Adapting traditional Sandali space heating for renewable energy sources

As the main route for the Silk Road highway for many centuries, the Central Asia region extends from Eastern Turkey through to Western China, including the Himalaya and high Tibetan plateau as well as the Sothern Steppe former Soviet Union republics. Within this diverse geography, Central Asians experience some extreme climatic conditions, with daytime temperatures ranging from +40°C in summer to less than -40°C in winter. In the rural and more remote parts of Central Asia, very few villages have a reliable access to clean and sustainable energy.

For many centuries in Central Asia, a traditional home heating method known as a 'Sandali' or 'Korsi' has provided families with a warm place to retreat into when the temperatures dropped below freezing. The homes and buildings in this region have limited insulation built within their construction and interior room temperatures can often approach the freezing conditions of the outside during prolonged spells of bad weather.

Traditional Sandali space heating methods involved placing a bio-fuel or charcoal stove, or bowl of embers, into a recess in the floor and positioning a low table over the pit. Optionally a chimney vent for smoke would be provided. Over the table were laid blankets, made from sheep wool, and traditional rugs that extended out to cover the pit sides. What was created was an enclosed and insulated area of warmth that the family would crawl into, leaving just their heads exposed. Sleeping and eating could then go on whilst the lower body remains in the relative warmth.

Figure 1: Central Asian Sandali (circa 1880)

A similar space heating method, known as a Kotatsu, has been used in Japan for centuries, where homes and walls have less insulation than their western counterparts. Technologies and designs in Japan have revolutionised the traditional Kotatsu. Here, the charcoal heater has been replaced by an electric heater that is actually built into the table underneath the table top. Blankets are similarly laid over the construct and provide the heated enclave. Kotatsu are commonplace in Japan and are readily available through purchase on the internet.

Figure 2: Picture of Japanese Kotatsu (circa 1800)

Figure 3: Modern day Kotatsu

Traditional Sandal had their disadvantages. Fire from the charcoal/bio-fuel heater was a constant problem and fumes also presented significant health risks. However, extreme low temperatures outside of the Sandali must have been considered an even greater threat to survival. Furthermore, traditional Sandali were space heaters and not storage heaters. Despite the blanket insulation, the heat source had to be continuously maintained to ensure that temperatures were kept above freezing.

The increased availability of fossil fuels in Central Asia over this last century have enabled many homes to replace their Sandali with larger stoves and Sandali are now only found in the most rural villages where the provision of coal is difficult due to the remoteness of the location. However, with the price of coal fuel rapidly increasing over the last decade, people are once again beginning to face winters without sufficient heating. For some it has been recognised that the time for the re-invention of the Sandali could be nigh.

In Central Asia, electrical energy is generally unreliable and in rural districts, grid supplies may be intermittent or may not be available at all. In these cases, off-grid renewable energy sources have, for some decades, been utilised and these solutions both respect the environment whilst combating climate change. For off-grid electricity solutions, renewable energy sources either charge to a battery bank or feed to a 'dump' when the battery bank is fully charged. Utilising battery power for electrical heating purposes is not an efficient use of the battery based supply – the battery drains rapidly and the heating element consumes a high proportion of the wattage being supplied. Battery energy is much more effectively used to supply lighting and enabling other domestic electrical appliances (e.g. computer, radio, television, etc.). The 'dump' also provides an opportunity for storage and space heating and in cold climates this can enable a modified Sandali design as a significant improvement upon the traditional space heating stove.

The modified Sandali construct follows that of a western storage heater but in a much simpler design. The solution has an insulated brick construct, packed around a series of heating elements that readily accept the 'dump' electricity. The bricks are required to have sufficient heat conductance to both retain and radiate heat. Materials for these bricks are limited to those available locally. However, the best sources are those materials currently used for lining of clay ovens that are used for the baking of bread. Bread baking ovens are found in every village in the region as bread is a staple foodstuff.

During the night, the power can be switched from battery to dump supply and heat the Sandali heating elements at the time when air temperatures are dropping to their lowest. Air, by a process of convection, passes through the construct and warms the surrounding area under the table. The result provides safe heating from renewable energy sources compared to the traditional Sandali format.

Wind-, hydro- or solar-power are all potential alternative renewable sources that can provide battery and dump electrical charge. However, with freezing winter temperatures and associated cloud cover, wind is the more likely alternative in the critical months when temperatures plunge below zero. Micro-wind turbine technologies are increasing in efficiency and with installation costs continuing to reduce, wind power is rapidly becoming the preferred option for renewable energy supply in these off-grid, remote and economically-challenged regions.

Projects introducing this solution will help to inform and empower local communities and their practices regarding household energy. A pilot project in Tajikistan is currently underway to adopt this model and then evaluate its impact in those homes and communities affected. 2Kw wind turbines are being introduced into four prospective village locations and the modified Sandali will be installed to provide for 'dump' storage heating, enabling the utilisation of all the available wind energy. Wind power / modern Sandali solutions could potentially appear in many more rural and remote homes and villages in the not too distant future.

Figure 4: Painting of family using a Korsi (Iranian source)