CONSOLFOOD 2016 - International Conference on Advances in Solar Thermal Food Processing
Faro-Portugal, 22-23 January, 2016

KEY DISRUPTORS FOR THE 21ST CENTURY

Julie L. Greene*

Solar Cookers International, Sacramento, CA USA
Email: julie.greene@solarcookers.org, web: http://www.solarcookers.org/

Abstract: *The 2015 Paris Agreement (COP21) identified an urgent need to replace high-emissions, carbon-based fuels with renewable energy to remain below a 2 degree Celsius global temperature increase. The essential tasks of cooking, water heating and food preserving result in daily, large-scale GHG and black carbon emissions. Switching to renewable energy for these daily tasks provides an opportunity to reduce the emissions associated with climate change on a large scale. Although proven solar technologies for cooking, heating water, and preserving food exist, adoption has been slower than anticipated. Key disruptors are needed to ensure a faster rate of adoption to reduce GHGs and black carbon emissions. Evidence from other sectors demonstrates that non-mechanical solutions, such as a mindset change, and supportive policies, may have the biggest potential to increase the adoption rate of solar and other renewable technologies.*

Keywords: solar, energy, adoption, policy, renewable

1. INTRODUCTION

1.1. The 21st century mandate to reduce emissions

Biomass and fossil fuel energy release greenhouse gas (GHG) and black carbon emissions, which contribute to climate change. Because cooking, water-heating, and food preservation are essential for the continuance of human life, and these tasks are performed at scale, the emissions impact of the food system deserves urgent attention.

1.2. Emissions: water-heating, cooking and food preserving

Billions of people cook and preserve food, and heat water with a variety of fuels including biofuels and fossil fuels that release emissions such as GHGs. Additionally, biomass fuels such as wood, crop waste, charcoal, and animal dung emit black carbon, which contributes significantly to climate change [1].

The global food system is a significant source of GHG emissions. Including the many aspects of food production, industrial agriculture accounts for 43-57% of world GHG [2]. Promoting sustainable food production systems at the local level will have a great effect on the reduction of emissions contributing to climate change. However, the widespread practice of burning dung as household fuel resulted in a loss of 20 billion kilos of cereal yield in Asia, the Middle East, and Africa in 1982 alone [3]. In addition to reducing soil fertility, using dung as fuel reduces the soils' abilities to sequester carbon, contributing to global temperature increase and decreasing crop yields [4]. Substituting renewable energy sources, like solar thermal, for food processing and household cooking use, will reduce the emissions load created by today's global food system.

1.3. Early efforts to reduce emissions with alternative technologies

To date, individuals, and public and private organizations have supported the research and development of renewable energy solutions for cooking, food processing, and water heating. These solutions included solar thermal cookers, solar food dryers, and improved combustion stoves, which continue to be adopted with varying degrees of success. Non-mechanical, supplementary innovations to increase adoption of these technologies included entrepreneurial training, financial instruments and other finance tools, and market penetration strategies.

1.4. The need to accelerate adoption of alternative technologies

The Paris Agreement of December 2015 (COP21) identified the need to phase out carbon-based fuels by mid-21st century to achieve global climate change goals. Transitioning food-related tasks to a greater renewable energy mix, such as solar plus biomass would be an important energy solution factor to meet the Paris Agreement goals. Because renewable solar energy is widely dispersed, it can be captured at the point of use, further reducing GHGs emitted during transportation. Therefore, an accelerated rate of adoption of solar energy technologies, captured at point of use, for many food-related tasks is essential to achieve the emissions goals the world community set in Paris.

1.5. Current pace of adoption: falling short

Solar thermal cooker innovation and performance have steadily evolved since the 1980's. Proven solar energy technologies (photovoltaic and solar thermal) exist that can cook all foods that humans eat. Efforts to increase adoption included training, research to improve performance, and user feedback evaluation. Dozens of successful devices using modern solar energy that cook and process food, and heat water are the result. Yet adoption rates for solar thermal technologies have not met expectations for two decades, due to multiple, complex, interdependent variables unrelated to product design. These variables include social, financial, and educational factors, as well as policy obstacles.

2. OBSTACLES TO SOLAR THERMAL TECHNOLOGY ADOPTION

The public's understanding of solar thermal cookers, water heaters, and food dryers has not kept pace with the rapid improvement of these solar thermal technologies. Misperceptions and misinformation about solar cooking technologies abound. Most common are myths surrounding performance, and the capability of solar cookers to cook a variety of type and quantity of foods.

2.1. Non-mechanical influences

Social, economic, and political factors may be more critical to technology adoption than the technology itself [5, 6]. Multiple factors, such as market formation, pricing, financing, quality of consumer after-care, and policy can assist or squelch technology adoption [7]. The Global Alliance for Clean Cookstoves has produced a body of literature that demonstrates significant technology research and development, and entrepreneurial skills training for market penetration [8].

While investment, research and development, and public education about improved combustion biomass stoves have increased since the launch of the Global Alliance for Clean Cookstoves, adoption of improved cookstoves and solar thermal cookers have been slower than anticipated. Research of the literature of improved biomass combustion stove technologies reveal a history of obstacles to their adoption that mirrors that of solar thermal technologies [9].

2.2. Example of a non-mechanical influence

Financial instruments have high impact on the success of technology adoption [10]. Microfinance is particularly important for people with little or no capital to invest in technologies that can provide long-term financial benefit. Finance options are critical for people earning less than $2 per day. Many organizations and individuals have successfully conducted microfinance programs to assist with adoption of cooking technologies [11].

But finance alone has not guaranteed successful access to necessities like food and safe drinking water; to the contrary, some research shows that some funding programs may impede development of local solutions in many sectors, including energy [12].

3. DISRUPTORS TO ACCELERATE SOLAR THERMAL TECHNOLOGY ADOPTION

Disruptions to the promotion of solar thermal technologies for cooking, heating water, and food processing include a change in the mindset and targets for the sector. Investment, research, user

training, and quality products are not sufficient to guarantee technology adoption: supportive energy policy has the bigger impact for change on a scale of magnitude [13].

3.1. The key disruptor: policy trumps design

When high-quality products are available that ensure consumer trust, market supply, and finance models, the importance of supportive policies and programs is essential. The policy cycle describes a feedback loop where subsidies, adoption, cost, and technology improvements conflate, resulting in further policy changes. Motivating policy-makers at all levels to support renewable energy-friendly policies to accelerate this policy cycle for sustainable, renewable modern energy is of prime urgency.

3.2. Policy as helper or as hindrance

Current policies, such as pricing, trade, economic development, etc., sometimes have the unintended consequence of slowing the adoption of proven technologies. An example is the World Trade Organization's policy identifying a local-content requirement as a discrimination against competitors that are non-local [14]. Such a policy discourages the development of local, appropriate technologies while favoring imports that result in increased GHGs and emissions to transport them to market.
National and regional policies drive transition. Germany's *Energiewende*, a multiple-decade plan to transition to sustainable energy, is yielding results [15]. Involving the electorate, the establishment of feed-in tariffs, and the recent switch to a reverse auction have been as instrumental in Germany's transition to renewable energies as the technologies themselves.
An example of a regulatory program supporting renewable energies was the California Energy Commissions'1998 Renewable Energies Program. The Center for Resource Solutions (CRS) worked with the Sacramento Municipal Utilities District (SMUD) in California, USA, to create a successful accountability and certification program for renewable energies to increase the public utility's renewable energy mix [16].

3.3. Motivating good policy

Social and political pressures, added to increasing environmental pressures, motivate action. New alliances, such as the International Solar Energy Alliance launched by India and France, and the Global Solar Council, were galvanized by COP21 in December, 2015. The private sector entered the fray with the Breakthrough Energy Coalition, led by a partnership of global investors and philanthropists.
If properly focused, alliances have a high potential to influence policy on many levels. Positive policies would include local content requirements to incentivize renewable and decentralized energy use and boost local manufacturing. And previous policies that penalize local content requirements must be eliminated, or changed.
Supportive policy, with strong accountability standards are essential to speed up adoption of renewable solar energy alternatives for cooking, water heating, and food processing. These will be key in reducing global reliance on carbon-based fuels. While applauding their success, such programs and policies can take decades to deliver results at all levels: international, national, and regional.

3.4. Accelerating the rate of policy change

Global agreements and carefully crafted policies can take five to fifteen years to produce results, and longer to achieve outcomes. With an urgent need for global emissions to peak in the current decade, the time to put supportive policies in place to support renewable energies must contract. A select focus on policies that directly impact the current global food system, cooking, water heating, and food processing have the greatest potential for immediate impact. With a need for global emissions to peak in the current decade, policies should be crafted to produce results in five years or less.

3.5. Incentivizing rapid change

Moving away from a global food system powered by fossil fuels to cooking, water-heating and food processing with locally available renewable energies will require visionary policies and programs at all levels. Cash incentive prizes for renewable, sustainable energy programs and policies that resulted in more people using solar for their food-system needs could motivate local people to craft their own solutions. Because successful innovation is not limited to the private sector, government agencies should not be excluded from participation in prize awards. Prizes that emphasize local-content, local innovation, and appropriate renewable technologies that respond to local needs would be awarded the highest level.

The most important disruptor may be the will to change the current promotion strategies that focus heavily on the mechanics of the technology.

4. CONCLUSION

Renewable, sustainable modern energy technologies exist that can wean the global economy from carbon-based fuel and reduce their emissions by mid-21st century. Appropriate renewable technologies used for the global food system, including cooking, water heating, and food processing, have a high emissions-reduction potential because billions of people perform these tasks every day. Important barriers to consumer adoption of these renewable energy technologies are the lack of adequate pro-renewable energy policies and programs, the existence of current policies that block the adoption of renewable energy solutions, the slow process of implementing or changing policy, and a mindset that selects mechanical improvement as the most important priority.

Incremental improvements in solar thermal and solar food preserving technologies will continue to increase user satisfaction with these devices. But the solution to increased adoption is to disrupt the universal mindset that global adoption of solar cooking will be achieved by tinkering with the technologies; instead, revolutionizing policy will achieve adoption goals. The new mindset needed is to choose the aggressive acceleration of renewable technology adoption with supportive policies at all levels. This includes alteration of current policies that impede adoption, as well as creation of policies and programs that promote adoption of many solar technologies.

Focusing on appropriate food system technologies used by billions on a daily basis – cooking, water-heating, and food processing—may produce the greatest, and quickest, reduction in emissions. Transforming the policies that block uptake of renewable energy technologies should be given top priority at the national and international levels. At the local level, policies that support the local integration of renewable energy through regional governments, community partners, microfinance and

market development should take top priority. Incentivizing prizes, such as cash or recognition, could play an important role. Policies and programs for renewable energy alternatives that support cooking, heating water, and food processing at the local level, at an accelerated rate in this decade, are top priority to keep global climate change at a minimum in this century.

ACKNOWLEDGMENTS

The author acknowledges the board members and staff of Solar Cookers International, especially Caitlyn Hughes for her assistance with research; the global Associates of Solar Cookers International for their outstanding work to promote solar thermal cooking globally; and to Patricia McArdle, Deepak Gadhia, Darwin Curtis, Dr. Paul Funk, and Dr. Catlin Powers for inspiration.

NOTES

[1] Bond T. Testimony for "Clearing the Smoke: Black Carbon Pollution" House Committee on Energy Independence and Global Warming United States House of Representatives, Washington DC, 2016.

[2] 2013 Trade and Environment Review. United Nations Conference on Trade and Development, Geneva, 2013, 20.

[3] Martinez-Alier J. The use of firewood and deforestation. Nuclear Monitor Issue #427-428, Special: Energy and Power, Alternative energy and its implications, 1995, 427-428.

[4] Porter JR et al. Food Security and Food Production Systems. Climate Change 2014: Impacts, Adaptation, and Vulnerability, Par A: Global and Sectoral Aspects, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, 2014, 504-505.

[5] Collings S. Stimulating solutions to energy access through the use of innovation prizes. GVEP International, 2015.

[6] Faris S. The Solar Company Making a Profit on Poor Africans, Bloomberg Businessweek, 2015.

[7] Stix G. Effective World Government Will Be Needed to Stave Off Climate Catastrophe. Scientific American, 2012.

[8] Smith G, Shankar A. Empowered Entrepreneur Training Handbook, The Global Alliance for Clean Cookstoves, Washington DC, 2015.

[9] Lambe F, Jörisoo M, Wanjiru H, and Senyagwa J. Bringing clean, safe, affordable cooking energy to households across Africa: an agenda for action. Stockholm Environment Institute, Stockholm and Nairobi, 2015.

[10] Lambe F, Jörisoo M, Wanjiru H, and Senyagwa J. Bringing clean, safe, affordable cooking energy to households across Africa: an agenda for action. Stockholm Environment Institute, Stockholm and Nairobi, 2015.

[11] Faris S. The Solar Company Making a Profit on Poor Africans, Bloomberg Businessweek, 2015.

[12] Leopold A. Big money for energy in Africa must be spent on small producers. The Economist: Intelligence Unit – Perspectives, 2015.

[13] Bhatia M, Angelou N. Capturing the Multi-Dimensionality of Energy Access. World Bank Group: Livewire 88699, Washington DC, 2014/16.

[14] Klein N. This Changes Everything: Capitalism vs. the Climate. Knopf, Canada, 2014.

[15] Key Messages on German Climate and Energy Policy. German Missions in the United States, Washington DC, 2012.

[16] Center for Energy and Environmental Policy. Environmental Policies for a Restructured Electricity Market: A Survey of State Initiatives, Newark, 2000, 81.

REFERENCES

Birol F. Energy and climate change: world energy outlook special report. International Energy Agency, 2015.

Food and Agriculture Organization (FAO) of the United Nations. Report on natural resources for food and agriculture in Latin America and the Caribbean, Environment and Energy Paper 8, Rome, 1986.

Lahn G, Grafham O. Heat, Light and Power for Refugees: Saving Lives, Reducing Costs. Chatham House Report for the Moving Energy Initiative, the Royal Institute of International Affairs, 2015.

Moyo D, Dead Aid: Why Aid Is Not Working and How There Is a Better Way for Africa. Farrar, Straus and Giroux, 2009.