

# Bringing Light to Uganda | Off-Grid Electricity Suitability Map

## BACKGROUND:

There is no question that electricity has significant benefits for households around the world. Benefits include reducing the death rate of babies born at night, helping children complete their schoolwork, and enabling individuals to work longer days (Martinot, 2000). Developing countries contain approximately 80% of the world's population but only use 30% of the world's commercial energy (Martinot, 2002). The conventional method of providing electricity to a population involves large, national companies that create and provide electricity to populations that are able to afford it through a national or sub-national grid network. This method has failed an estimated 1.4 billion people who lack electricity due to poor access or the inability to pay for this service (International Institute for Applied Systems Analysis, 2012).

How should governments, non-profits, or companies provide electricity to this unserved population? One way to accomplish this is through off-grid electricity systems including biomass, solar, or hydro systems. In order for organizations to install these systems it is important for them to consider four important aspects of any area they work in:

- 1. Financial Services:** Organizations need households to have access to financial services that can provide loans to them. Loans allow households to afford an electricity system and without them, the organization will not be able to sell their product. This is, arguably, the most important aspect for off-grid suitability.
- 2. Road Access:** Organizations supplying off-grid electricity systems also need access to roads in order to best distribute, install, and maintain their systems.
- 3. Population density:** A higher population density will allow organizations to have a larger target market for their product.
- 4. Distance from electricity transmission and distribution lines:** Being close to electricity lines doesn't mean that households have connected to the grid due to high costs and poor services but areas that are close to these lines might have a lower number of households that need electricity. Systems installed in these areas should also be able to connect to the grid should grid service become better and cheaper and households wish to connect to it.

## METHODS:

In order to analyze this question I chose to look at Uganda. I compiled data from various sources on population, roads, electricity distribution and transmission lines, and financial services locations. I classified each of these four different areas mentioned above from 1 to 5; 1 being more suitable to off-grid electrification and 5 being less suited. Areas that are farther away from the grid are better suited to off grid technology while areas closer to financial services are more suitable. Along those same lines, areas with greater population are better suited to receive projects and areas that are along roads would be easier to reach for these projects. To assess the overall suitability of off-grid electricity locations, I combined each of these suitability maps together. I produced two different maps; one that assumed that all of these areas are of equal importance and the second that assumed that financial services are more important and gave it more weight (40%) than the other areas (20% each).

## RESULTS:

By looking at the two different maps, it is clear that giving equal weight to each part of this puzzle changes the most suitable locations for off-grid technology compared to giving more weight to financial services locations. I decided to weight financial services higher than the other aspects because, as discussed, a key aspect to insuring these companies and organizations thrive is to insure that their target audience can afford their systems. This weighted map essentially mirrors the locations of financial services, which could indicate that any organization should start by finding suitable financial services and then look at other factors. In the second map, each of the classifications were given an equal weight. This map indicates that there are several areas in Northern Uganda that may work well for off-grid technology. These two maps show the importance of understanding what aspects of Uganda's (or any country's) landscape are important to finding suitable locations for off-grid electricity. Some organizations may rely more on roads to deliver their product to local communities while others may believe that having access to larger populations is the most important indicator of suitability. Different maps can be made for individual countries and organizations depending on their needs and preferences. This could be a useful tool for existing off-grid organizations moving into new areas or a new organization seeking to start their work.

## LIMITATIONS:

This map may give off-grid electricity companies a place to start but, as with any project, they will need to perform a more in-depth local assessment of each prospective location to make sure that the area has all of the requirements for a successful project (including government policies, environment, community needs, etc.). This map also does not analyze what type of technology would be right for each area. The available technology is diverse and there is almost always a type of home or village system that would work in any environment. Even though an organization could start with this assessment, this map can only give them overall information and they would need to assess each community at a more detailed level.

### Data Sources:

Electricity Data: "Energy Utilities in Uganda," *Energy Sector GIS Working Group*, <http://fspmaps.com/>, accessed on February 20th, 2014.

Population data: "Projected Mid year Population (2000) by District, Sex, Year," *Uganda Bureau of Statistics*, <http://countryvstat.org/home.aspx?c=UGA&tr=26>, accessed on February 20th, 2014.

General Uganda Administrative Data (roads, borders, etc.): *Uganda Bureau of Statistics and UNOCHA*, [https://cod.humanitarianresponse.info/search/field\\_country\\_region/187](https://cod.humanitarianresponse.info/search/field_country_region/187), accessed on February 20th, 2014.

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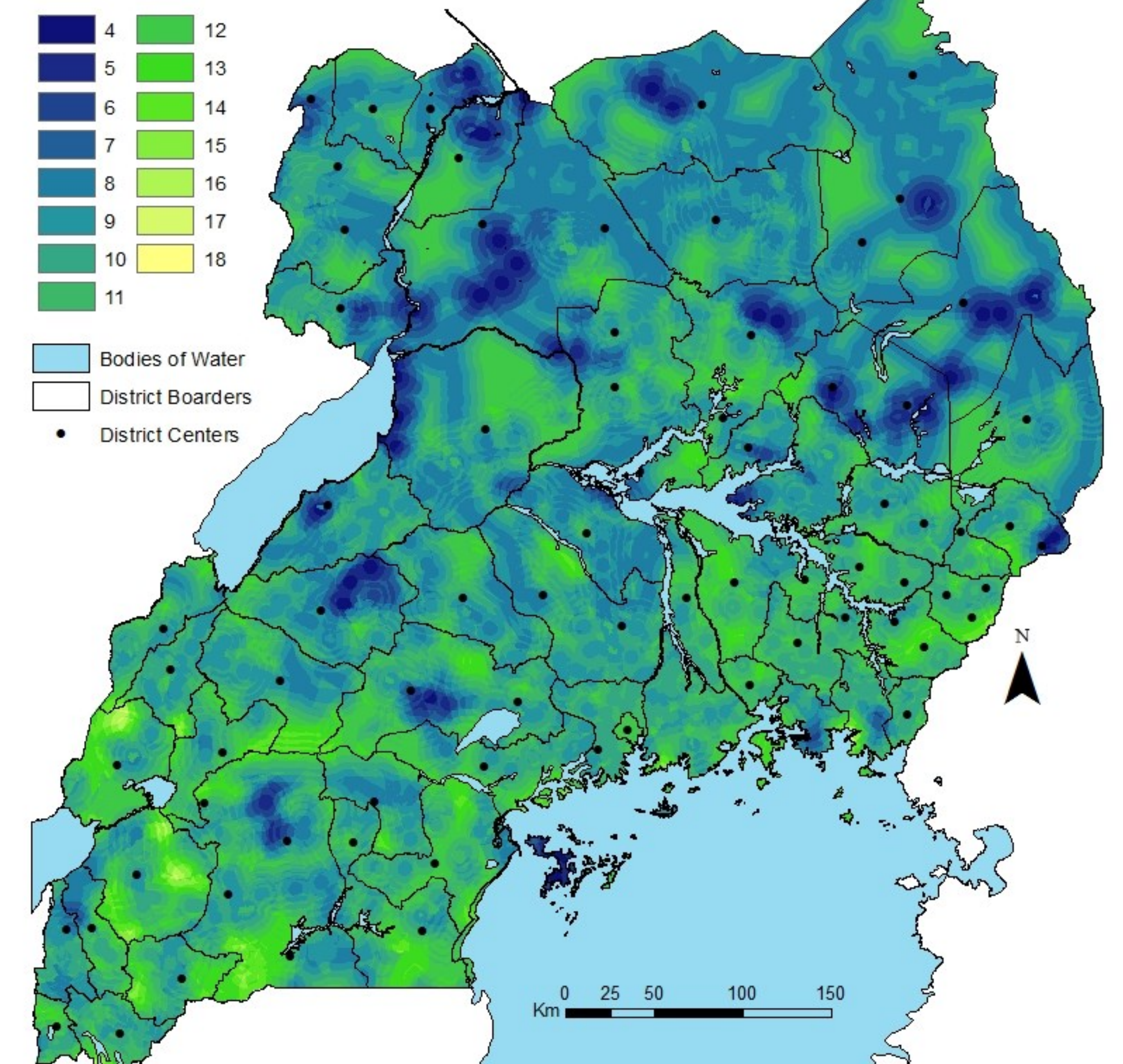
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## Overall Suitability Map: Unweighted

Lower numbers indicate greater suitability



## Overall Suitability Map: Weighted

40% Financial Services, 20% Roads, 20% Population Density, 20% Electricity Lines  
Lower numbers indicate greater suitability

