Bridging gaps: Exploring energy systems' nexus contributions

CGIAR NEXUS Gains Talk : Energy, water, and multisectoral linkages in Africa

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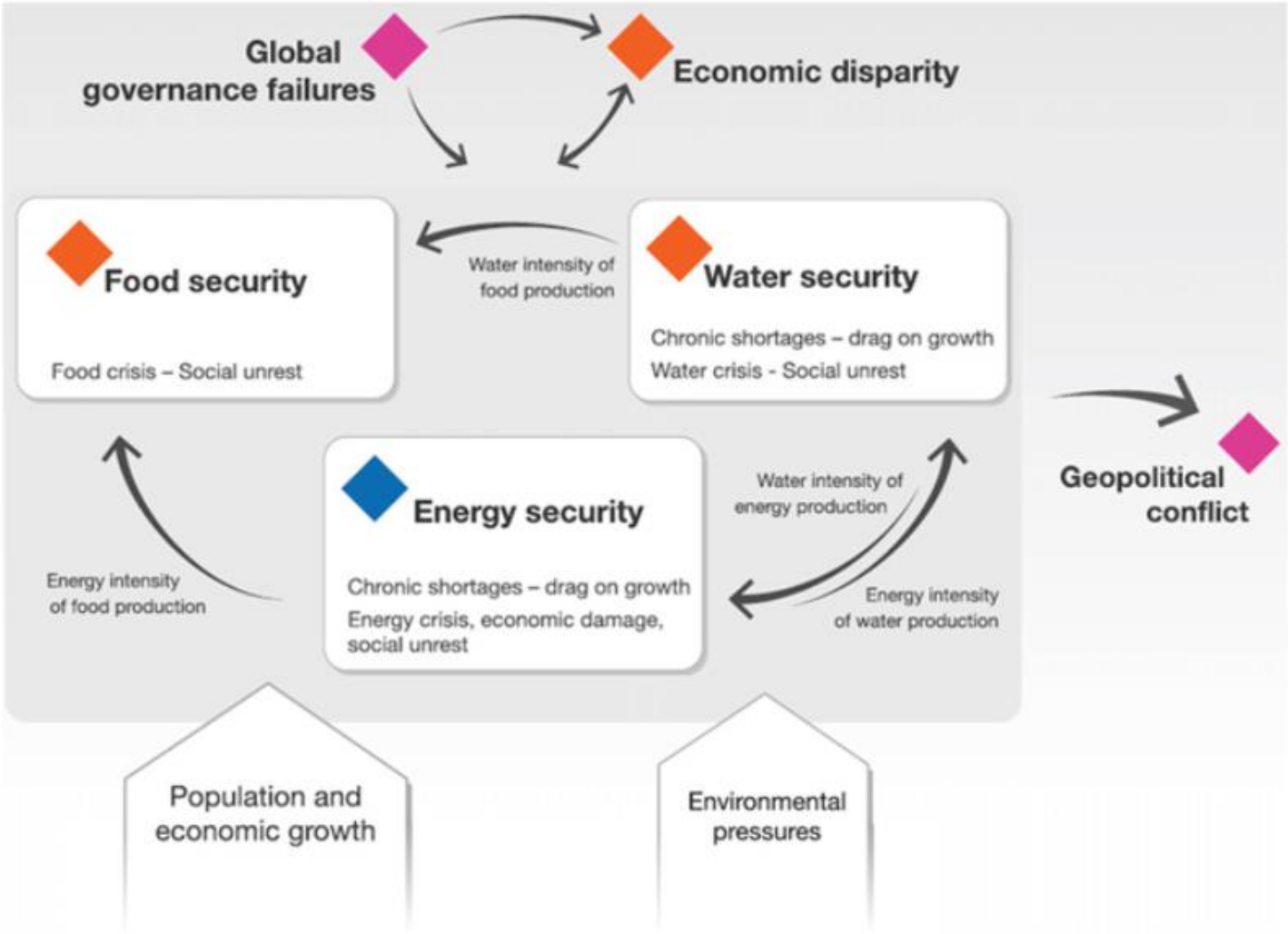
Water Energy Food Nexus

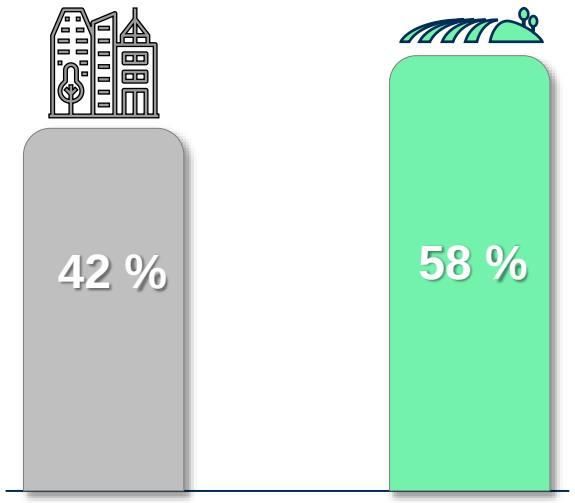
Sub-Saharan Africa: The scale of the problem and interconnections in Water, Energy, and Food Systems

Bazilian, et al. 2011, "Considering the Energy, Water and Food Nexus: Towards an Integrated Modelling Approach."



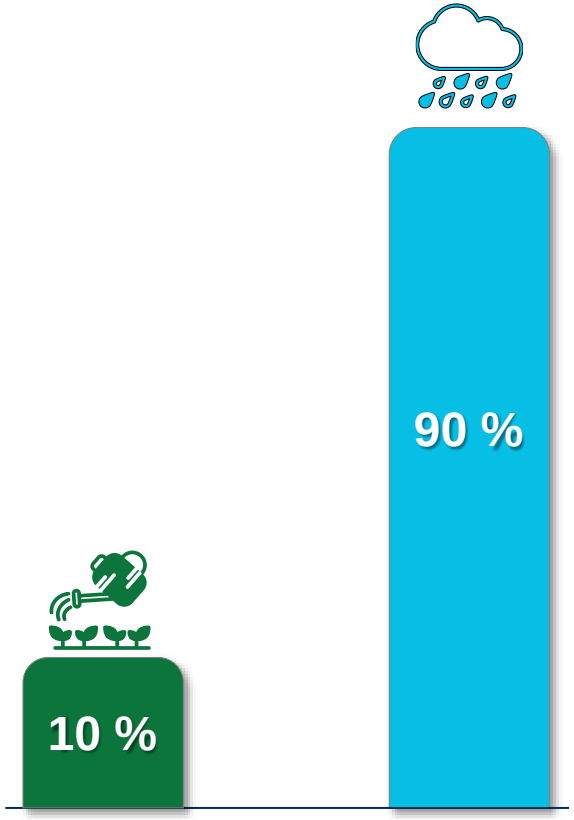
Water Energy Food Nexus in Rural Africa

Zoom In: Understanding the Rural Context and Its Challenges



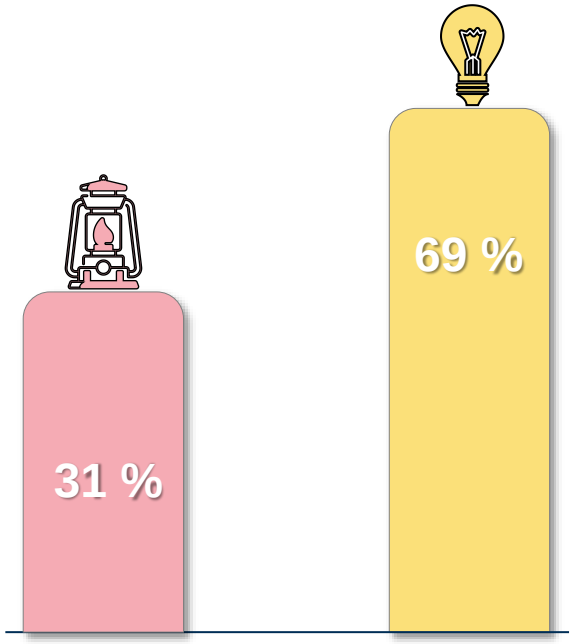
Urban Vs. Rural Population @ 2022

Source: World bank



Irrigated Vs. Rainfed Agriculture in Rural Areas @ 2020

Source: Giacomo Falchetta et al, 2020

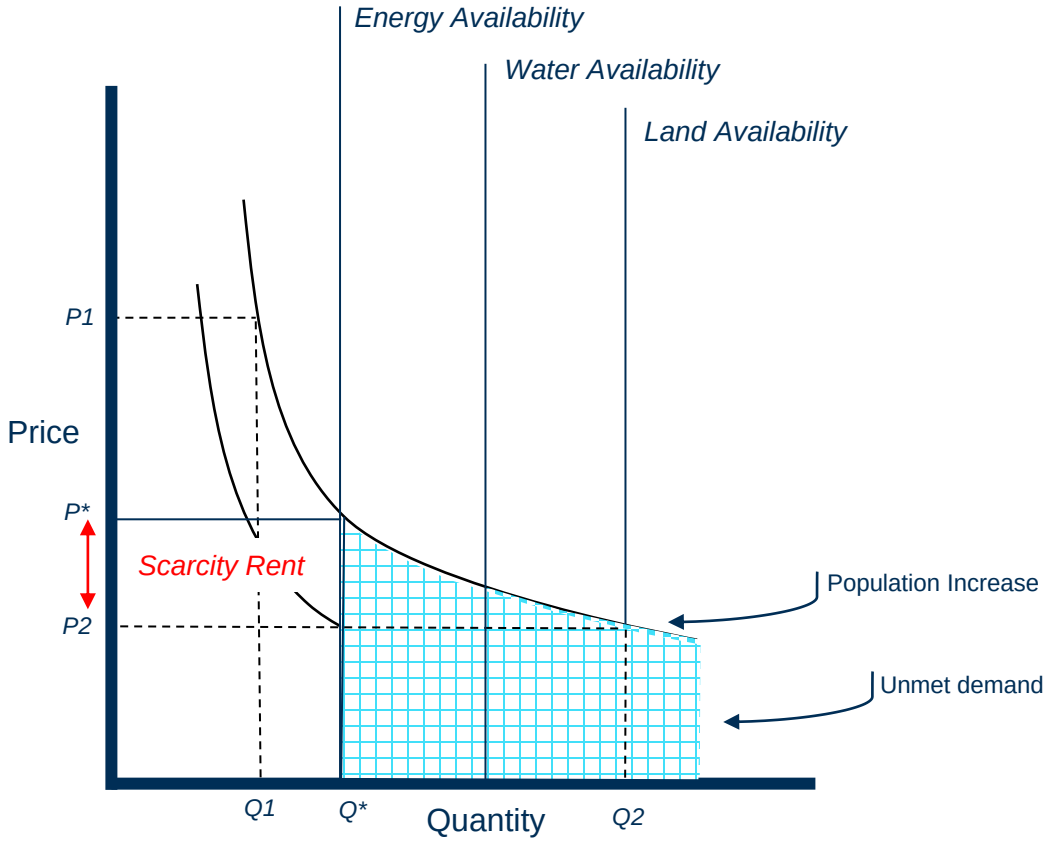


Non-Electrified Vs. Electrified Rural Population @ 2021

Source: world bank

Water Energy Food Nexus in Rural Africa

The role of energy in unlocking the WEF Potential as one of the most crucial resources



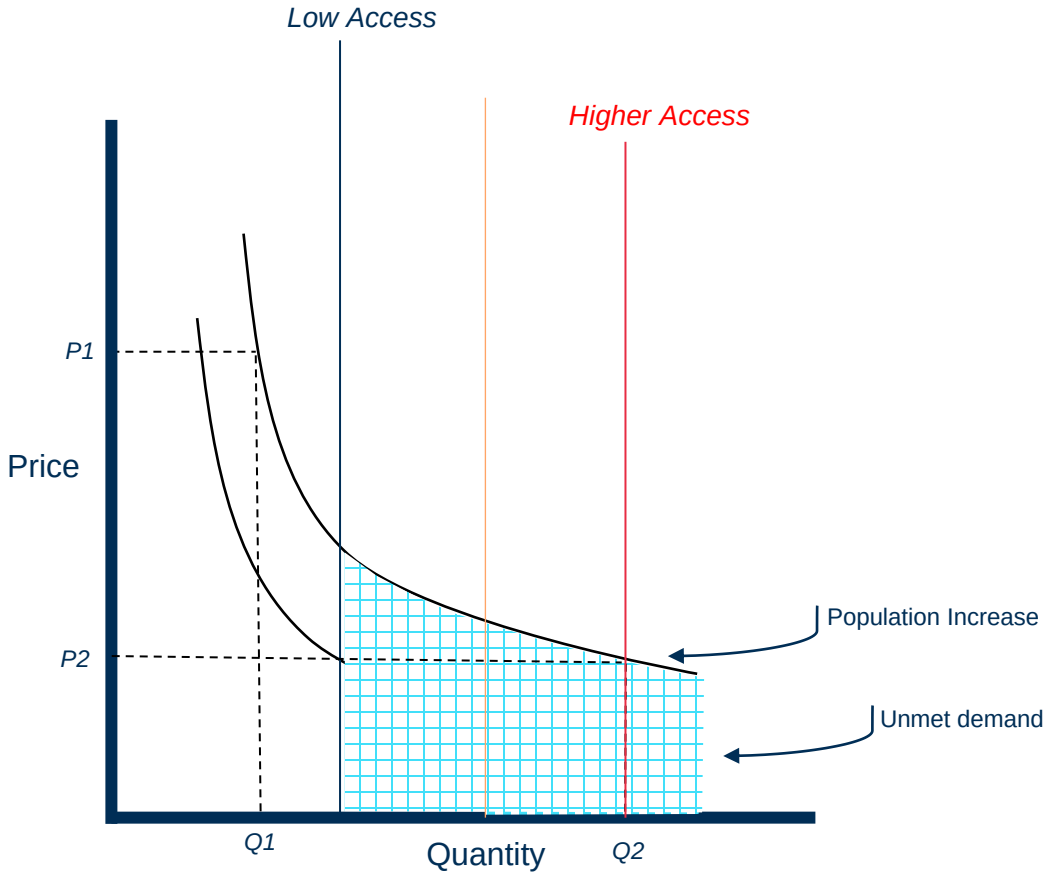
The limited availability of resources tends to increase the level of unmet (latent) demand, and the prices.

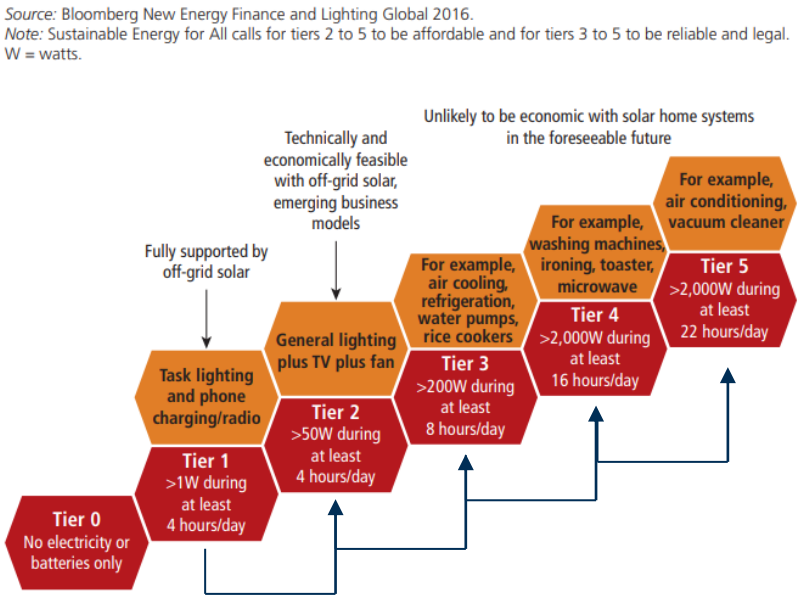
Addressing the unmet demand of different commodities within the rural communities, would be possible only if the scarcity of resources are resolved.

Electricity emerges as the most scarce resource, triggering a shortage in the supply of multiple interdependent resources in rural Africa.

Water Energy Food Nexus in Africa

Low Tiers of electricity access, can't support the full release of the integrated system potentials





- Granting basic access to electricity in unelectrified regions can enhance people's lives in various ways.
- However, achieving sustainable access, where electricity contributes to an improved community from multiple perspectives, is only possible when higher access is ensured.

Water Energy Food Nexus in Rural Africa

Future projections of electricity demand in rural Africa should encompass various aspects of demand, rather than concentrating solely on household needs.

Understanding the demand loads is a very challenging task

- × Unpredictable user behavior and adaptation dynamics
- × Varying needs and priorities
- × Lack of infrastructure data
- × Unpredictable development and urbanization dynamics
- × Lack of reliable demographic and socioeconomic data
- × …

Falchetta, Giacomo, Nicolò Stevanato, Magda Moner-Girona, Davide Mazzoni, Emanuela Colombo, and Manfred Hafner. "The M-LED Platform: Advancing Electricity Demand Assessment for Communities Living in Energy Poverty." *Environmental Research Letters* 16, no. 7 (July 2021): 074038. https://doi.org/10.1088/1748-9326/ac0cab.

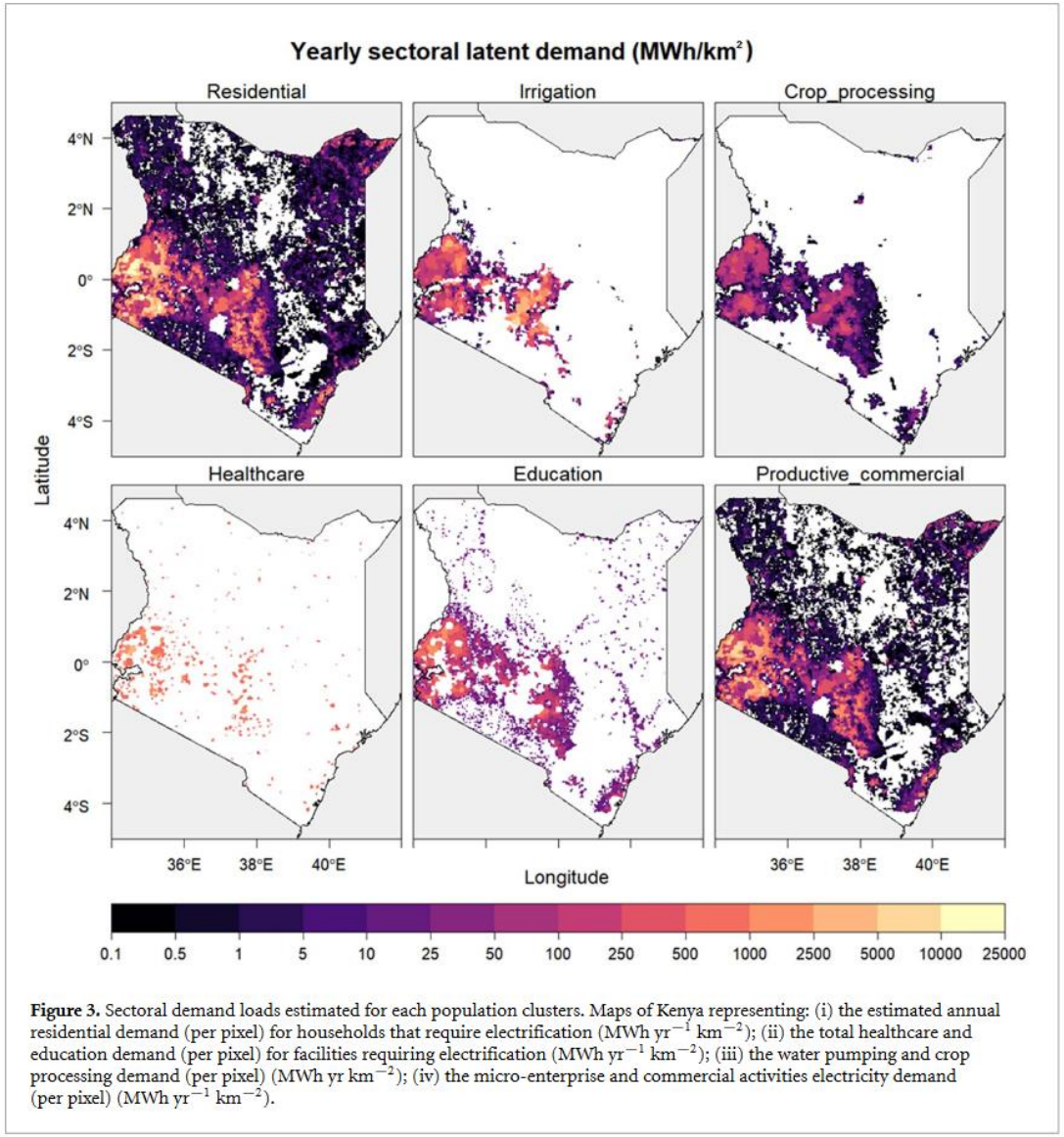


Figure 3. Sectoral demand loads estimated for each population clusters. Maps of Kenya representing: (i) the estimated annual residential demand (per pixel) for households that require electrification (MWh yr^{-1} km^{-2}); (ii) the total healthcare and education demand (per pixel) for facilities requiring electrification (MWh yr^{-1} km^{-2}); (iii) the water pumping and crop processing demand (per pixel) (MWh yr km^{-2}); (iv) the micro-enterprise and commercial activities electricity demand (per pixel) (MWh yr^{-1} km^{-2}).

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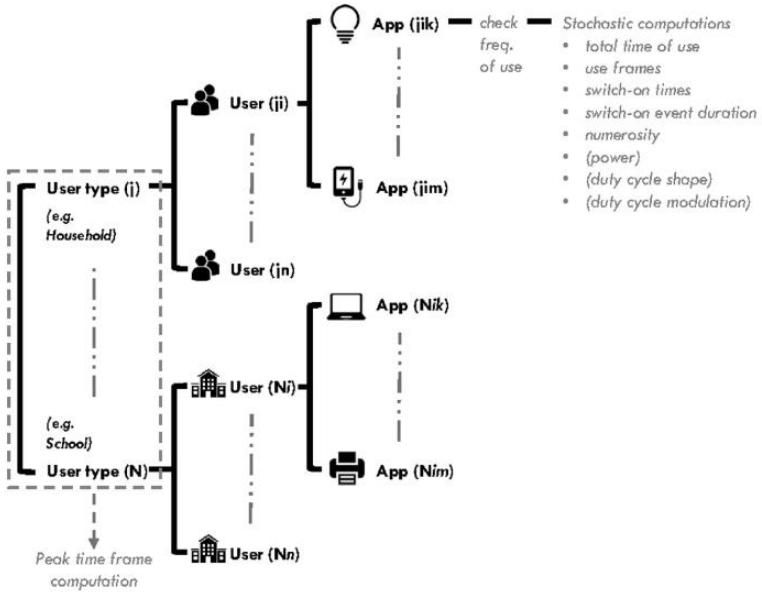
Modelling Energy Demand in Rural Africa

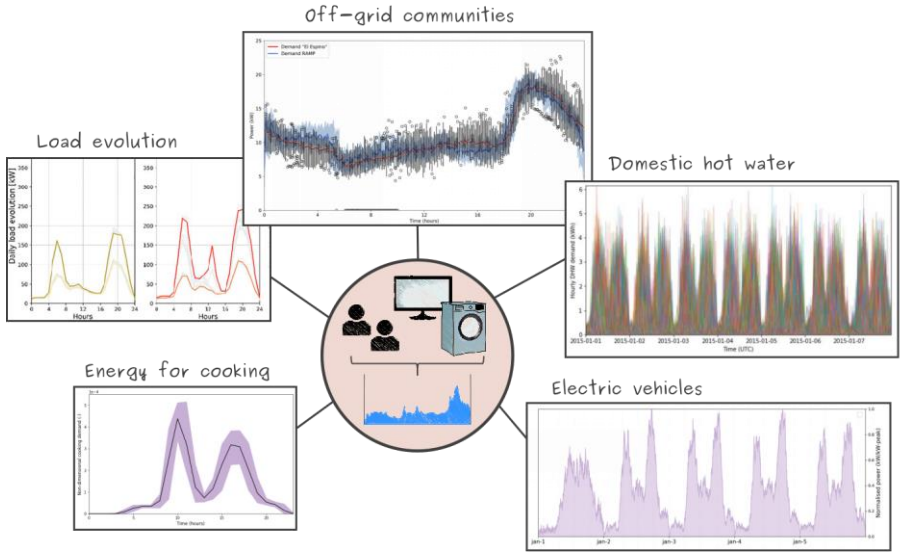
To model energy demand in this context, a customized approach is essential, one that is capable of addressing the challenges mentioned.



Source: Lombardi, Francesco et al,. "Generating High-Resolution Multi-Energy Load Profiles for Remote Areas with an Open-Source Stochastic Model." *Energy* 177 (June 15, 2019): 433–44. https://doi.org/10.1016/j.energy.2019.04.097.

- Capable of accounting for and analyzing unpredictable user behavior
- Relies on minimal data collection
- Models complex devices beyond simple household appliances
- Active and collaborative development community in an open-source ecosystem

An **Open-Source Stochastic** model for in **Generating Load Profiles** in **Rural Context**, to cope with **Uncertainties** in estimating the demand:



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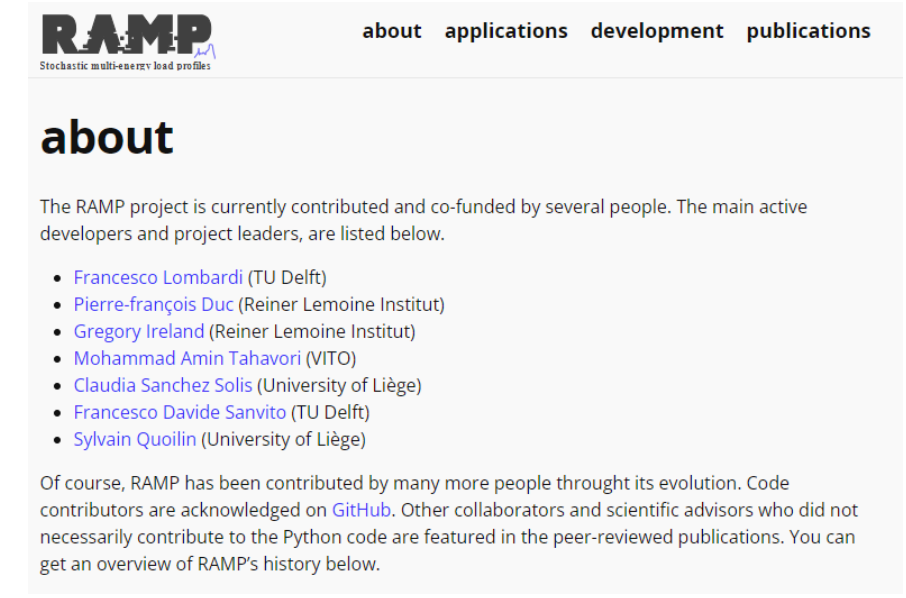
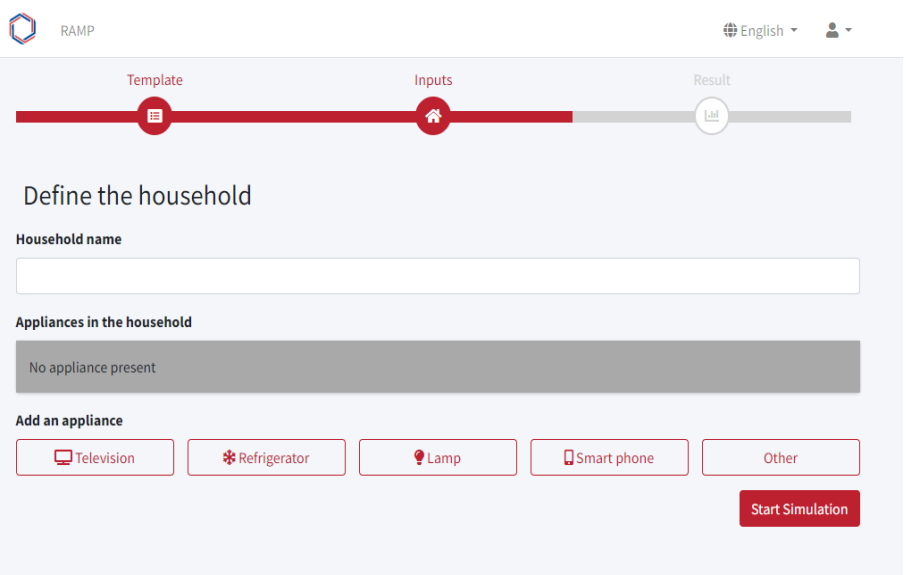
Modelling Energy Demand in Rural Africa

Addressing the challenges in rural context

RAMP
Stochastic multi-energy load profiles





https://github.com/RAMP-project/RAMP

https://rampdemand.org/

Check RAMP website for more info!

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Thank you!

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