



# POWERED



**LIGHTS ON:**  
Buddhist monks  
clap as the first  
electric lights in  
their monastery  
are switched on.



PAULA BRONSTEIN/FOR IEEE (ALL IMAGES)  
JIM MICHAMON/MAPMAN\* (GLOBE)

# UP

## A remote Himalayan village gets electricity for the first time



**SOLAR INSTALLATION:** Engineers set up solar panels that generate electricity for Lingshed.



**ONLINE ACCESS:** A new computer lab lets students explore the internet.



**WIRED IN:** Volunteers mount electric lights in Lingshed's monastery and school.

**ESSENTIAL QUESTION:** How is electricity created and brought to homes, schools, and local businesses where you live?

High up in the mountains of the Himalayas in northern India, a line of 17 volunteers and 55 horses and donkeys walked along a narrow trail. For two days, they scaled peaks and crossed rivers. Finally, they arrived in Lingshed, a 1,000-year-old village nestled deep in the mountains.

Lingshed is so remote that its inhabitants don't have electricity. A man named Paras Loomba wanted to change that. "There are basic amenities that everyone in the modern world should have: food, water, shelter, and electricity," says Loomba. He's the founder of an organization called the Global Himalayan Expedition, located in India. It electrifies villages in the area using *solar power*—a way of generating electricity by harnessing the sun's rays. On August 15, 2016, Loomba and a group of volunteers switched on the lights in Lingshed for the first time.

### ENERGY ACCESS

Life in remote villages like Lingshed hasn't changed

much in centuries. Most people there are farmers. The village is home to Lingshed Monastery, where Buddhist monks have lived and people from the surrounding area have worshipped since 1440. The monks have relied on candles and kerosene lamps for light: Like about half the people in the Himalayas, they live without electricity.

In recent years, people in Himalayan villages have begun to abandon their ancient

homes and way of life, says Loomba. As younger generations grow up, they move away to cities, where there are more opportunities.

Loomba thinks electricity can help villages like Lingshed better survive in the modern world. Not only does electricity provide access to light and computers, but it also gives the people who live there an income.

"Once we electrify villages, tourists come to stay in the homes there," Loomba says. "They eat meals, they charge their phones and e-readers, and they pay the villagers for these services." Since 2013, the Global Himalayan Expedition has managed to light up 25 villages.

*Continued on the next page* →



## OFF THE GRID

Most electricity in the world is produced in power stations that burn fossil fuels to heat water. Steam from the boiling water turns the gigantic blades of turbines to produce electricity. A network of power lines carries this electricity to homes and businesses. But these electricity supply systems often don't extend to faraway places like Lingshed.

To tackle the problem, the Global Himalayan Expedition teamed up with the IEEE Smart Village initiative, based in New Jersey. They decided to bring electricity to distant areas using a system of solar microgrids (see *Energy From the Sun*, below). These local sources of electricity are shared among a group of people. In Lingshed, it would light up the monastery and a school, as well as power a small computer lab.

## CURRENT CLASH

Last August, a group of engineers and other volunteers began their journey to power up Lingshed. The team carried wires, batteries, LED bulbs, and solar panels—the devices that would convert sunlight into electricity. They brought enough supplies to build 14 microgrids.

The team's microgrids would

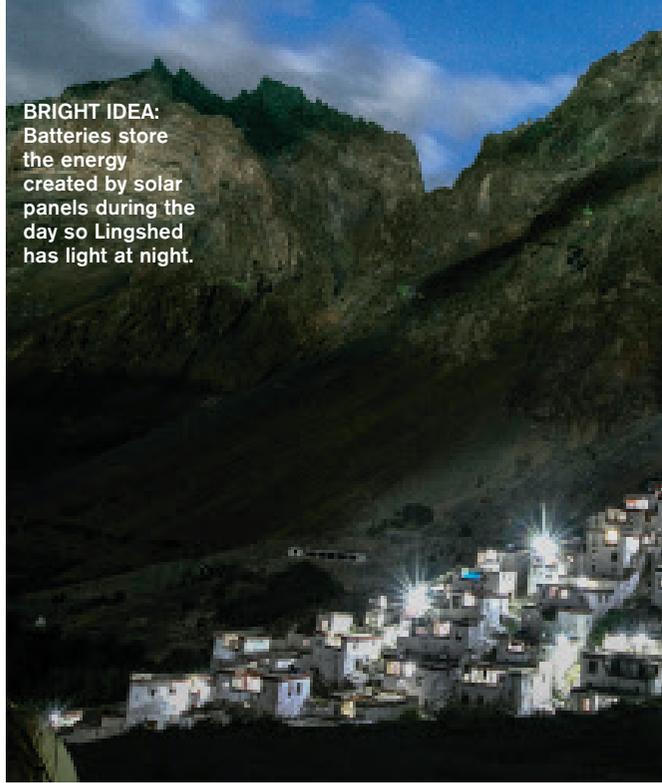
electric current that flows in only one direction. It's different from an alternating current (AC), which changes the electric current's direction 60 times per second.

The AC system is more often used to transmit power over long distances. That's because it's easier to step down, or reduce, the large amount of electricity needed to send the power a long way. It's necessary to step down the current so that it's safe enough to flow through wall outlets and into homes.

The solar panels in Lingshed wouldn't generate too much electricity or have far to go, making DC power the better choice. DC systems also lose less energy than AC systems. That's because electricity is lost as the electric current in AC power alternates. So the DC setup would be more efficient, too.

"We can light up a whole house with exactly the same amount of power that you would use for one

**BRIGHT IDEA:** Batteries store the energy created by solar panels during the day so Lingshed has light at night.



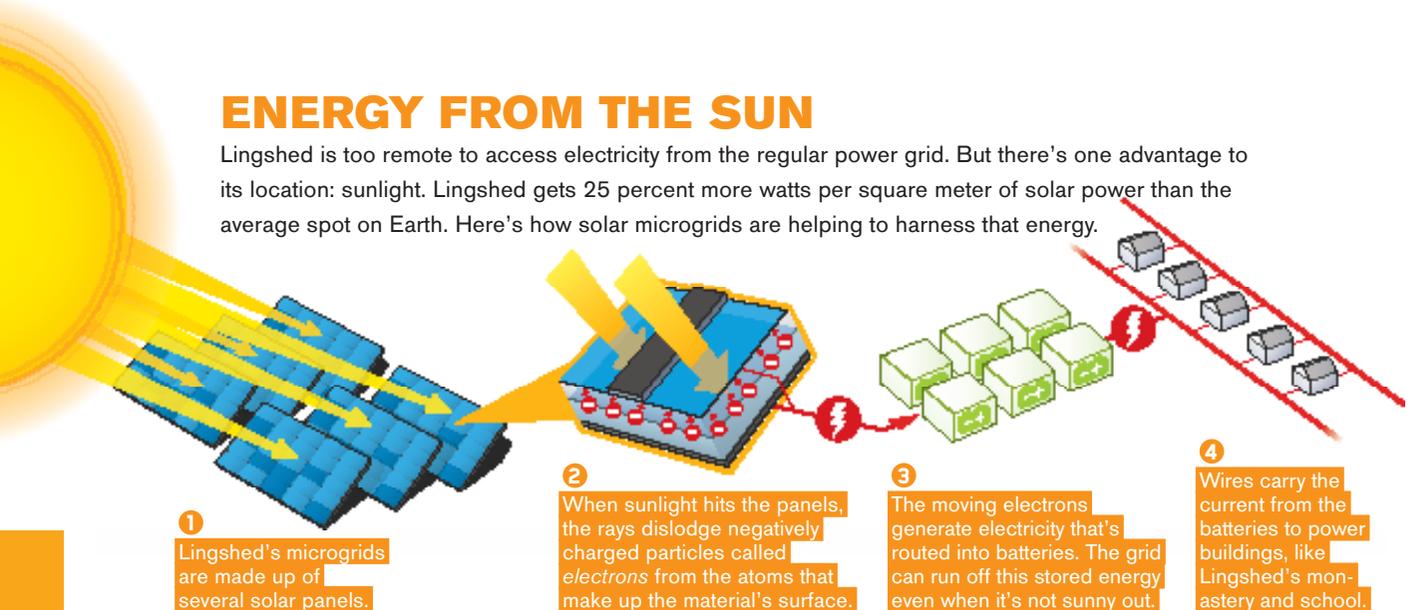
## ELECTRIC EXPERIMENT

When the group finally arrived in Lingshed, a long line of villagers, monks, and schoolchildren greeted them. The local people pitched in to help the volunteers string wire and tap nails into the monastery's walls. With no electricity for power tools, they had to install the entire system by hand.

In a small building near the school's dormitories, electrical engineer Dave Goldsmith from Seattle

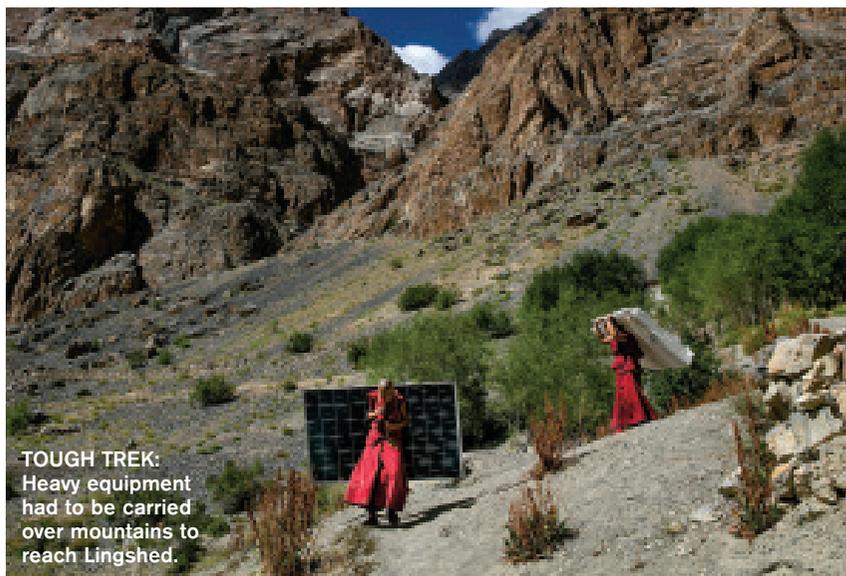
## ENERGY FROM THE SUN

Lingshed is too remote to access electricity from the regular power grid. But there's one advantage to its location: sunlight. Lingshed gets 25 percent more watts per square meter of solar power than the average spot on Earth. Here's how solar microgrids are helping to harness that energy.





**LIGHTING LESSON:** Volunteers explain how the monastery's and school's new LED lights will work.



**TOUGH TREK:** Heavy equipment had to be carried over mountains to reach Lingshed.

them had never seen one before in their lives," says Goldsmith. "They couldn't stop smiling!"

## A BRIGHTER FUTURE

After two days of hard work, the microgrids were ready for their debut. In the darkness, the monks stood around in silence, waiting for the magic moment. The volunteers took a deep breath and flipped the switch. Bright-white light suddenly filled the monastery.

"Monks are usually calm and silent. But they were clapping and jumping around," says Loomba. "I've never seen a monk jumping before!"

Loomba is hopeful that Lingshed's new lights will help keep the centuries-old village alive well into the future. Loomba says: "Light means a lot to people—especially when they have stayed in darkness for years and years." ❁

—Stephanie Warren Drimmer

new computer lab. Most computers use far more energy than the solar-powered system could supply. So Goldsmith came up with a smart solution: a network of five small, inexpensive, low-power computers called *Raspberry Pis*. "A standard desktop computer runs on about 400 watts," he says. "Raspberry Pis use only about 12 watts." Watts are units that measure power, or how much electricity is being used by a device.

Goldsmith connected the computers to the internet using

a satellite link. But paying to get online would be expensive for villagers. So he also connected the computers to an offline *server*—a computer where information is stored that's connected to a network of other computers. This server downloads educational material, like online encyclopedias, when connected to the internet. Then kids can access the stored information even when they are offline.

"It was so cool to see the kids play with the computers. Some of

## CORE QUESTION

Why does Loomba believe that bringing electricity to Lingshed will improve the lives of villagers there?