A spark of new energy in Africa

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Solar generator in Benin. Credit: Electric Light Fund (SELF), on Flickr

Grace Wu and Ranjit Deshmukh grow vegetables in their garden, bicycle to school each day, and are rarely seen in clothes more formal than blue jeans and t-shirts. Though they seem to live a quiet life, these two graduate students from UC Berkeley are helping to design renewable energy systems employed on a continent-wide scale half a world away.

Last year, Wu designed a computer program to site solar and wind energy development in the western United States. Then she and Deshmukh refined the model to map renewable electricity potential in India. Now the International Renewable Energy Agency, an intergovernmental group that represents more than 100 countries across the globe, is contracting the pair as technical research partners for a new project to green Africa's power grid.

In collaboration with researchers at the agency and at the Lawrence Berkeley National Laboratory, Wu and Deshmukh are working with officials from 22 countries in eastern and southern Africa to identify zones that are well-suited for development of electricity production from wind, solar, and geothermal energy. "This is part of a multi-step process that aims to increase the amount of renewable energy in the African grid," Wu says.

This isn't a typical academic project that languishes in the ivory tower. Stakeholders in the 22 different governments affiliated with the project "have the potential and the actual desire to implement the work we're doing," Wu says.

It's no surprise that African nations are looking to produce more power. Frequent electricity shortages stifle economic growth and limit quality of life. If the energy currently generated on the continent were equally distributed, it would only be enough to turn on one standard light bulb per person for a scant three hours a day. In many parts of eastern and southern Africa, hospitals and industries resort to using diesel generators during blackouts.

"Africa is in infrastructure dire straits," Wu says. "They don't have enough infrastructure for the kind of growth that they want to achieve."

Though most of Africa currently runs on coal, international

organizations like the Inernational Renewable Energy Agency and the African Development Bank are encouraging the continent to use more renewable energy. In eastern and southern Africa, renewable energy currently makes up less than 2 percent of the power supply. With plentiful wind and sun, renewable energy could enable this region to produce more watts of electricity and be more self-sufficient in its power production. It would also lower greenhouse gas emissions and clean up local air quality.

Renewable energy sources also make economic sense. Wind power is already cost-competitive with fossil fuels in some parts of Africa, and solar continues to get cheaper as technologies improve. Low-carbon power generation is also eligible for funding from 'Power Africa', a $7 billion initiative led by the United States to increase electricity production in Sub-Saharan Africa, and from the 'Clean Development Mechanism,' which offers funds that richer regions, like the European Union, put towards renewable energy projects in poorer areas of the world to offset their own carbon emissions.

To make renewable electricity even more economically feasible, 22 countries in eastern and southern Africa are coming together to share resources by connecting their transmission lines. This initiative, known as the Africa Clean Energy Corridor, will allow strong winds or bright sunshine in different parts of the continent to benefit electricity production for the whole region.

Wu and Deshmukh are compiling data about renewable energy resources , transmission lines, land use, and demand for electricity from all the countries that will be part of the Africa Clean Energy Corridor. The data comes from disparate groups ranging from environmental agencies in Tanzania to utilities in Lesotho. Then the researchers input the data into their computer program to map out the best places to site renewable energy power plants. They're looking for places where the winds are

strongest and the sun shines the most, as well as where it will be cheapest to build a power plant and extend transmission lines. Their method also accounts for protected natural areas and other land uses, to ensure that no development takes place in ecologically sensitive places or agriculturally valuable areas.

Deshmukh says that in addition to enabling economic growth by increasing electricity supplies, the project will also result in cleaner local air quality and less carbon dioxide emissions. "There will be less diesel consumption in all these areas," he says. "There will be cleaner energy, so climate change will be mitigated."

While many stakeholders laud Africa's desire to invest in renewable energy, others are concerned that these large-scale developments will not improve access to electricity for the majority of Africans who currently live without it. According to the African Development Bank, only one in four Africans have access to electricity. In rural areas of sub-Saharan Africa, the number is even starker: 90 percent of people living in the countryside must do without electricity.

To minimize costs, power plants are sited close to existing power lines in Wu and Deshmukh's model. Because of this, Wu and Deshmukh's project will only serve those who are already connected to the electrical grid. "This type of siting analysis does not ensure equitable energy access, or improve energy access for those who don't already have it," Wu says. "This is a project that benefits large load centers, which are mostly cities and industrial areas."

Even though this project won't immediately serve people who don't already have power lines going to their homes or businesses, Wu and Deshmukh are confident that this is a step in the right direction. There are two aspects to energy access, Deshmukh explains: producing the power, and then building wires to take the electricity to houses.

"Identifying zones and developing utility-scale renewable energy projects is just a step further, but not enough, to providing energy access in sub-Saharan Africa," he says.

Building power lines is expensive, and rural households don't tend to use enough electricity to make an investment in distribution cost-effective. In developed countries, government subsidies paid for expanding the grid to the countryside to ensure that all citizens could have power to turn on lights, charge cell phones, and operate businesses. "Unless governments and the international community take it upon themselves to develop this transmission infrastructure (in Africa), they're not going to solve the energy access problem,"Deshmukh says.

Like the Johnny Appleseed of renewable energy, the team is planning to make their data and computer program code freely available to the countries they are working with, and hosting workshops to teach representatives from these countries how to use them. "They may either adopt our methodology or modify it," Deshmukh says. "But it will start a process, or further the process in some countries, to identify these high-potential renewable energy zones."

Although the International Renewable Energy Agency tasked Wu and Deshmukh with finding the cheapest, most efficient, and least environmentally damaging zones to build renewable energy power plants – not with expanding energy access – the duo is determined to make their work useful for improving electricity availability to people living in poor, rural areas. They're deliberately making the code versatile, so that it can be adapted as conditions change. Their intention is that countries in eastern and southern Africa will have the capacity to modify the computer program to include criteria that would increase access to electricity among the rural poor.

Perhaps more useful than the code itself, in Wu's opinion, is the data-

gathering that they're doing for the project – getting and organizing figures from different countries about their renewable energy potential, electricity systems, and demographics. These types of data have never been brought together before for so many different countries in one easy-to-use format.

By sharing these resources, the pair is hopeful that other groups could use the data they've compiled and their computer program to not only increase clean power production across Africa, but also maximize energy access by bringing electricity to those who currently have none. "It could be used to target the most remote populations that would really benefit from off-grid renewable energy," Wu says.

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