenhouse Gas Inventory figure of 1.44 tonnes of CO₂ emitted per ton of wood, SCI estimates use of those 3.3 million solar cookers will prevent carbon dioxide emissions by 23 million metric tons over the life of the solar cookers. According to the United States Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator, this is the equivalent of not driving over 56 billion miles or not burning over 25 billion pounds of coal.

Solar cookers are especially beneficial in areas where wood, charcoal, and animal dung are traditionally used as fuel. As reported (Martinez-Alier, 1995) it is estimated that in Asia, the Middle East, and Africa about 400 million tons of dung are burned per year and each ton implies the loss of 50 kg of cereal yield. When animal dung can be used as fertilizer instead of fuel, cereal crop production can increase by 20 billion tons per

year. Using solar cookers reduces the need to burn dung for cooking, making possible an increase in the cereal yield in many countries.

SCI Global Map of Solar Cookers



Data compiled by Solar Cookers International. Visit www.solarcookers.org to learn more

Government investment in solar cooking solutions has significant economic and environmental benefits. According to the World Bank and the Institute for Health Metrics and Evaluation, the total global cost of air pollution is roughly 1.6 trillion USD. Therefore, simple solutions such as solar thermal cooking that reduce air pollution can save economies billions of dollars.

2. Advocacy

SCI is actively engaged in global discussions regarding scaling energy access, poverty alleviation, human health, and environmental stewardship. SCI advocates with global leaders to ensure solar cooking is recognized as a critical solution in achieving climate and health goals. To facilitate the sharing of best practices and the scaling up of solar cooking, SCI engages a team of Global Advisors who provide subject matter and regional expertise.

The annual High-Level Political Forum (HLPF) held at the United Nations in New York City each July is one of SCI's top advocacy opportunities to promote solar cooking. Since 2015, when the United Nations established agenda 2030 and the 17 Sustainable Development Goals (SDGs), the HLPF became the venue where member states deliver their Voluntary National Reviews (VNRs) to report their progress toward accomplishing the SDGs. Solar cooking is a cross-cutting solution that can make a positive impact on all 17 SDGs; hence, SCI prioritizes advocacy at the HLPF to promote solar cooking among policy makers, to encourage member states to include solar cooking in their VNRs, and to connect with high-impact partners that can help scale solar cooking worldwide.

SCI and collaborator Public-Private Alliance Foundation (PPAF) Executive Director Dr. David Stillman hosted a shared exhibition space at HLPF 2018 and 2019. The SCI/PPAF exhibition displayed solar cookers, a test station for SCI's Performance Evaluation Process (PEP) (in 2018) and showcased the SCI/PPAF collaborative efforts in Haiti for clean, sustainable solar cooking solutions. SCI's advocacy team was interviewed by UN News and other organizations, which helped amplify the messaging about the many benefits of solar cooking and the importance of SCI testing solar cookers according to ISO standards.



SCI Associate Rose Bazile engaging government leaders about solar cooking's positive impact on all 17 Sustainable Development Goals (SDGs) at the High-Level Political Forum at the United Nations in New York.

Photo Credit: Alan Bigelow, Ph.D., SCI Science Director

In addition, SCI's travel funds supported SCI Global Advisor Dr. Mrs. Janak Palta McGilligan to participate at HLPF in 2017. She highlighted solar cooking as a critical energy solution based on her decades educating rural Indian women about the benefits of solar cooking and empowering them with the ability to solar cook. Local experts, especially women, are crucial in spreading this technology, because they speak the same language, cook the same foods, understand the culture and available resources, and lead by example.

SCI's travel funds also made it possible for Dr. Mrs. Janak Palta McGilligan and other SCI Global Advisors to advocate for solar cooking at The Global Alliance for Clean Cookstoves Conference in New Delhi, India in 2017. SCI amplifies solar cooking advocates' voices around the world to leverage expertise and experience.

Numerous examples of solar cooker innovations and institutional scale solar cooking exist in India. For example, the 6th SCI World Conference 2017 was held in the state of Gujarat, India at the Muni Seva Ashram, where solar concentrators are used for air conditioning and a roof-top solar steam cooking system at the Ashram's Green Campus school is used to prepare food for students and faculty. Solar cooking is a well-suited solution for India because its population is large and growing; air pollution is considered hazardous in some regions; and many people live in rural areas where there are challenges for accessing cooking fuel.



*SCI Global Advisor Dr. Mrs. Janak Palta McGilligan.
Photo credit: Charley Cross, SCI Volunteer*

SCI also advocated for solar cooking at the United Nations Climate Change Conference in Bonn, Germany in November 2017 and Katowice, Poland in December 2018. Government leaders, such as those from South Africa, Papua New Guinea, and Nigeria, examined SCI's global data on solar cooking, and learned how their country can increase the adoption of solar cookers.



*SCI Press Conference with the World Health Organization at the United Nations Climate Conference, raising awareness about the importance and effectiveness of solar cooking as a climate change solution.
Photo credit: 2018 United Nations Framework Convention on Climate Change*

SCI joined forces with Angeline Heine-Reimers, Energy Planner for the Republic of the Marshall Islands (RMI) at the United Nations Climate Change Conference 2018 in Katowice, Poland. Solar cooking is critically important and relevant in the RMI. Ms. Heine-Reimers spoke about the importance of solar cooking at SCI's press conference. She explained, "Climate change is not a future problem, it is impacting the Marshall Islands right now....The land is disappearing with sea levels rising. We are experiencing climate change impacts now. For small islands like mine, where you are associated with the land, your identity is the land. Your culture is the land. If the land disappears, who are you as a person? That's a very scary thought to think about because it's hard to imagine who you are without having your home. That is why we are addressing climate change through many avenues, including solar cooking."

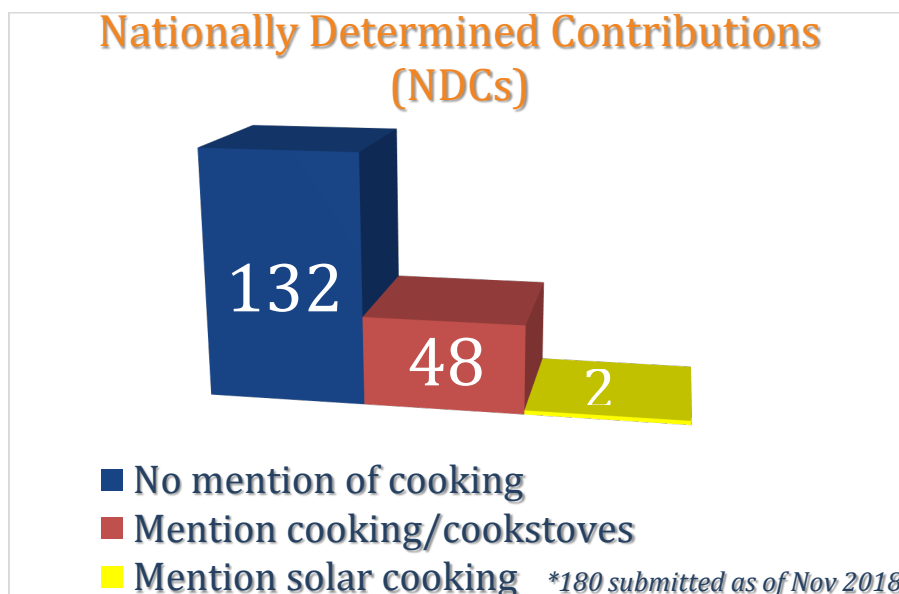
Only 4 of the 20 main islands comprising the Marshall Islands have access to electricity, making this an ideal place to harness solar energy for cooking and purifying water. With an abundance of sunlight and limited access to electricity, solar cookers represent a clean and simple opportunity to improve the lives of many, while limiting greenhouse emissions.



SCI Science Director Alan Bigelow, Ph.D., Energy Planner for the Republic of the Marshall Islands Angeline Heine-Reimers, SCI Executive Director Caitlyn Hughes and SCI Board Treasurer Mike Paparian advocating about the urgent need for more solar cookers at a United Nations Climate Conference press conference in 2018.

The Solar Cookers International Board of Directors unanimously agreed to award the SCI Order of Excellence to the Republic of the Marshall Islands for its commitment to solar cooking, as evidenced by including solar cooking in its official plan to address climate change. SCI Board Member Dr. Peg Barratt presented the Order of Excellence in Washington D.C. at the RMI Embassy to Ambassador Gerald Zackios. Solar Cookers International encourages other countries to follow the Republic of the Marshall Island's leadership by including solar cooking in their official policies to address climate change.

Solar cooking is an effective mitigation and adaption solution for countries and communities to address climate change. Of the 165 Nationally Determined Contributions (NDCs) or plans on how countries will reduce emissions impacting climate change, 48 of them mention cooking or cookstoves. Somalia and the Republic of the Marshall Islands specifically mention solar cooking as a solution in their plans. More government leaders can include solar cooking in their national programs, policies, plans, and budgets to address climate change and global challenges.



Countries' plans to address climate change (NDCs) and the opportunity for impact of solar cooking, as of November 2018.

3. Research

Solar Cookers International encourages the testing of solar cookers for the benefit of all – manufacturers, consumers, and decision-makers in government and community-based organizations. SCI developed the Performance Evaluation Process (PEP), to help everyone choose the best solar cooker for their needs. Just like the miles-per-gallon performance specification for automobiles, people need to know the standard cooking power for each solar cooker to make informed decisions. PEP measures the standardized cooking power (in Watts) of different solar cookers. PEP test stations apply a protocol that harmonizes with guidelines published by the International Organization for Standardization (ISO). SCI encourages everyone in the solar cooking sector (manufacturers, customers, project managers, etc.) to utilize this resource to learn, connect, and implement solar cooking. SCI's global PEP testing centers empower communities with income and knowledge and standardize comparison for solar cooker manufacturers on all continents. SCI has testing centers in Lalitpur, Nepal; New York, USA; California, USA; and Nairobi, Kenya.

In addition to the SCI PEP testing center, SCI's collaborations in Nepal exemplify best practices in natural disaster preparedness and solar thermal cooking technology implementation. The opportunity for solar cooking in Nepal is significant, since 80% of the people use firewood and farm residue for cooking fuel.

Nepalese collaborators have been leading solar cooking workshops for local groups, such as students, women headed households, people with disabilities, elderly, and more. When communities know about a solution such as solar cooking and have access to it and training before a disaster strikes, it increases their chances of being able to effectively utilize it during and after a disaster or crises situation. SCI's local Nepalese partners exemplified this best practice before the 7.8 magnitude earthquake in Nepal in 2015.



Nepalese woman solar cooking. Photo credit: SCI Global Advisor Julie Greene

This woman is one of many who benefited from solar cooking. She lives in sunny Machhegaon, Kathmandu Valley, Nepal. As part of the 57% of the population in Nepal that lives on less than \$2 per day, she earns about \$100 US each month to support her family of five. Her biggest expenses are cooking fuel (\$30 a month) and rice (\$30 per month). This widow and breadwinner for a family of five started solar cooking in February 2014. With the solar cooker, she cuts her monthly fuel costs in half—saving \$15 per month which she can use to buy more food for her family. She was already confidently using this solar cooker technology to safely cook and pasteurize water before the earthquake struck and was therefore prepared in the aftermath. Solar cooking is also an effective solution for her and her family to deal with the wood, liquid petroleum gas (LPG), and kerosene fuel shortages resulting from political tensions and border trade restrictions. Solar thermal cooking supports fuel independence.

4. Strengthening the Capacity of the Solar Cooking Sector

SCI has over 30 years of experience helping hundreds of collaborators worldwide share best practices to scale up and meet the cooking-fuel demand of approximately 3 billion people who currently cook over open fires. SCI is leading the effort to help people adapt to their changing energy-access needs in our rapidly shifting world and adopt high-impact, financially sound strategies to successfully implement solar cooking.

SCI's collaboration in Haiti is one such example. Haiti has a tremendous solar resource and is taking advantage of it. SCI is collaborating with multiple organizations, such as the Public Private Alliance Foundation, Solar C3ITIES, Solar Household Energy, Solavore, and several SCI Associates and supporters, including Rose Bazile, RNC to advance solar cooking. SCI is working with these organizations to encourage growing their social entrepreneurship from their home base and to develop curriculum for teaching clean, sustainable cooking technologies. SCI has provided input on a solar cooking course being taught at the Université Notre Dame D'Haiti UDERS De Hinche, Haiti. Solar Cookers International manages the world's largest online database of solar cooking information, the Solar Cooking Wiki (www.solarcooking.org), which significantly contributed to the content of the course. The course contains topics such as local manufacture,

best practices, and water pasteurization. With SCI knowledge resources, Ms. Bazile is educating nurses and doctors at a local hospital while also training local women on solar cooking.

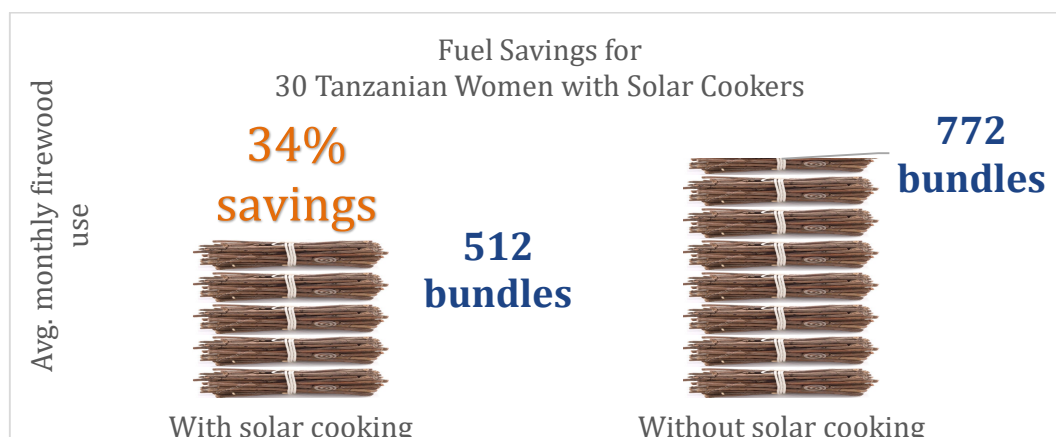
Another such example is Sperancea Gabone, a local and global champion of solar cooking from Tanzania, where 98% of the wood used is for firewood and charcoal. The average Tanzanian household burns 4 tons of wood a year for heating and cooking, but solar cooking changes that. Ms. Gabone has taught thousands of people in her area about solar cooking. She has done multiple trainings and solar cookers distributions to women in surrounding villages.



*Tanzanian women with their locally produced solar box cookers, thanks to Solar Cookers International.
Photo credit: Sperancea Gabone, Macedonia Ministry*

The solar cookers are produced locally, with local materials. Communities are empowered with the knowledge and ownership of how to make and maintain solar cookers. Local production strengthens the local economy and is more environmentally friendly than transporting large amounts of product over long distances. This project incorporated complimentary technologies, including retained heat baskets (insulated baskets to keep food hot) and WAPIs (Water Pasteurization Indicators). WAPIs show visibly when water has reached pasteurization temperature and is safe to drink.

Ms. Gabone uses the Solar Cooking Adoption and Impact Survey, designed by SCI, to track fuel use and savings with solar cooking. In the first ten months, thirty women reduced their total fuel usage by 1,955 bundles of wood (24% savings), 566 kilograms of charcoal (28% savings), 486 liters of kerosene (25% savings), and 694 bags of crop waste (19% savings) with solar cooking. They saved five and a half million Tanzanian Shillings (\$2,438 USD), or 25%, of their fuel costs. The rate of smoke-related health problems, for themselves and their families, dropped from 77% to 44% with solar cooking. In a second phase, savings on fuel expenses were as high as 35% in certain months.



SCI supports capacity development for collaborators such as Ms. Gabone to share information, develop best practices, and strengthen and scale the activities of the solar cooking sector. SCI does this in many ways, including events, webinars, conference calls, email and print publications, and more. For example, SCI connected Ms. Gabone to a solar cooking partner in Uganda, who has a financially sustainable and scalable solar cooking business. This empowers Ms. Gabone and other solar cooking collaborators with knowledge, opportunities, resources, and connections to scale their solar cooking activities to help meet the demand of 3 billion people cooking over open fires who could benefit from solar cooking.

5. Conclusion

SCI shares a variety of resources to empower its collaborators and government representatives to further solar cooking. SCI manages the Solar Cooking Wiki, the world's largest online database of solar cooking (www.solarcooking.org) with over 1,700 webpages of information and automatically translatable into 37 languages. It includes best practice guides on solar cooking training and project design; a by-country directory of collaborators and solar cooking history; and up-to-date news and events.

Government leaders and communities can implement solar cooking to achieve sustainable solutions to global challenges. Solar Cookers International connects government leaders to solar cooking information, resources and local experts. Haiti, the Republic of the Marshall Islands, India, Nepal, and Tanzania are just a few examples of how SCI works with local experts to grow this solution through advocacy, research and sector capacity building. Solar cooking is a viable and effective solution to implement during this critical time for the environment and world population. To connect with Solar Cookers International directly and learn more about its work, please visit www.solarcookers.org.

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