

Universal energy access beyond lighting: modelling demand for productive uses

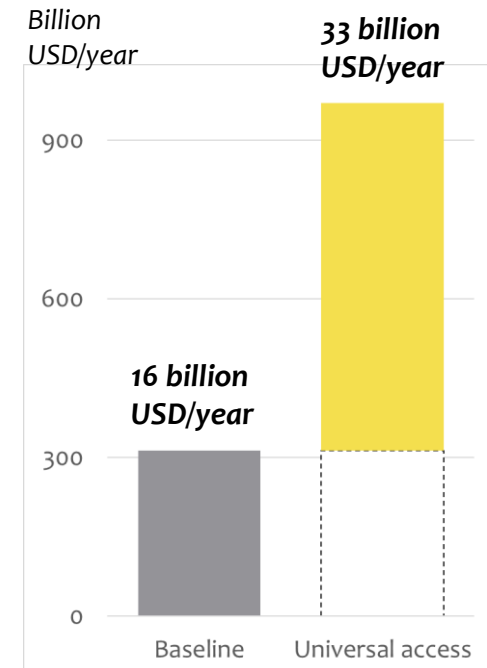
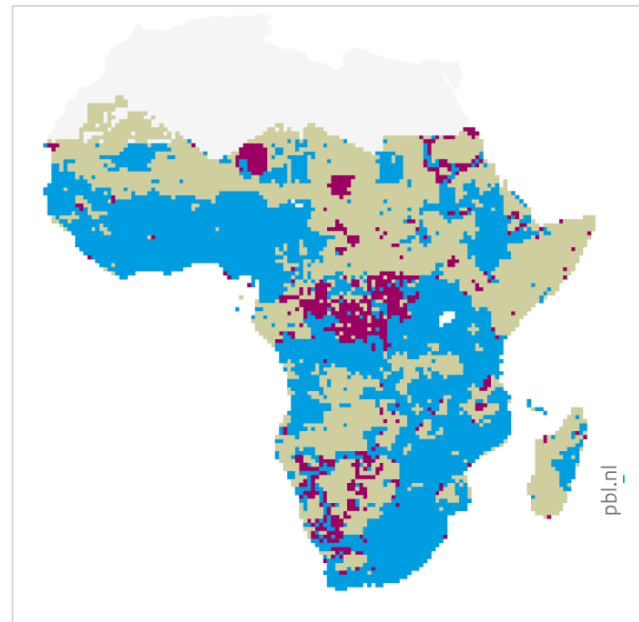
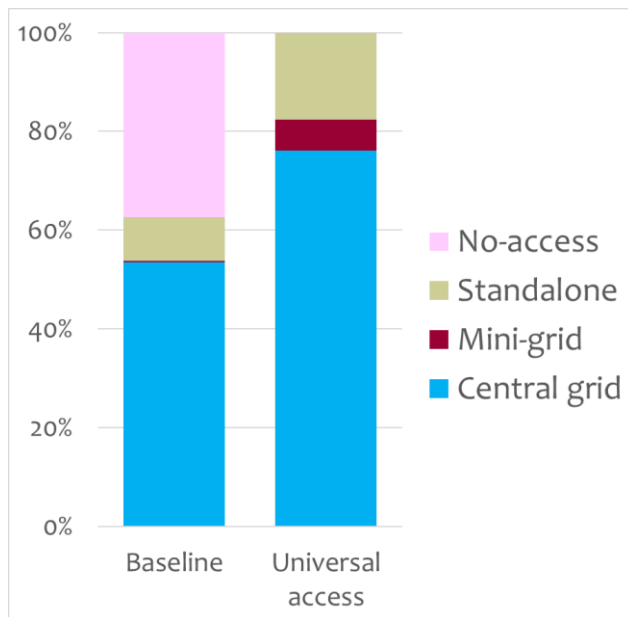
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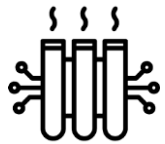
Background

- Access to electricity
 - projected 500 million people lack access to electricity in 2030
 - Off-grid technologies play an important role



Background

- Our previous studies showed how enormous the task of providing universal access to clean and modern energy is in SSA
- Those studies only focused on demand for residential end-use services:



space heating



space cooling



water heating



cooking



Lighting & appliances

Background

- Increased energy access may not always directly lead to improved livelihoods and economic development; thus, the productive use of energy (PUE) is aimed at enhancing income generation opportunities and productivity
- PUE is the additional electricity use of households on top of their own private consumption in order to provide additional income



agricultural uses
(e.g. irrigation)



agro-processing
(e.g. milling,
husking, hulling)



manufacturing
(e.g. carpentry,
tailoring, welding
and looming)



service sector
(e.g. gastronomy,
beauty salon)



Background

- Self employment – up to 80% labor force, 42% of rural SSA operate EP, needs-driven vs opportunity driven
- Crop processing is expected to become more relevant, , given agriculture is the main employment sector
- PUE : local value creation, the export of higher-quality end-products and ultimately, creation of local wealth
- The use of energy for income-generating activities can help to improve the viability of business models.
- But the challenge is that there are no representative, encompassing empirical data, let alone census data about the level of electricity demand for PUE

Methodology

- Micro-enterprise are grouped in two categories

Agro MEs



agro-processing
(e.g. milling,
husking, hulling)

Non-agro MEs

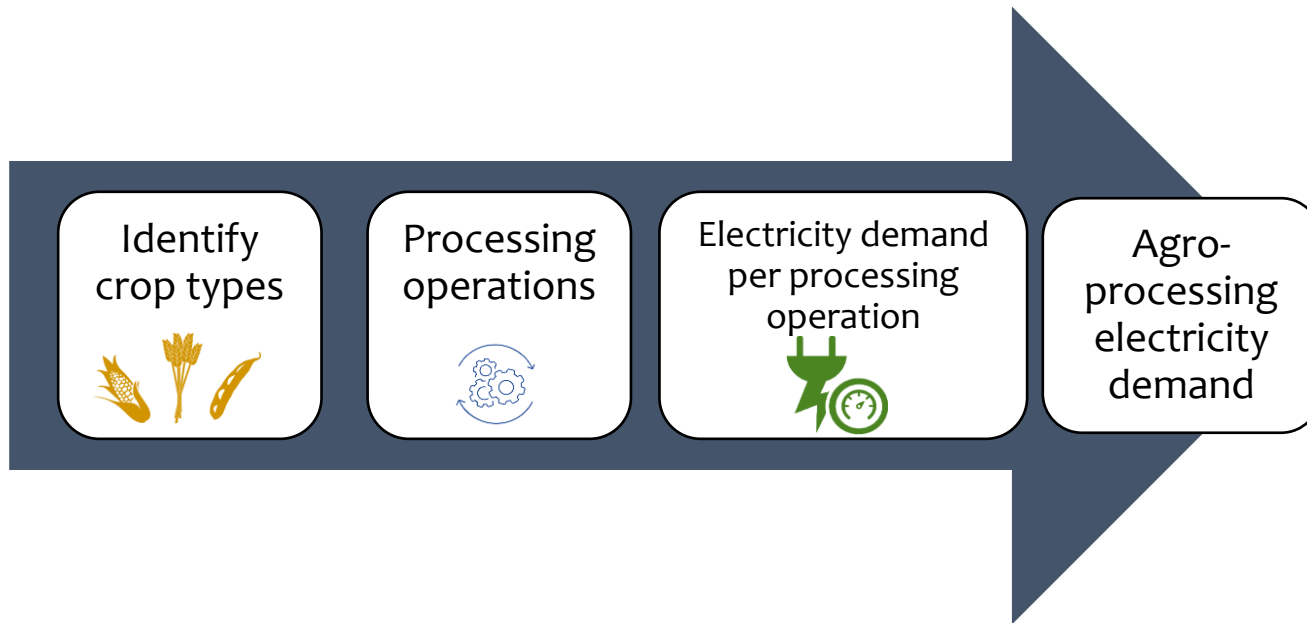


manufacturing
(e.g. carpentry,
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service sector
(e.g. gastronomy,
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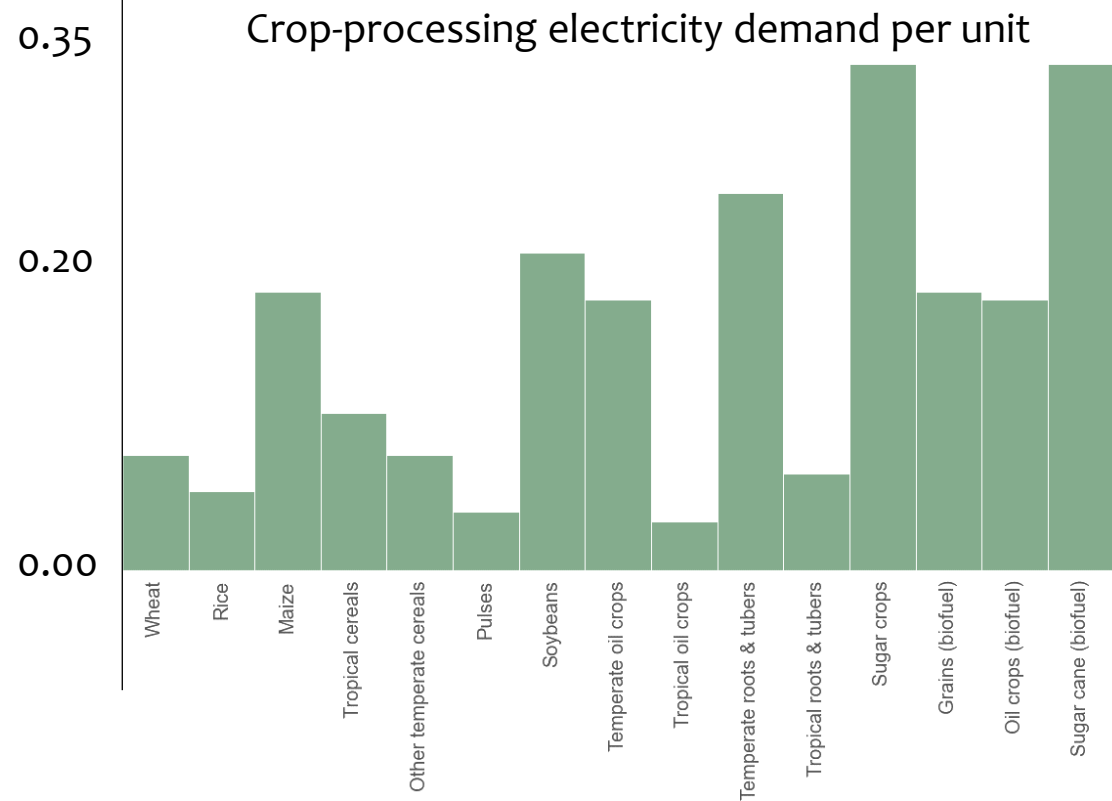
Agro-processing ME



- projecting the demand from Agro-processing facilities as an addition to agricultural activity (milling, husking, threshing, hulling, grating, pressing)
 - Identify common products in SSA
 - Processing operations of selected crops
 - Processing steps most likely to take place locally at ME
 - electricity requirements of different crop processing operations

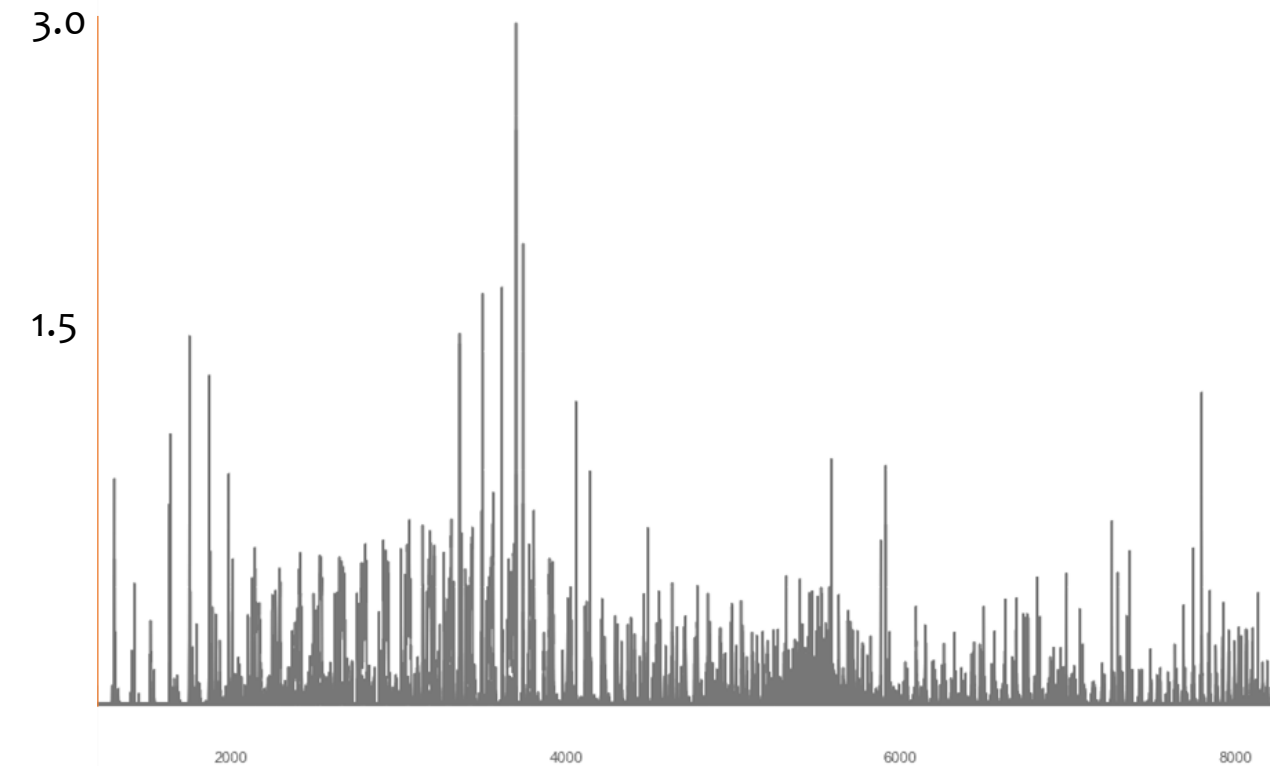
Agro-processing ME

MJ/Kg



1e+6
tonne

Annual crop produce per grid-cell



Non-agro ME



Uptake model

$$\ell_U = \log\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \sum_j \beta_j X_i + \sum_k \beta_k D_k$$



Connection
model

$$\ell_C = \log\left(\frac{Q_m}{1 - Q_m}\right) = \beta_0 + \sum_j \beta_j X_i + \sum_k \beta_k D_k$$



Sales model

$$s_m = \beta_0 + \sum_j \beta_j X_i + \sum_k \beta_k D_k + \varepsilon_j$$



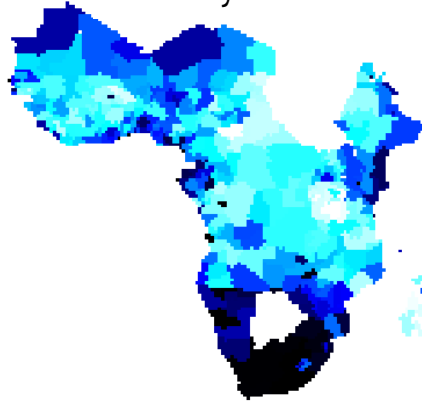
Consumption
model

$$el_m = \beta_0 + \sum_j \beta_j X_i + \sum_k \beta_k D_k + \varepsilon_j$$

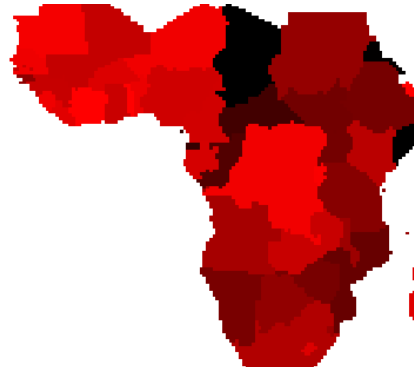
- projecting demand from non-agricultural, non-farm businesses
 - Determinants of the uptake of microenterprises
 - Microenterprises with access to electricity
 - Determinants of the performance of microenterprises
 - Electricity demand of microenterprises

Variables and sources

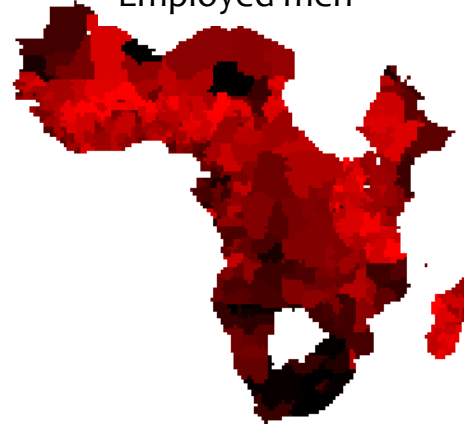
Literacy rate



Doing business with elec



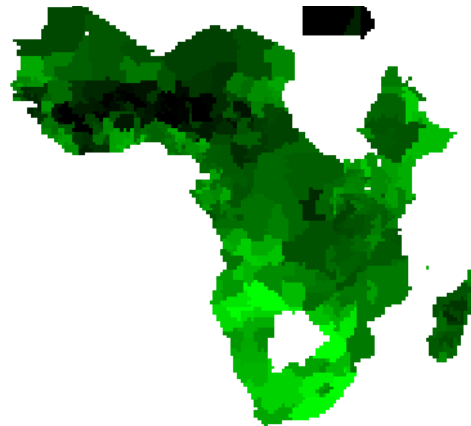
Employed men



Employed women



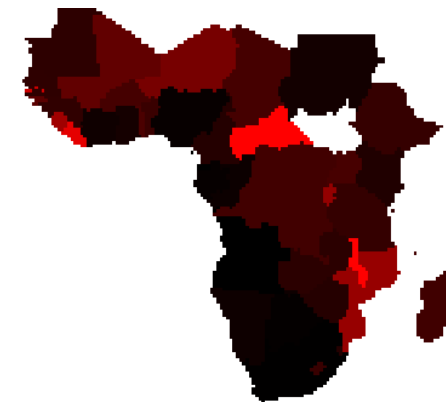
Female headed HH



Lending IR



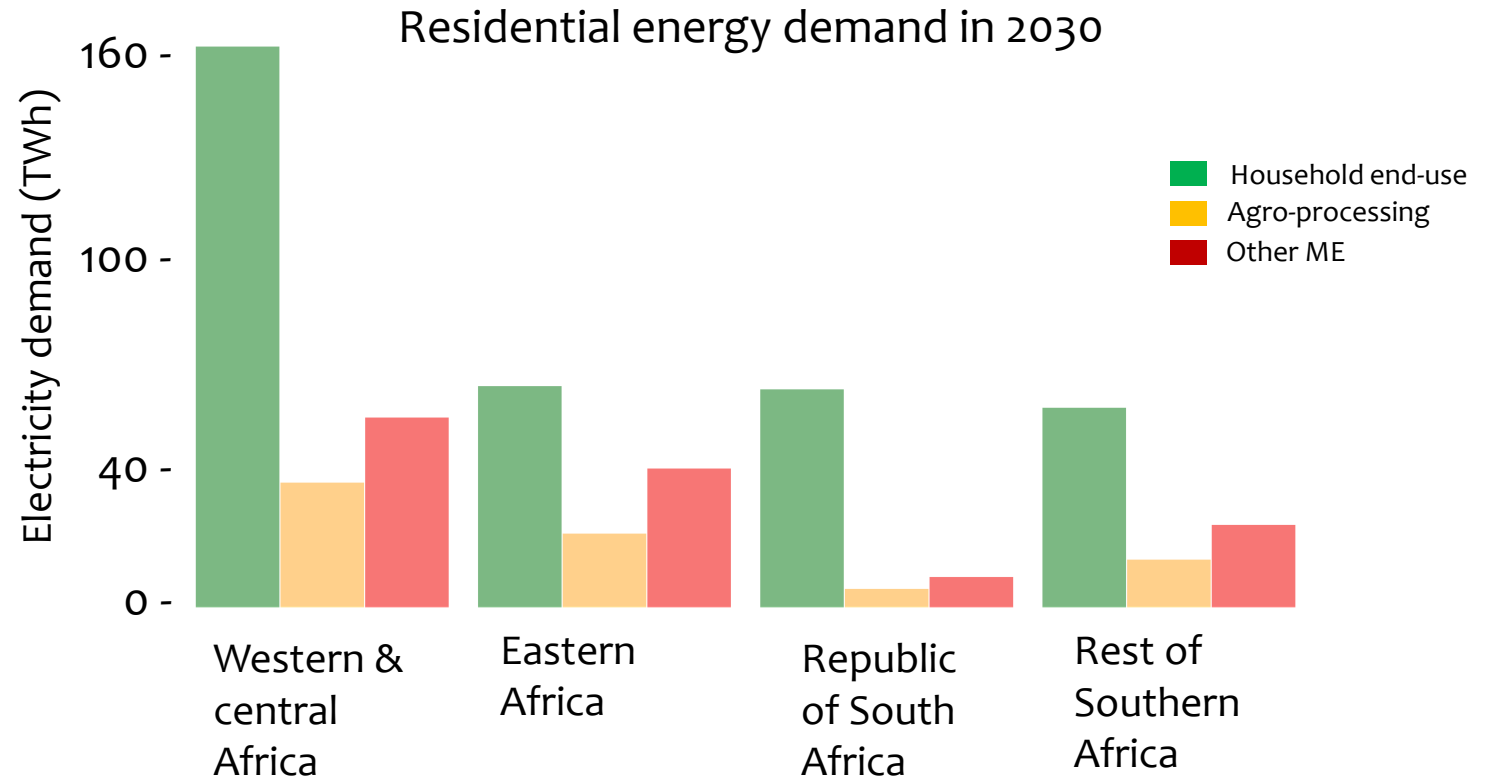
ODA received as % GNI



- 23 drivers in 4 categories are identified for projecting the probabilities of uptake, sales and consumption of ME
- WB Household Survey
- WB EP survey
- WB Doing Business Studies
- WB Development Indicators
- USAID DHS
- Peer reviewed literature

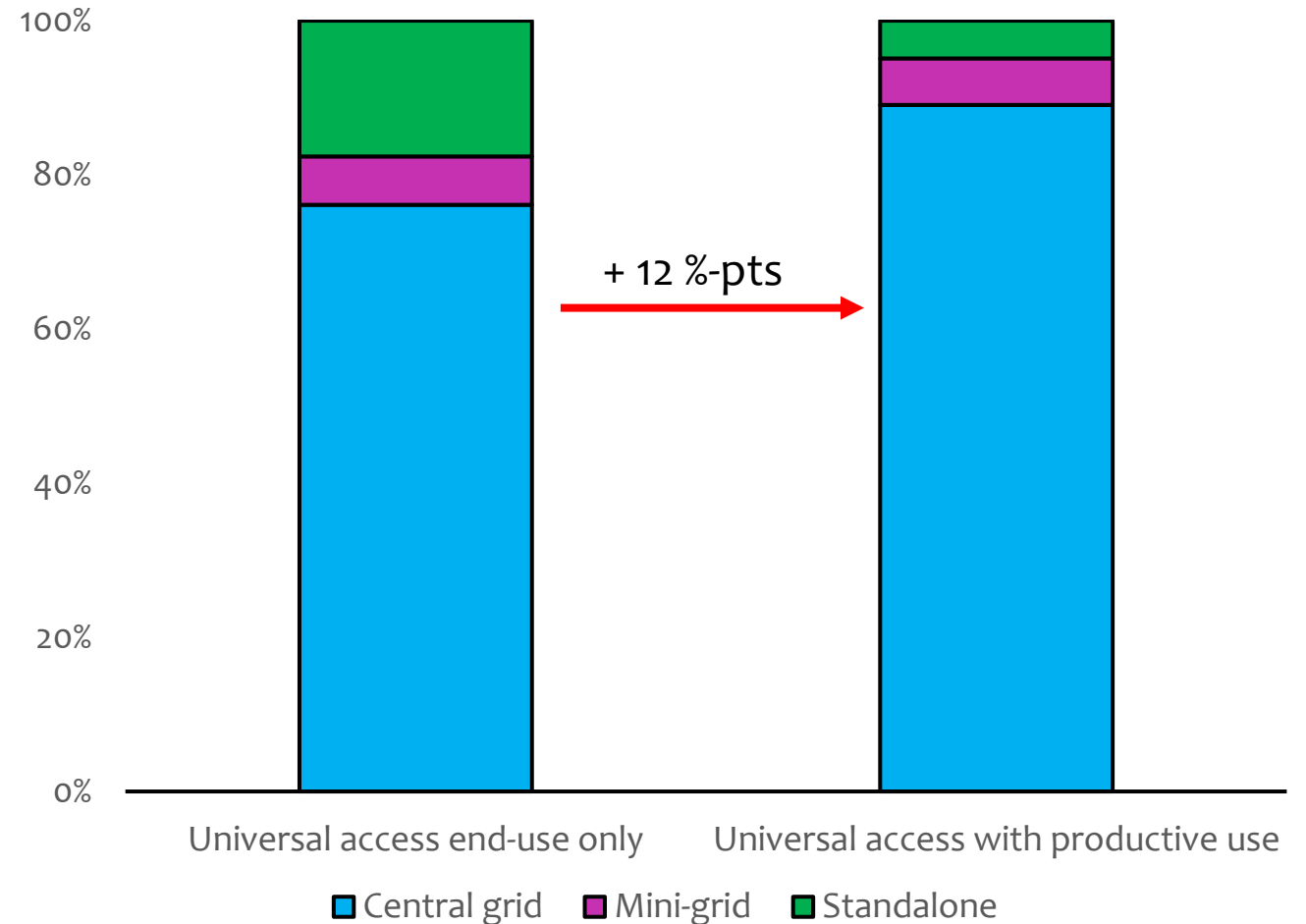
Results

- This results are preliminary, still working on fine tuning some of the independent variables.



Results

- There is a considerable shift from decentralized systems to centralized system
- This might result in a significant increase in capital investment (installed capacity, T&D)





Conclusion and next steps

- Adding PUE in energy planning considerably changes the landscape, off-grid systems should be designed ready for integration into larger networks
- There is a significant amount of work put into identifying drivers for uptake, performance and consumption of micro-enterprises
- Lack of data, explorative, simplified assumptions – **sensitivity analysis**
- Investigate the impact on electricity system investment and electricity related emissions
- Add more activities, such as aquaculture, livestock



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Thank you

Non-agriculture MEs

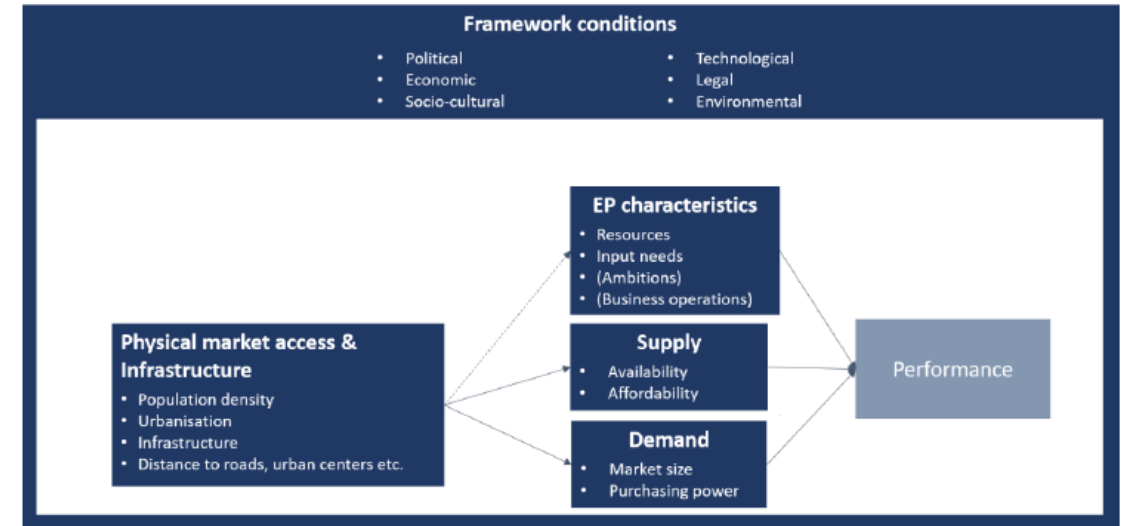


Figure 15. Sales model conceptualization.

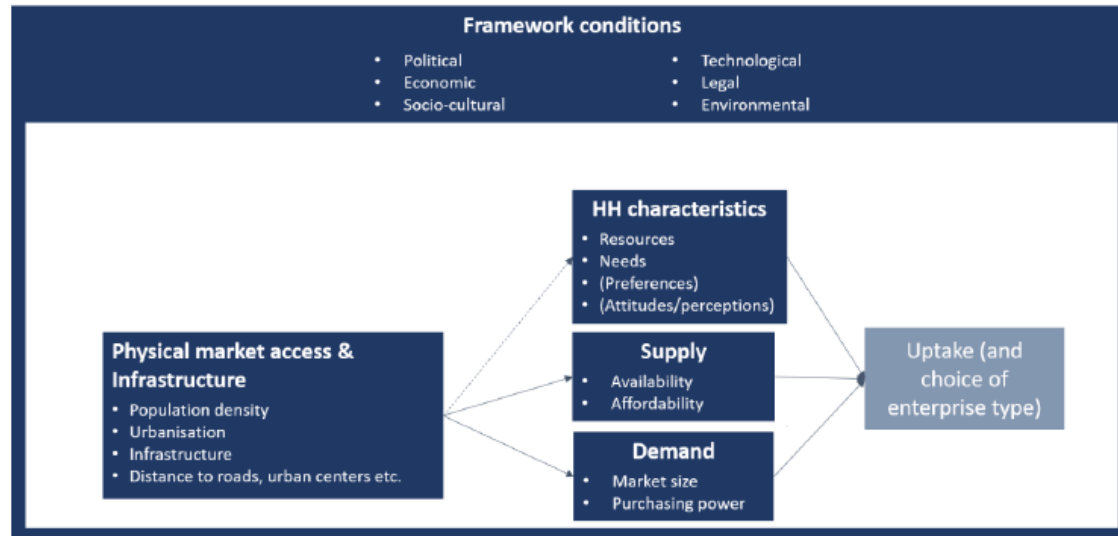


Figure 14. Uptake model conceptualization.

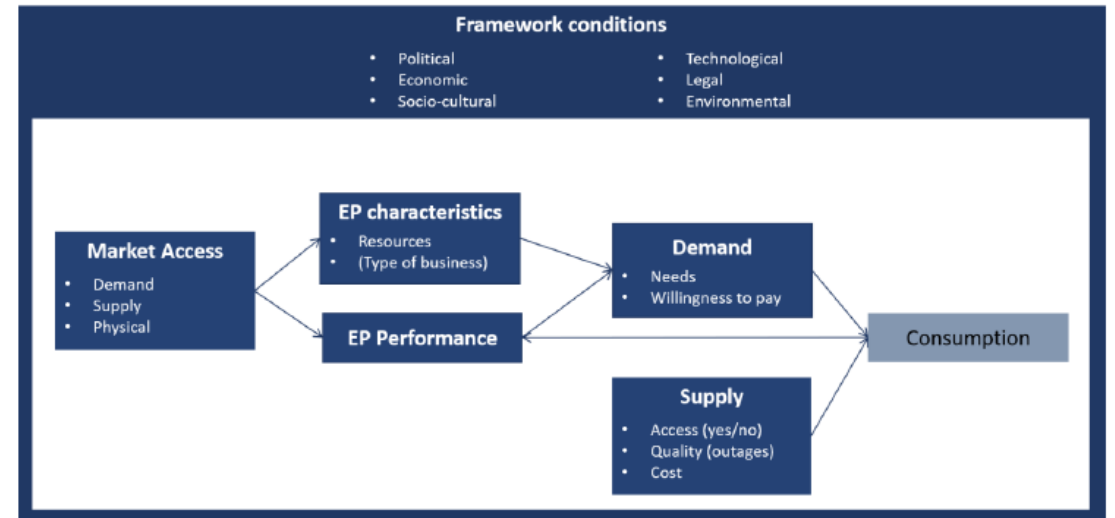


Figure 16. Consumption model conceptualization.