In my capacity as BioRegion's solar power project coordinator, I made my first trip to the Darhad Valley in Summer 2006 with Cliff, Joan, and the BioRegions team. My primary goal was to investigate the proposal for new systems submitted to BRI by an Ulaan Baatar solar power company on behalf of the Renchinlhumbe community. I also hoped to identify people who could be candidates for further solar power training and the job of maintaining any new solar power, or *photovoltaic* (PV) system.

In Ulaan Baatar, I spoke with Zorig, the solar technician who conducted the November 2005 solar power training in Renchinlhumbe, which he described as very basic, and who was the author of the proposal submitted to BRI for new PV systems at the school and hospital. He told me he followed Renchinlhumbe's lead in designing the systems (i.e. determining the wattage required for each system) and was adamant that the citizens there need extensive training before any new system is installed. Following the training, Zorig evaluated and repaired the library and kitchen systems at the boarding school. Funding for the training in Renchinlhumbe came from a grant from the Bozeman Sunrise Rotary Club.

During the month I was in the Darhad, I spoke with as many people as I could about Renchinlhumbe's energy needs and how best to meet them. The school teachers and hospital staff were very encouraged to hear that BioRegions is applying its resources to the energy dilemma they face. Tuul, the assistant school director, told me that government curriculum requires computer education classes for secondary students. The school has 10-15 computers (some were in Moron being repaired) but no electricity to operate them. Teachers give their lectures about computers and how to operate them, as required, but the students get no chance to apply any of the lessons.

Sharkhuu, who has collected weather data in Renchinlhumbe twice daily for 30 years, was pleased to hear that the town is moving toward solar power like the nomadic herders in the area who have relied on it as their electricity source for years. Bold, who operates the town's diesel generator during its winter operational months, expressed concern over the generator's expected demise. It is on its last legs and the town has no funds to replace it when it stops working.

The hospital's head doctor, Dr. Purevsuren, reported that last year the townspeople took up a collection to purchase a solar panel for the hospital. The panel charges a battery that can be connected to a clip lamp, loaded onto a cart, and wheeled around the hospital to where the light is most needed. Tsedendorj is a hospital employee who attended Zorig's training last November. He has since taken over the care of the hospital solar panel; after the training, he grounded the system and devised a new mounting structure so that the panel can be rotated to track the sun's path.

After several failed attempts at a face-to-face interview, I sent Baira, the Post-Telecom employee responsible for the post office solar array, a list of questions pertaining to the functioning of the largest solar array in Renchinlhumbe. The 1kW system has required no more maintenance than clearing snow and dust from the panels, but it cannot sustain peak use during the winter months. The system can run at full capacity for only 4 hours.

Aside from my interviews, I also examined electrical equipment already available and asked the hospital and school staffs what they would like to use the electricity for. Lights, computers and musical equipment took priority at the school, while lights and medical diagnostic equipment took precedence at the hospital. Dr. Purevsuren told me that the hospital has many pieces of equipment, like EKG and ultrasound machines, dating back to the socialist era in the 1980's when the Mongolian government operated a diesel power station in Renchinlhumbe. He maintains that he could acquire better and more modern equipment if the hospital had the power to operate it.

From the data I had collected up to that point, I began to make calculations of energy output requirements that any new PV system would have to attain in order to meet the expressed needs of the school and hospital. All indications were that the systems included in Zorig's proposal were insufficient to satisfy winter use. Up until the last week of my time in the Darhad, I was unable to determine how Zorig had arrived that the wattages for each system. Zorig said he followed Renchinlhumbe's lead, while everyone I spoke to in Renchinlhumbe said he hadn't asked them what they wanted the power for, nor had he looked at any equipment to their knowledge. Mishig said he had provided Zorig with a map of the school grounds, but nothing beyond that. I was baffled.

I held out hope that Odkhuu would know the answer but I had a very difficult time tracking him down for an interview. Odkhuu was the school director at the time of the November training. I only had a few minutes to speak with him as he had to run to catch a ride back to his ger in the countryside where he has been living since his retirement from the school last winter. He said that almost 20 teachers and staff participated in the training and that Zorig conducted 2 separate trainings—one for the school and one for the townspeople. He told me that Zorig did not ask specifically what the power needs of the school were. Odkhuu said that he (Odkhuu) estimated the wattages of each system based on his knowledge of the size of a normal domestic unit. He simply made the wattage a lot bigger.

I returned home at the end of June with a lot of work to do. With the help of Conor Darby at Independent Power Systems in Bozeman, I synthesized my interview and technical data and developed a new design for solar power systems at the school and

hospital with winter peak use in mind. The ideal systems included high capacity batteries and high efficiency inverters and charge controllers to maximize the power gleaned from the weak winter sun. The boarding school would have 3 discrete new systems—1kW for the kitchen and dormitory, 3kW for the classrooms, and 4kW for the computer lab. The hospital system would also be 4kW. The price tag was astronomical.

With the prospect of funding this ideal solar project very dim at best, we re-evaluated the project. Cliff and I discussed designing the system for 10 months instead of 12 to reduce the overall cost by eliminating some of the battery capacity. Other ideas included designing a smaller system with a compatible generator to charge the batteries during periods of little sunlight or simply using less expensive, less efficient components that are available in Ulaan Baatar or Moron. We also examined the possibility of expanding, rather than reducing, the system by thinking town-wide. More people would benefit and the town's reliance on diesel generators would reduce more significantly. Both of these factors might make the project more attractive to potential funders, especially if some of the other cost-cutting ideas were implemented as well.

A change of course this significant requires the input and assistance of the people of Renchinlhumbe. During the Summer 2007 work trip to Renchinlhumbe, BioRegions will present the community with the various alternative solutions we have devised and solicit their input and suggestions regarding which to pursue. BioRegions will continue to work with the community and other Mongolian partners to develop a comprehensive needs-assessment, design an appropriate and fiscally reasonable PV array, and establish a local community organization to oversee and administer the project.

Photo captions

- A stall at UB's "Black Market" selling PV system components, alongside a booth selling traditional horsehair rope and Mongolian saddles.
- Several of the boarding school's computers
- Tsedendorj with the hospital's rolling cart, solar charged battery, and clip lamp
- Post-telecom office in Renchinlhumbe and the largest PV array in town.

Renchinlhumbe Weather at a Glance

- 285 days of sun per year
- Wind blows hard from the end of April until early June.
- From mid-June to September the only wind is before a storm.
- During the summer rainy season, it can stay cloudy and stormy for several days at a time. It used to be common to have 2-3 days of gentle rain; now the storms are more extreme—shorter and more violent.
- Between October 20 and March 10 there is very weak light from about 10 am to 5 pm at about 30 degrees above the horizon. There is virtually no wind during this time.
- From mid-December to mid-January there is 'ice fog' in the morning which generally dissipates by afternoon.
- Before 2000, the average hottest temperatures were 28-29 C (82-84 F), but recently the temperature has