Energy Access in Zambia: From the Ground Up

Faculty Advisors: Rob Fetter, Jonathan Phillips, Subhrendu Pattanayak, John Fay, Marc Jeuland, Robyn Meeks, Dalia Patino-Echeverri, John Simpkins

Students: Aashna Aggarwal, Ayo Balogun, Ian Ferguson, Adaiya Granberry, Manfei He, Kemunto Okindo, Pooja Madhusudan Rao, Harshvardhan Sanghi, Rachel Wall, Sumin Wang, Miranda Wolford, Evelyn Yun
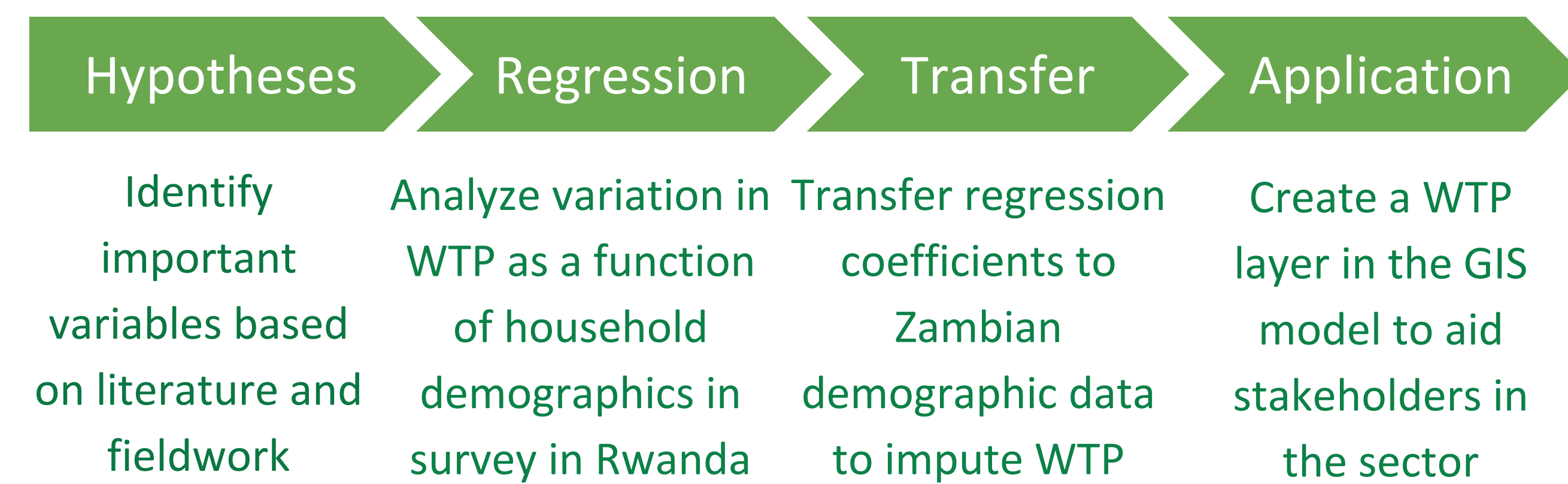
OVERVIEW

Zambia is a landlocked country in southern Africa with a population of 15.5 million. The overall electrification rate is 27%, with a large discrepancy between urban (62% electrified) and rural areas (4.5% electrified).

We identified private off-grid companies as vibrant drivers of last-mile electrification. We aim to help the Zambian off-grid energy space:

1. **Determine the willingness to pay for electricity** in localities.
2. **Identify policy and financial constraints**, **examine recent important policy development**, and **recommend collaborative efforts** to change policy within the off-grid community.
3. **Design a user-friendly geospatial application** for off-grid market selection and improved electrification planning.

WILLINGNESS-TO-PAY

To aid in gauging demand for electricity, we developed a willingness-to-pay (WTP) model for electricity access based on demographic characteristics. The analysis was conducted using a benefits transfer methodology (Johnston et al., 2018) applied to a detailed survey from Rwanda (Grimm et al., 2017) and Zambian national census data (LCMS, 2015).

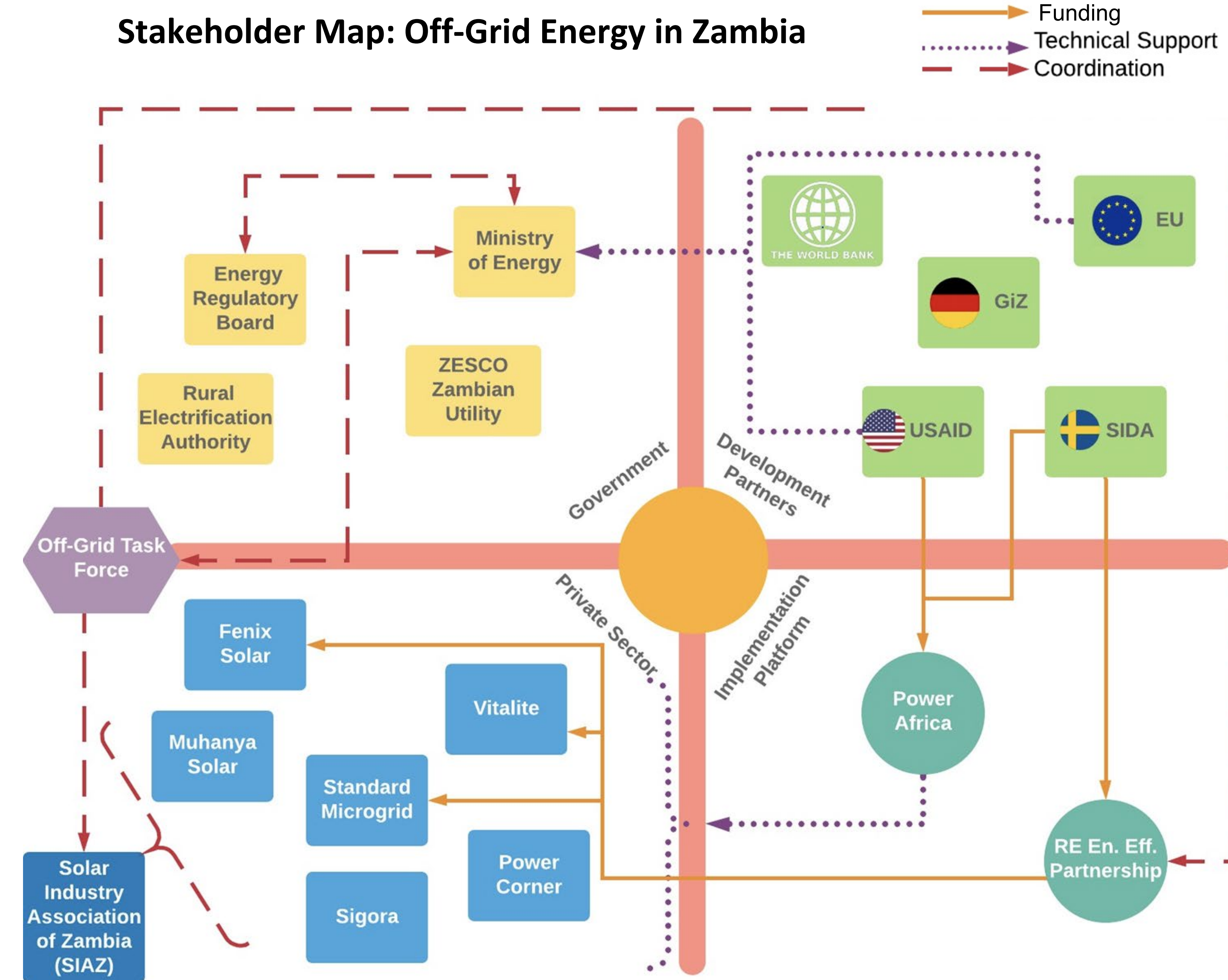| Hypotheses	Regression	Transfer	Application
Identify important variables based on literature and fieldwork	Analyze variation in WTP as a function of household demographics in survey in Rwanda	Transfer regression coefficients to Zambian demographic data to impute WTP	Create a WTP layer in the GIS model to aid stakeholders in the sector

We conducted informal interviews with residents of rural communities in Choma, Monze, and Chibomba. Residents were asked questions about electricity usage and hopes, aspirations and expectations for electricity access. We used their qualitative responses and our own observations as inputs into our model.

A microgrid site we visited in the peri-urban area of Ngwerere, outside Lusaka. This 20 kW panel serves 150 households and about a dozen businesses, including a movie theater.

Stephane, a shop owner, is able to sell cold drinks thanks to electricity supplied from the microgrid.

POLICY

We conducted interviews with over 40 companies, government agencies, development partners, NGOs and other stakeholders operating within the Zambian off-grid ecosystem to evaluate the policy landscape and clarify institutional roles.

Stakeholder Map: Off-Grid Energy in Zambia

Funding
Technical Support
Coordination

Ministry of Energy
Energy Regulatory Board
ZESCO Zambian Utility
Rural Electrification Authority
Off-Grid Task Force
Fenix Solar
Muhanya Solar
Standard Microgrid
Vitalite
Sigora
Power Corner
Solar Industry Association of Zambia (SIAZ)

THE WORLD BANK
GiZ
EU
USAID
SIDA
Power Africa
RE En. Eff. Partnership

Government
Development Partners
Private Sector
Implementation Platform

We identified some of the challenges and priorities facing off-grid solar development as follows:

- **Challenges**
  - Reactive policy creates uncertainty as the government often changes regulation and policy after the project has already been implemented.
  - The multidimensional nature of energy access requires coordination between different financing mechanisms.

- **Recommendations**
  - A more flexible policy framework that accommodates innovations and is capable of quick response.
  - Tailored financing schemes to increase the inclusiveness of the market and build up local capacity for future development.
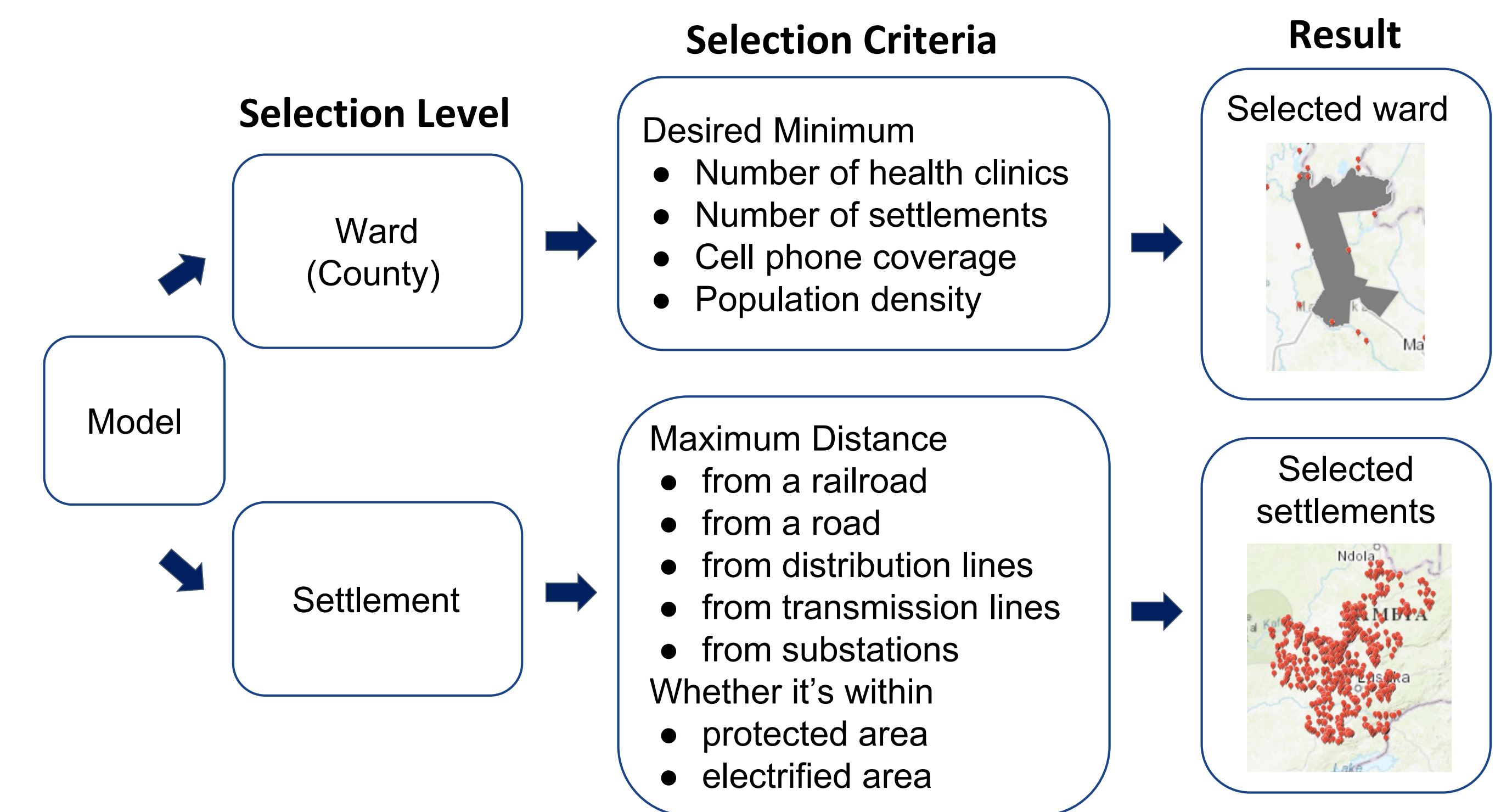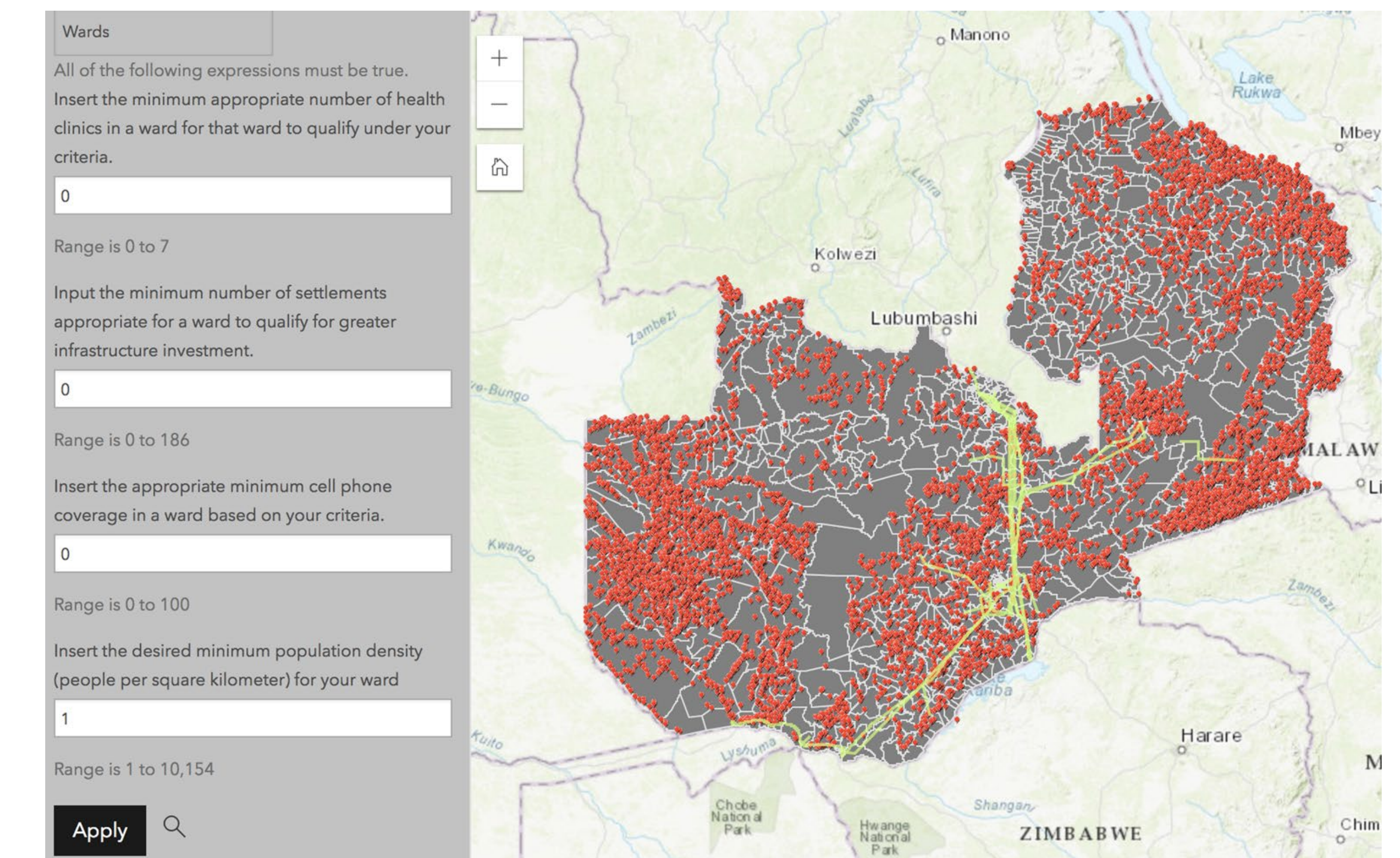
ACKNOWLEDGMENTS

GEOSPATIAL MODEL

The geospatial application is designed to facilitate the process of site and market selection and allow users – especially microgrid developers, solar home system companies, and electrification system planners – to identify optimal markets based on multiple criteria that they can flexibly apply.

To Access the Application: http://bit.ly/2H4GLTY

Selection Level

Model → Ward (County) → **Selection Criteria** Desired Minimum
- Number of health clinics
- Number of settlements
- Cell phone coverage
- Population density

→ **Result** Selected ward

Model → Settlement → Maximum Distance
- from a railroad
- from a road
- from distribution lines
- from transmission lines
- from substations
Whether it's within
- protected area
- electrified area

→ Selected settlements

CONCLUSION

Our work facilitates energy access for communities throughout Zambia and beyond by providing developers, system planners, and other stakeholders with improved tools, information, and insights.

- Our user-friendly GIS tool allows companies to sort potential sites by various characteristics and select the most attractive sites.
- The addition of the WTP layer to the GIS model will allow companies to estimate demand for their electricity services.
- Our policy report aids companies by detailing regulation and identifying key financial, government and development partners.

With better information and tools in the hands of potential market entrants, off-grid electricity systems can attract greater investment, include more local companies and entrepreneurs, scale faster, and provide better services to more people.