SOLAR COOKERS

Can solar cookers offer higher living standards and reduced emissions?

A range of high-tech, and simpler, designs of solar cooker is now available to work in hot, sunny – and also cooler – climates around the world. *Mini Pant Zachariah* reports from Mumbai.

View of an evacuated tube Cooker SM 70 being marketed by SLICK in Britain

Photo: Dave Oxford

Solar power of course draws on a free renewable energy to create electricity, but a burgeoning sector is enabling the harnessing of heat for cooking, which can promote energy efficiency in all manner of climates – solar cookers. Indian solar cooker innovator Deepak Gadhia and Julie Greene, Executive Director, Solar Cookers International (SCI), co-chaired the 6th SCI World Conference held in Gujarat, India, this January, that demonstrated how these technologies are entering the mainstream.

Gadhia adapted box type solar cookers to generate high temperatures for deep frying. He has also been working with German scientists to manufacture so-called 'Scheffler concentrators' which focus solar energy to generate real heat. They use parabolic reflectors to concentrate sunlight on a surface used for cooking.

Gadhia later developed solar steam cooking systems, able to feed 50,000 people every day. Scheffler concentrators create very high heat that boils water and converts it to steam. This steam is collected from steam receivers and stored in a pressurised vessel from where it is directed to a cooking vessel.

Speaking to *Energy World* at the Gujarat conference, Gadhia said: 'We know the power of the sun, we just did not realise its potential and possibilities.' Greene told participants that solar cooker technology is a sustainable and environmentally responsible tool which helps families fight poverty by boosting their access to cheap and abundant cooking heat.

Serving remote communities

Dr Janak Palta McGilligan, Director at the Jimmy McGilligan Centre for Sustainable Development in Indore, India, is one expert who has spread the use of these systems to remote communities, far from electrical grids.

She has overseen the training of more than 6,000 young tribal Indian women in solar cooking and food processing, helping install solar cookers capable of cooking for 10 to 15 people (called 'SK-14' cookers by manufacturers). She told *Energy World*: 'Communities in these remote, tribal areas use firewood or cow dung cakes for fuel. Cooking becomes physically demanding, time consuming and great source of socio-economic empowerment for these women.'

Data compiled by California-based SCI's Programme Manager Caitlyn Hughes on the impact of box solar cooker adopted by 30 women in Tanzania, over a span of 10 months, revealed a collective reduction in their fuel consumption of 700 bags of crop waste (19% savings), 550 kg of charcoal (28% savings), 2,000 bundles of wood (24%), 500 litres of kerosene (25%) and 60 litres of LPG (29%). This saved the community $2,400 in energy costs – a 25% saving over the previous year and a major benefit for a poor community.

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tonnes with one year's typical use, or 23mn tonnes over their lifespan. SCI estimates that over 4bn meals have now been solar cooked.

Different kinds of solar cookers

Different kinds of solar cookers serve different needs, explained Hughes. Parabolic solar cookers that use parabolic shaped reflectors to direct sunlight to a small area to generate heat for cooking can reach temperatures of up to 350°C, ideal for colder regions such as Nepal. Evacuated tube cookers, where the cooking chamber is made of two layers of blown glass in the shape of sealed tube, with air between the two layers of glass, are also effective, preserving heat in even cooler climates, even sun-poor locations such as Britain. Box solar cookers function like an oven and are good for baking, while panel solar cookers typically cook at lower temperatures and function like a slow cooker.

Despite these advantages, the adoption of solar cookers has not been as widespread as might be expected. This is because using them takes skill and experience. In the Kakuma refugee camp, in Kenya, for instance, solar fuel technology was introduced as a safer, cheaper, healthier and more sustainable option in 2003. 'A consistent firewood supply to about 200,000 refugees was and has been a tall order to aid agencies. In the camp, firewood is chronically scarce and there have been considerable adverse health, socio-economic and environmental impacts from its use,' said Godfrey Kaburu, an engineer at the United Nations World Food Programme (UNWFP), and a delegate at the world conference.

A collapsible solar cooker that can be folded up and taken any place under the sun for cooking a meal

Photo: Mini Pant Zachariah

But inadequate funding, poor beneficiary involvement and lack of cooker maintenance prevented solar cooking from being adopted on a large scale. Kaburu's research, released in November, showed that despite widespread awareness of solar cooking in the refugee camp, firewood was the most widely used fuel type, followed by charcoal, with solar being used by less than 1% of people. 'There is great potential to scale-up solar fuels to be widely used, sold, supported and

Heliac, of Denmark, has created a prototype of concentrator solar cooker made with special solar concentrating foil

Photo: Heliac

ideally even produced locally in the camp,' he added. But it takes effort.

A similar situation was faced by Gadhia when he tried to organise micro-finance for marginalised rural poor communities to help buy solar cookers. There were no takers for the loan. 'The point is to take the available [solar] technology to the poor and, with the involvement of dedicated local NGOs train the people, help them with packaging and marketing. We need to create business models where we build, operate and then transfer the projects to the people,' said Gadhia.

To that end, Kaburu proposes setting up 10 solar cooking bakeries for refugees in Kakuma, while proposing the UNWFP funds the installation of an institutional solar cooker.

> ***'People have cooked over fire for tens of thousands of years... we are attempting to change that behaviour in one generation'***
>
> **Julie Greene, Solar Cookers International**

But once they are in place, trainers need to keep persuading people to use them, Greene said: 'People have cooked over fire for tens of thousands of years. We are attempting to change that behaviour in one generation. Behaviour change can be difficult and government policy and support can make new technologies available until the price-per-unit is in the affordable range.'

'An additional barrier can be the assumption that every person wants the new technology equally. Working with people who have decided for themselves that the technology is a solution they choose for themselves can save a lot of time and resources. The best tool in the world will make no impact if a person has no desire to use it,' added Greene.

That said, awareness and education have brought solar power from 'an odd idea' to a potential solution on every continent in just 40 years - but more needs to be done and the quality of technology needs to be consistently high. SCI has devised a protocol for cooker standards as a result.

considered for only the sunshine rich countries of Africa, Asia and the Americas. But people such as Dave Oxford are promoting solar cooking in sun starved nations such as Britain and elsewhere. Working with Stewart Maclachlan, he founded SLiCK, a solar cooker retailer in the UK.

In August 2016, SLiCK demonstrated all four types of solar cooker at a UK event. If it is sunny, solar cooking between May and August even with a humble CooKit panel cooker is possible in the UK but cooking during the rest of the year is more of a challenge, said Oxford.

However, evacuated tube cookers can and do work. On a bright and sunny Christmas Day in London in 2014, Maclachlan cooked part of his Christmas dinner in an evacuated tube cooker. 'On that day, we knew we had done it. He had demonstrated that, even in the UK, if it is sunny, you can use a solar cooker in the depths of winter,' Oxford said.

All kinds of price tags

Solar cookers come with all kinds of price tags. Some can cost as little as $9, while some Scheffler concentrators, large enough to cook for 500 people, can cost $30,000. But the truth is that these can pay for themselves in roughly five years though energy savings.

Danish manufacturer Heliac has been trying to keep these cooker prices down. It produces solar concentrating foils which are scalable and cheap. The size of its planar cooker lens is at present 109 cm by 140 cm, boiling one litre of water in 15 minutes at under 1 kW/m². 'With a planar lens the cost of the concentrator can be significantly lowered as compared to parabolics, which require more expensive mounting structures,' said Sedi Byskov, Development Engineer at Heliac.

He added that, regarding safety issues, cookers can be constructed so glint and glare can be avoided. Unveiled at the January conference, Heliac's solar cooker is 'as yet a prototype' and the company is looking for partners to help use its foil to make customised solar cookers.

'Our solar cooker functions at a solar elevation angle from 0–90°C. It can be used in cold climates as well as hot. In northern climates, meals such as rice and curry have been prepared, while the ambient temperature was 0°C,' Byskov said.

As technology advances and diversifies, solar cooker supporters are considering developing a solar cookers. At the conference, solar cooker testing protocols were introduced by Dr Alan Bigelow and Dr Ajay Chandak, of India-based PRINCE (Promoters, Researchers & Innovators in New and Clean Energy), using a testing instrument that is affordable, robust and easy to use. It assesses the amount of sunlight focused on the cooking vessel to heat it and how long it retains the heat to cook food, with protocols helping a buyer reach an informed decision.

Such precision could also aid the use of cookers in industrial applications.

Dr Chandak said: 'Many industrial applications demand heat below 250°C in the form of steam or thermic oil or hot air or ovens etc and it is possible to provide this heat through solar concentrator technologies. This being a clean source of energy, the environmental benefits are obvious with zero emissions.' He suggested cooker use be supported through subsidies or tax rebates. Solar energy is best suited for food processing and pharmaceutical industries, said Dr Chandak.

He advocates the development of solar food processing parks for processing agro-products where boiling, frying, roasting, oven, drying, and more is handled by solar cookers. This could create a new organic marketing niche, he suggested.

'Our goal is that solar cooking will become simply the way people cook on every sunny day,' said Greene. 'Imagine if every village had a solar cooking specialist team how quickly this technology would spread. India has a unique opportunity on the global stage and in its economic development to have a large and positive impact on its people with solar cooking adoption. It is definitely taking a leadership role in developing and introducing institutional-scale solar concentrators for cooking and other uses, including industrial-scale food processing,' she said.

And new technical possibilities are throwing up other environmentally friendly solutions. Within a year, Gadhia will train the sun's rays in a hybrid contraption utilising biogas for cremating dead bodies. In India, a country of 1.25bn people – the energy saving potential of such a system is mind-boggling – each cremation currently consumes up upwards of 100 kg of precious wood.