

Allison Moen  
Ankeny Centennial High School  
Ankeny, IA, USA  
South Sudan, Renewable Energy

## **The Potential for Renewable Energy in South Sudan**

What if you lived in a situation without access to electricity and limited access to food in your rural location, meanwhile dealing with imminent dangerous warming temperatures and lingering conflicts from civil war? In South Sudan, a country with two-thirds of the population in need of humanitarian assistance, this is the harsh reality many people face every day. Despite the expansive fertile land and plentiful potential for solar and wind energy, South Sudan's fragile government has been unable to make improvements for its people ever since the civil war began in 2013. Renewable energy has the potential to provide localized energy access, particularly using solar energy, to simultaneously improve the food system and provide electricity to rural populations. In this country that heavily relies on imports to provide for the people, the ideal goal is to help citizens become self-sufficient, and reduce the need for international aid in the food and energy sectors. For South Sudan, renewable energy offers essential opportunities for the young country's future.

The population of South Sudan is around 10,984,074 people, the 83rd most in the world. Approximately 20% of the population lives in urban areas, leaving 80% living in rural areas ("South Sudan", CultureGrams). South Sudan gained independence on July 9, 2011, but has spent much of the last decade facing violence and humanitarian challenges (Herlinger). South Sudan became a transitional government after the civil war began in 2013. There are two legislative assemblies: the Council of States from the previous government, and the Transitional National Legislative Assembly, created from a combination of original legislative members and members of the South Sudan Armed Opposition. The government was created to include the previous administration as well as rebels ("South Sudan", Britannica School). The government has offered little hope that their standard of living will improve.

For farming families, the quality of life is especially low. Typical farms in rural South Sudan are on small plots and rely on rainwater to grow their crops. This makes crops less reliable depending on the weather each year. In the northern parts of South Sudan, mechanized farming is gradually becoming more common. Nearly four-fifths of the population relies on farming to make a living. The most important crops for subsistence are sorghum, corn, cassava, as well as millet and rice in smaller amounts. Peanuts are also an important cash crop for farmers able to grow them ("South Sudan", Britannica School). South Sudan has a hot and tropical climate with low temperatures typically reaching around the high 60s and 70s degrees Fahrenheit, while the highs reach the 80s and 90s. South Sudan possesses many important water sources including the White Nile and Blue Nile as well as the Sudd, one of the largest wetlands in the world ("South Sudan", CultureGrams). South Sudan's land is over 90% arable, and 50% of that land is perfect for agricultural use. Despite this, only 4% is cultivated. The country's geography provides plenty of fertile lands, yet the small subsistence farms are only able to do so much with the rain they receive. People rely on agriculture for food, yet the unstable economy prevents these small farms from truly becoming reliable sources of combating food insecurity (Onyango). Farming families can only do so much with the resources available to them, yet South Sudan still has plenty of underutilized farm potential.

An average immediate family in South Sudan may have five people. In rural areas, it is also common for households to have extended families living together, which can result in twenty or more people living in the same house ("South Sudan", CultureGrams). A typical South Sudanese diet may consist of fish, meat, milk, millet, and sorghum. Some elements of their diet may depend on whether they live in an urban or

rural area (“South Sudan”, AFS). South Sudan is dependent on food imports. Despite the potential of their fertile land, the country continues to increase in food insecurity, with nearly 65% of the population being severely food insecure (“U.N. Urges Efforts”). The vast majority of South Sudanese people depend on agricultural activities as their main source of income (Collins et al.). There are two tracks for young people seeking education in South Sudan. One involves eight years of primary school followed by four years of secondary education. Afterward, they can continue further in education if they choose. The alternate path involves eight years of schooling condensed into four years, designed for students with limited access to schooling. Even with these options, the ongoing conflict has caused a widespread strain on education, and many young people still do not go to school today. This is apparent in the low literacy rates throughout the country (“South Sudan”, Britannica School). The majority of South Sudan's population does not have access to basic healthcare. Most existing healthcare organizations come from international donors, however many professionals left the area during the years of war. Communicable diseases run rampant throughout the country, and the lack of healthcare is a factor in South Sudan having one of the lowest life expectancies in the world (“South Sudan”, CultureGrams). The civil war leaves behind lingering conflicts that continue to affect food transportation and access, leading to further food insecurity. This combined with the floods and droughts hitting the country increases the barriers to nutritious foods to combat malnutrition (“Hunger and Malnutrition”). Throughout the country, five million people are living without daily access to safe water and sanitation. Oftentimes, young girls are forced to walk long distances with heavy water to maintain any access (“Water for South Sudan”). The standard of living continues to worsen for citizens of South Sudan, and food insecurity is near the top of the list of crucial problems that need to be fixed.

Food insecurity is not the only problem facing the country. South Sudan is the least electrified country in the world. The reliance on diesel generators for energy is not sustainable in the long run. Renewable energy costs have decreased dramatically, and international assistance could bring these resources into conflict settings like South Sudan (“South Sudan’s Renewable”). Rural parts of South Sudan are often left without power sources, and even well-populated areas have little access to power. Statistically, less than 1% of people in rural areas have power, and only one-sixth of people in urban areas do (“South Sudan”, CultureGrams). South Sudan's economy largely relies on oil fields, which have only recently begun to recover from COVID-19. Still, the economy is extremely vulnerable to any climate-related events that may affect people's welfare. An estimated two-thirds of the population needed humanitarian assistance in 2022. Persisting conflicts prevent developments in energy sources and infrastructure that are needed by the population. Women and children are disproportionately affected by the humanitarian crisis striking South Sudan (“The World Bank”). Renewable energy sources are a more sustainable, environmentally friendly option using the sun, wind, water, waste, and heat from the Earth. It offers an increased economic resiliency that fossil fuels may not offer in times of conflict, and it can be cheaper. Renewable energy sources prevent harmful gasses from polluting the atmosphere, and with the materials, it could bring South Sudan new jobs, new opportunities, and the capability of planting and harvesting more crops to spread to the population (“Renewable energy- powering”). Renewable energy may have the potential to turn these opportunities into realities.

As the least electrified country, South Sudan's electrical infrastructure includes an electrical grid in Juba and various localized grid systems in other smaller cities. These are supplemented by thousands of diesel generators, used by households and businesses. All of this diesel has to be imported. Any existing electricity is largely inaccessible for most families, not only because of the lack of diesel but also because of its price. For commercial users, the prices are the most expensive in all of East Africa, at \$0.44 per kilowatt-hour. Despite South Sudan’s massive oil reserves, oil is not a realistic source of electricity for the country. The third-largest oil reserve in Africa is in South Sudan, and 98% of the country's annual budget comes from oil revenues. Still, oil production has decreased by half since the conflict, and oil production has brought in relatively little income since the civil war began (Chen et al.). This means the financial situation for the government will continue to worsen, and the citizens of South Sudan certainly will not

receive any benefit from the oil in their country. Renewable energy offers an opportunity that can help individual farmers long-term, sustainably helping food security.

South Sudan needs both energy and food security, and renewable energy offers both of these things simultaneously. The goal for South Sudan is to form a resilient and sustainable food system, with inclusive growth and the potential for job creation (Onyango). In many cases, developing countries often do not have the public funds needed to build renewable energy infrastructure. A project like this would require a private investor, possibly a non-profit organization with a focus on renewable energy implementation. Morocco is a developing country that has successfully built a widespread renewable energy infrastructure. With 40% of the country's energy now coming from renewable sources, and with Morocco being home to the world's largest concentrated solar power plant, this country is an excellent example for South Sudan to follow (Papathanasiou). South Sudan has significant solar energy potential, and the estimated solar capacity is 436 W per m<sup>2</sup> per year according to the Sudd institute. This meets the standard for the production of high-quality electricity. While the country consistently gets eight or more hours of sunshine every day, it is no wonder the country has such positive potential for solar power. South Sudan also has wind energy potential, with a density range between 285 W and 380 W per m<sup>2</sup>, which can meet the required level for energy generation (Chen et al.). The need for energy combined with the incredible potential for renewable energy in South Sudan opens many opportunities.

When renewable energy is implemented, there must be goals that tackle multiple issues, including food security. In Sub-Saharan Africa, agriculture typically accounts for over 50% of employment and 15% of the national GDP. However, many farmers still rely on irrigation that is rain-fed. Food waste is a significant issue that not only reduces a farmer's income but also prevents food from reaching the market. One key barrier is the fact that agriculture only accounts for 2% of energy consumption. This means that many rural areas do not have access to reliable, affordable electricity (“Renewable energy- powering”). Food security threatens an overwhelming majority of people in rural areas of South Sudan. Solar-powered cold storage is a sustainable solution to prevent food loss. Food waste leads to a less productive economy, and it leaves many people hungry. In Sub-Saharan Africa, many areas lack access to cold food storage. Building sustainable designs prevent further issues with the changing climate by reducing greenhouse gas emissions. This kind of infrastructure also provides women in developing countries with reliable jobs, as they are often responsible for producing crops and performing post-harvest processes. The goal of cold storage is to allow food to last longer thus it can make it to the market, bringing more food to the shelves and reducing food insecurity (Yimere). Electricity from solar power can provide energy for cold storage. This increases income for farmers, and it increases food production. These farmers with access to cold storage are able to invest more in their products and are ultimately able to grow more. Energy access also opens up increased opportunities for transferring agricultural products to markets at a more continuous rate. With more food available, food security is improved and farmers do not face the risk of wasted products affecting them financially (“Energized: Policy innovation”). When cold storage is available, farmers can trust that their production has a much smaller chance of being wasted. They can invest in their product and bring more products to be sold in markets. As less food is wasted in production, more food can reach families facing food insecurity.

Other forms of renewable energy infrastructure may offer great benefits to agriculture in South Sudan. Solar-powered irrigation provides an affordable opportunity for Sub-Saharan African countries to boost productivity in agriculture. They can increase the number of crops grown and grow a larger variety. Irrigation systems using solar power reduce greenhouse gas emissions by 95% in comparison to systems using fossil fuels (Wentworth). When mechanical energy is used for processes like irrigation, time and effort are saved and more can be produced and gathered. Solar irrigation also provides a more environmentally friendly, self-regulating form of infrastructure which would benefit farms in South Sudan. Solar-powered irrigation results in higher yields and incomes for families compared to those relying on hand-watering or rain. There is a higher upfront cost to solar irrigation in comparison to other

forms of solar infrastructure, although if the funds become available the long-term benefits will be worthwhile (“Energized: Policy innovation”). These types of infrastructure must be invested in to create a self-sufficient, resilient food system in South Sudan.

Some organizations are already working in South Sudan. The United Nations Mission in South Sudan, or UNMISS, has worked in South Sudan since the country gained independence in 2011. This mission has a large budget of 1.12 billion dollars, and part of the mission includes providing power to the country (Chen et al.). It is important to implement sustainable renewable-energy solutions in rural areas that will benefit local communities in the least electrified country. Power for All is a non-profit organization working to build progress in the combination of ending hunger and spreading clean energy. They do so by collecting data and knowledge that connects these sectors, creating country-wide work that figures out the barriers to progress and works to remove them. The organization focuses on small-scale solutions, like standalone solar, renewable energy mini-grids, and other machinery perfect for farmers and families in rural Sub-Saharan Africa (“Powering Agriculture”). These types of organizations offer inspiration for what type of work has been done, and what type of work needs to be done in South Sudan. They also have the ability to lead efforts in expanding renewable energy infrastructure in South Sudan.

A specific type of renewable energy infrastructure with the potential to benefit South Sudan is mini-grids. Widely distributed solar mini-grids may be the most achievable and useful investment for South Sudan. This type of renewable energy offers an opportunity for UNMISS and other international and national partners to fund and build infrastructure that will sustainably provide electricity for the country. Renewable energy mini-grids allow energy to be distributed without the need for a traditional centralized grid or the need for funds to transport diesel for power (Chen et al.). Creating a mutually beneficial solution for energy and food can start with renewable energy-powered technology designed for agricultural growth. This can include cold storage or solar pumps. Most importantly, mini-grids with the target of agricultural development can help expand rural electricity access and ultimately lower food insecurity in these areas (“Why Increasing the Role?”). Mini-grids offer energy in an affordable, localized way that could make all the difference for people living in rural South Sudan.

In many cases, renewable energy infrastructure such as mini-grids may be abandoned within six months after installation. To make it a long-term, sustainable option, anyone involved in bringing mini-grids to a rural area should work with the community to identify needs and interests. Education is an important factor in ensuring that the infrastructure is properly maintained to keep it working for years to come. A strong partnership between the people of South Sudan and those installing infrastructure can ensure a thorough education for the people of South Sudan on the maintenance of the new energy sources. Keeping maintenance equipment nearby assists in preventing the need for additional visits in the community after a couple of years. This increases the independence of the farmers and families in these rural areas in their ability to keep their mini-grids working for many years (Sayhinyazan and Duran). A few solar companies are in operation in the country, mostly centered in the capital city of Juba. SunGate Solar, which runs out of Wau, is one of these few solar companies. In Wanyjok, Northern Bahr el Ghazal, a small solar mini-grid was recently commissioned (Chen et al.). Organizations like SunGate are crucial to the future of renewable energy for small communities. For rural communities in South Sudan, renewable energy could be key in providing a resilient food system that keeps people fed and far from starvation. With proper funding from non-profit organizations and education on maintenance, solar mini-grids offer a realistic and sustainable solution to small communities in rural areas of the country.

South Sudan's economy has often relied on fossil fuels, and when combined with their cycle of conflict, there is little opportunity to follow a new path. The country's main export is oil and the total dependence on this production hurts South Sudan significantly. Not only this, but they must import most diesel used for the little electricity that does exist. Renewable energy could help break this cycle, and if the government partners with national and international organizations with this new goal, this form of

sustainable infrastructure could change the course of the country (Chen et al.) Imported diesel will never provide sustainable energy to the large part of the population living in rural areas. Renewable energy infrastructure creates the possibility for a system that does not hold too much reliance on vulnerable grids built by the government. It creates the possibility to build more energy and food simultaneously, addressing the danger of food insecurity.

Renewable energy infrastructure can provide a sustainable food system and electricity access to help many South Sudanese people discover a better future. With proper renewable energy infrastructure, citizens can become self-sufficient in food and energy, and the need for aid from international organizations can be significantly reduced. The potential for solar energy in South Sudan is clear, and when combined with the broad fertile farmland, farmers can produce enough to provide for the citizens of their country. Reducing the need for humanitarian assistance in South Sudan will change the country for the better. For the people on rural farms, who have no electricity access and where the warming temperatures endanger the ability to provide food, renewable energy offers hope for a brighter tomorrow.

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