

# AFRICA ELECTRICITY SYMPOSIUM 2025

## ELECTRICITY ACCESS, ENERGY CONSUMPTION AND WELFARE OF HHs IN UGANDA

A presentation at the AES

By

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# INTRODUCTION - 1

- Household welfare is the wellbeing and quality of life of individuals in the household in the economy and is a trending issue in economies today (Mduduzi & Talent, 2018).
- Understanding the drivers of household welfare is important for policies that improve individual and social welfare in the economy (Nguyen & Nguyen, 2019).
- HH welfare indicators in Uganda are unappealing specifically poverty, health, housing conditions and HH consumption expenditure per capita.
- About 8.3 million Ugandans ~ 20.3 percent, were living in poverty based on the national poverty line (UBOS, 2021).
- Highlights from UNHS 2023/2024 puts the poverty rate of Ugandan population at 16.1 percent (UBOS, 2025) ~ 7.4 M people.
- HH consumption expenditure was estimated at only UGX 339,263 (95 US dollars) with disparities between rural and urban.

## INTRODUCTION -2

- Household consumption expenditure on energy, affects aspects of human welfare differently, with critical policy implications (Karumba & Uchapondwa, 2017).
- Amidst several potential drivers , the central importance of electricity access and energy consumption in boosting HH welfare as recognized literature.
- Electricity access is a lifeline for people, helping to drive economic opportunities, boosting welfare outcomes(job creation, improving education health) among others.
- Yet, globally, electricity access gap is estimated 660 million people and about 600million of whom are in Sub-Saharan Africa ,(IRENA,2024) with global Consumption of energy is at 617 exajoules(UN STAT).
- Sub-Saharan response to close the gap, USD 109.35bn and EUR 1.0bn has been committed by WBG,ADB and other development partners, to enable access to electricity to 300 million people by 2030, under “**Africa Mission 300,**”.
- Strategically, Electricity access and Energy Consumption are prioritized under SDG7, 4/22/Africa Agenda- 2063, Africa -Mission 300 2030, Uganda NDPIV (2030)

## INTRODUCTION -2

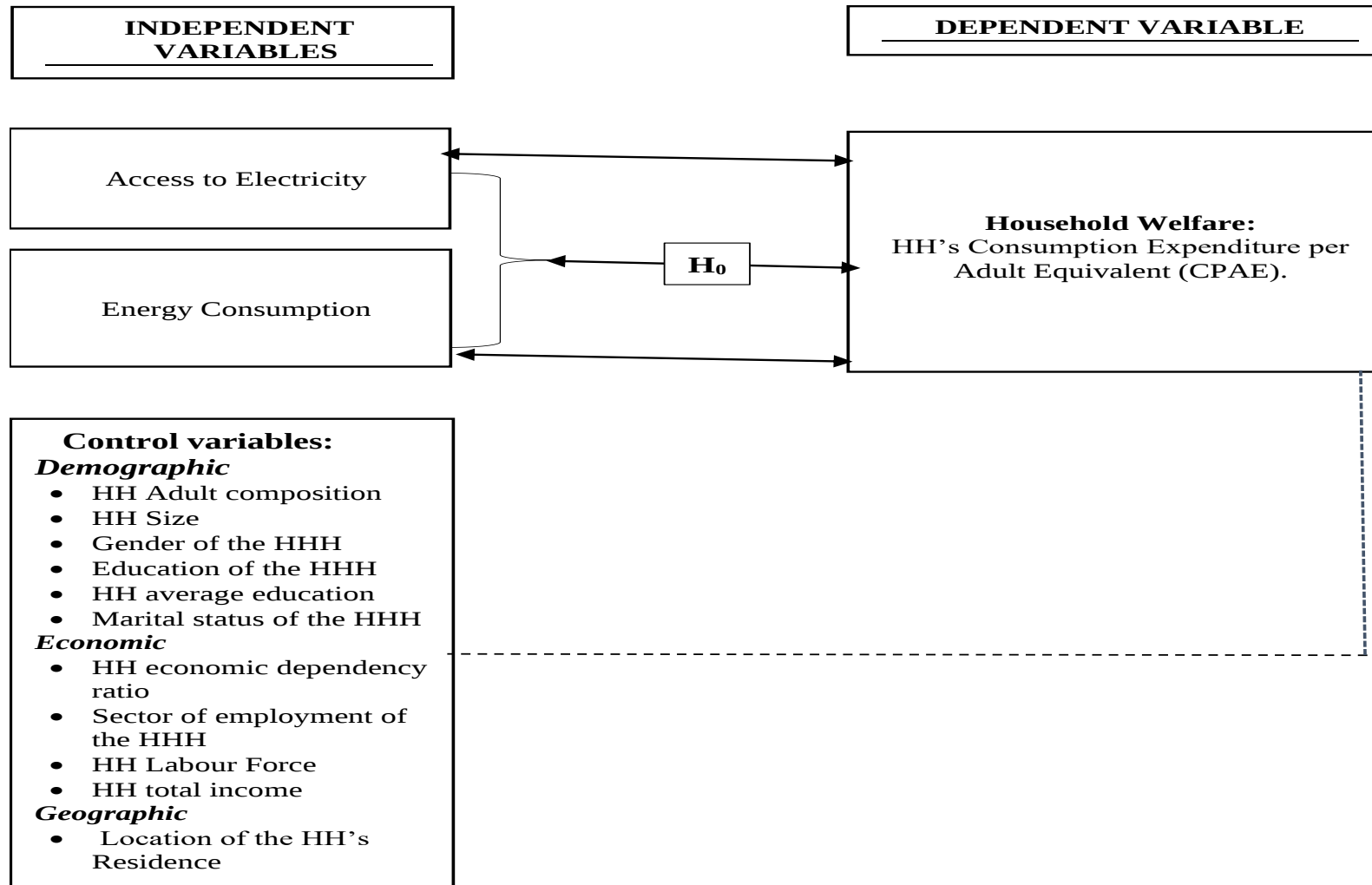
- Empirical literature linking electricity access, energy consumption and welfare of HHs is still wanting , and this motivated the current study.
- Welfare improvement programs undertaken by government in the past have include; Entandikwa, PEAP,PAP,OWC, an among others.
- Specifically, Gou investments in electricity have focused on generation, transmission & distribution and this effort is noted.
- Prioritizing rural electrification (“last-mile” links), unlocking private funding, and resolving distribution transfers will lead to improved HH welfare indicators. In the country.

## Purpose

- To examine relationship between HHs' electricity access, energy consumption and welfare of HH in Uganda.

# CONCEPTUAL FRAMEWORK

**Figure 1.1: Conceptualization of the relationship between electricity access, energy consumption and household welfare**



# THEORETICAL ANCHORING



This study is anchored on;

**1. Bergson-Samuelson Social Welfare Function (BSSWF) (1956); as the main theory.**

*That maximization of happiness of a representative agent, such as a HH head, will eventually maximize the entire HH happiness.*

**2. Other theories that have strengthened the study include;**

- i. The Muellbauer (1980) True indexes of HH welfare model:
- ii. Measuring HH welfare, maximises available budget for goods & services
- iii. The Deaton's (1980) approximations order to accurate living index HH model:  
Estimating consumption in a single-equation model
- iv. The Kusnic and DaVanzo (1980) complete Income-Leisure HH model: HH welfare considers Total income.

# APPLICATION OF THEORIES IN THE STUDY



| THEORY                                                                                                                         | Description                                                                                                                                                                                                              | Justification of use                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>▪ Bergson-Samuelson Social Welfare Function (BSSWF) (1956).</li> </ul>                  | <ul style="list-style-type: none"> <li>▪ That maximization of happiness of a representative agent, such as a HH head, will eventually maximize the HH happiness.</li> </ul>                                              | <ul style="list-style-type: none"> <li>i. It allows for consistent evaluation of policy impacts on individual welfare while respecting the need for ethical clarity and transparency.</li> </ul>                                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>▪ The Muellbauer (1980) True indexes of HH welfare model</li> </ul>                     | <ul style="list-style-type: none"> <li>▪ Muellbauer's (1980) model offers a rigorous and flexible method for constructing true welfare indexes that account for price, income, and demographic heterogeneity.</li> </ul> | <ul style="list-style-type: none"> <li>i. It's widely applied in empirical microeconomics and poverty/welfare measurement, offering better accuracy than traditional price indexes or income comparisons.</li> </ul>                                                                                                                                               |
| <ul style="list-style-type: none"> <li>▪ The Deaton's (1980) approximations order to accurate living index HH model</li> </ul> | <ul style="list-style-type: none"> <li>▪ Deaton's (1980) approximation is a powerful tool to estimate real changes in household welfare using price and expenditure data.</li> </ul>                                     | <ul style="list-style-type: none"> <li>i. It offers a computationally simple, yet behaviorally grounded approach to assess how price and income dynamics affect living standards, particularly useful in countries like Uganda, where comprehensive utility functions may not be available.</li> </ul>                                                             |
| <ul style="list-style-type: none"> <li>▪ The Kusnic and DaVanzo (1980) complete Income-Leisure HH model</li> </ul>             | <ul style="list-style-type: none"> <li>▪ The Kusnic and DaVanzo (1980) income-leisure concept of household welfare by integrating valued non-market time (leisure) with income.</li> </ul>                               | <ul style="list-style-type: none"> <li>i. It emphasizes that ignoring leisure leads to biased welfare comparisons, especially across different working hours, labor statuses, or household types.</li> <li>ii. This model is particularly useful in contexts like Uganda, where informal work, subsistence farming, and gendered unpaid labor dominate.</li> </ul> |

4/22/2026

# METHODOLOGY

| Approach & Design                                                                                                                                                | Data & sources                                                                                                                                                                                           | Analytical tools                                                                                                                                                                                                                                        | Model specification                                                              | Estimation                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>▪ The study followed a quantitative research approach</li> <li>▪ Explanatory and longitudinal research designs</li> </ul> | <ul style="list-style-type: none"> <li>▪ Secondary data</li> <li>▪ Data was obtained UBOS for UNPSs for 4 waves.</li> <li>▪ Specifically, UNPS: 2019/2020, 2017/2018, 2015/2016 and 2013/2014</li> </ul> | <ul style="list-style-type: none"> <li>▪ Descriptive statistics- to understand the patterns &amp; variability in data.</li> <li>▪ Regression analysis - to establish the causal logical relationship between outcome and predictor variables</li> </ul> | <ul style="list-style-type: none"> <li>▪ Regression econometric model</li> </ul> | <ul style="list-style-type: none"> <li>▪ 2SLS-RE and</li> <li>▪ 2SLS-FE to address issues of endogenous regressors , to make the estimates inline with empirical econometrics.</li> <li>▪ Hausman specification test was used and 2SLS- FE was found to be appropriate estimation technique</li> </ul> |

# METHODOLOGY-3

## Model Specification.

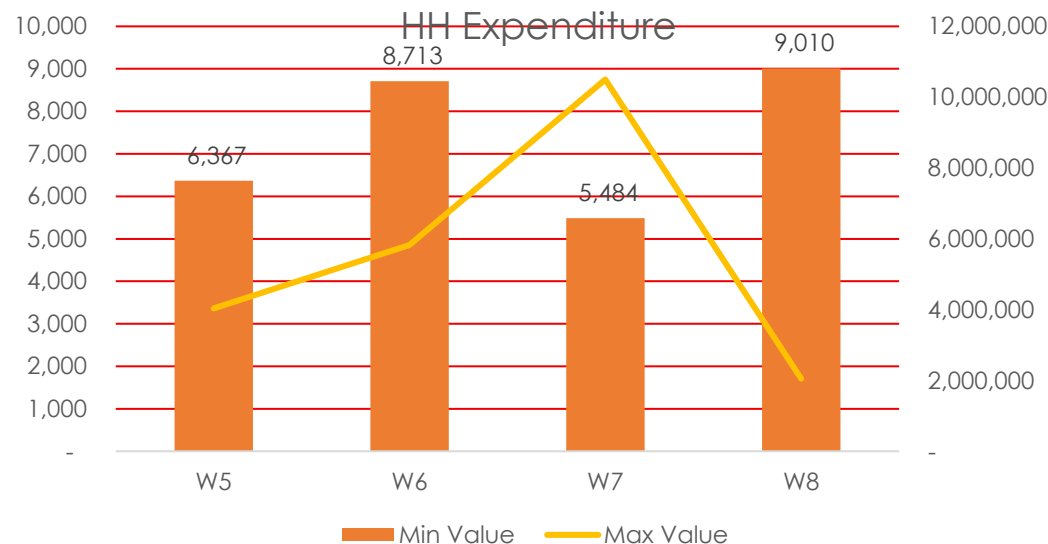
$$\begin{aligned}
 & \text{Log}(\text{consexp\_adul teq})_{it} \\
 &= \delta_0 + \delta_1 \log(\text{hhenergycons})_{it} + \delta_2 \text{hhelectraccess}_{it} + \delta_3 \text{hhsiz e}_{it} \\
 &+ \delta_4 \text{hhresidence}_{it} + \delta_5 \text{hhdepratio}_{it} + \delta_6 \text{hhhgender}_{it} \\
 &+ \delta_7 \text{Log}(\text{hhhincome})_{it} + \delta_8 \text{hhlbrforce}_{it} + \sum_{i=1}^{q-1} \theta_i \text{hhheduc}_{it} \\
 &+ \sum_{j=1}^{q-1} \theta_j \text{hhhemploysector}_{it} + \sum_{k=1}^{q-1} \theta_k \text{hhadultcomp}_{it} + \epsilon_{1t};
 \end{aligned}$$

# KEY FINDINGS

## Descriptive statistics CPAE

Descriptive statistics on Consumption Expenditure Per Adult Equivalent(CPAE) (in UGX per month) of the HH in the sample

| Statistic         | Obs          | Mean Value      | Minimum Value | Maximum Value     | CV           |
|-------------------|--------------|-----------------|---------------|-------------------|--------------|
| Wave 5: 2013/2014 | 2,449        | 65,371          | 6,367         | 4,036,518         | 1.526        |
| Wave 6: 2015/2016 | 2,632        | 109,298         | 8,713         | 5,820,494         | 1.495        |
| Wave 7: 2018/2019 | 2,444        | 113,405         | 5,484         | 10,500,100        | 2.279        |
| Wave 8: 2019/2020 | 2,418        | 138,067         | 9,010         | 2,047,018         | 1.142        |
| <b>Overall</b>    | <b>9,943</b> | <b>106, 485</b> | <b>5,484</b>  | <b>10,500,100</b> | <b>1.697</b> |



- It is revealed that both the maximum and minimum values for HH expenditure are observed in Wave 7, this may be to huge disparities amongst HHs.

# KEY FINDING -2

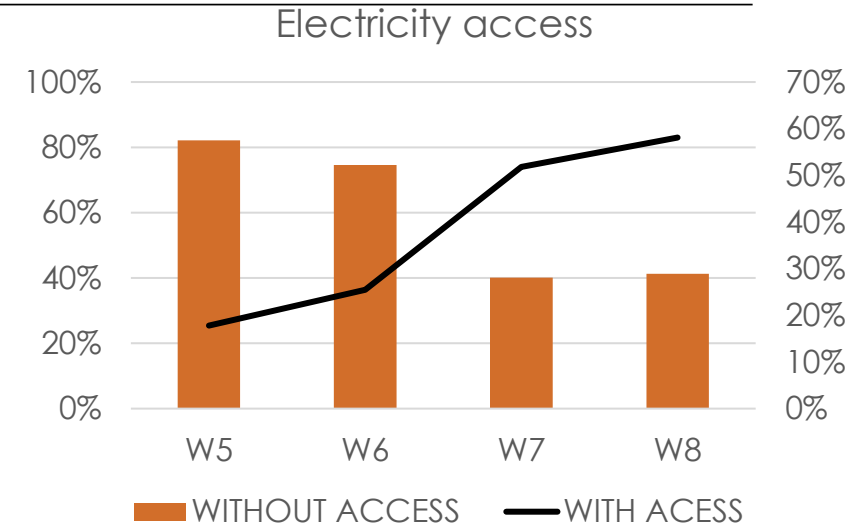
## Descriptive statistics Electricity access by HH

Descriptive statistics on “access to electricity” by households in the sample

| UNPS Wave                               | Households<br>“without access to electricity” |              |              | Households<br>“with access to electricity” |              |
|-----------------------------------------|-----------------------------------------------|--------------|--------------|--------------------------------------------|--------------|
|                                         | Obs                                           | Freq.        | Percent      | Freq.                                      | Percent      |
| Wave 5: 2013/2014                       | 2,449                                         | 2,012        | 82.16        | 437                                        | 17.84        |
| Wave 6: 2015/2017                       | 2,648                                         | 1,974        | 74.55        | 674                                        | 25.45        |
| Wave 7: 2018/2019                       | 2,444                                         | 1,177        | 48.16        | 1,267                                      | 51.84        |
| Wave 8: 2019/2020                       | 2,418                                         | 999          | 41.32        | 1,419                                      | 58.68        |
| Overall                                 | <b>9,959</b>                                  | <b>6,162</b> | <b>61.87</b> | <b>3,797</b>                               | <b>38.13</b> |
| Pearson Chi-sq. = 1200*** (Pr. = 0.000) |                                               |              |              |                                            |              |

Source: Author’s compilation from analysis of raw data

- HH without access to electricity were higher in waves 5 and 6.
- HH with access started increasing in wave 7.



## KEY FINDING -3

### Descriptive statistics Energy Consumption expenditure

**: Descriptive statistics on “energy consumption expenditure” (UGX per month) by households in the sample**

| Statistic         | Obs          | Mean Value   | Minimum Value | Maximum Value  | CV           |
|-------------------|--------------|--------------|---------------|----------------|--------------|
| Wave 5: 2013/2014 | 2,449        | 9,677        | 0             | 255,600        | 1.766        |
| Wave 6: 2015/2016 | 2,648        | 8,766        | 0             | 425,000        | 1.950        |
| Wave 7: 2018/2019 | 2,444        | 9,185        | 0             | 800,000        | 3.066        |
| Wave 8: 2019/2020 | 2,418        | 9,123        | 0             | 225,000        | 2.106        |
| <b>Overall</b>    | <b>9,959</b> | <b>9,178</b> | <b>0</b>      | <b>800,000</b> | <b>2.269</b> |

Source: Author’s compilation from analysis of raw data. Energy consumption expenditure is measured in UGX per month).

**Note:** Subsistence HH use energy at ‘0’ value due to crop residues, firewood from nearby bushes and/natural sources of energy

# KEY FINDINGS- REGRESSION ANALYSIS - 4

## Regression estimates of the empirical model

| Dep. var: Logarithm of household consumption expenditure per adult equivalent |                                           |           |         |                   |           |         |
|-------------------------------------------------------------------------------|-------------------------------------------|-----------|---------|-------------------|-----------|---------|
| Independent Variable                                                          | Model 1: 2SLS-FE                          |           |         | Model 2: 2SLS-RE  |           |         |
|                                                                               | Coef.                                     | Std. Err. | p-value | Coef.             | Std. Err. | p-value |
| Logarithm of energy consumption                                               | 0.1415***                                 | 0.05261   | 0.007   | 0.1716***         | 0.03157   | 0.000   |
| Access to electricity                                                         |                                           |           |         |                   |           |         |
| <i>HH has access</i>                                                          | 0.4723***                                 | 0.07919   | 0.000   | 0.7007***         | 0.07623   | 0.000   |
| <i>Ref: HH has no access</i>                                                  |                                           |           |         |                   |           |         |
| Household size                                                                | -0.0588**                                 | .01002    | 0.000   | -0.0363**         | 0.01189   | 0.002   |
| Logarithm of HH income                                                        | 0.0843*                                   | 0.04499   | 0.061   | 0.0467            | 0.03984   | 0.241   |
| Location of HH residence                                                      |                                           |           |         |                   |           |         |
| <i>HH is in Urban</i>                                                         | -0.1896                                   | 0.1249    | 0.129   | -0.2594**         | 0.08932   | 0.004   |
| <i>Ref: HH is in Rural</i>                                                    |                                           |           |         |                   |           |         |
| Dependency ratio                                                              | -0.0643*                                  | 0.04674   | 0.096   | -0.0141           | 0.02119   | 0.506   |
| Gender of the HHH                                                             |                                           |           |         |                   |           |         |
| <i>HHH is male</i>                                                            | 0.0022                                    | 0.0788    | 0.978   | 0.0167            | 0.06989   | 0.811   |
| <i>Ref: HHH is female</i>                                                     |                                           |           |         |                   |           |         |
| Education level of the HHH                                                    |                                           |           |         |                   |           |         |
| <i>Some Primary Education</i>                                                 | 0.1151                                    | 0.09237   | 0.213   | 0.1582*           | 0.09340   | 0.090   |
| <i>Completed Primary Education</i>                                            | 0.1954**                                  | 0.09901   | 0.048   | 0.2018*           | 0.10517   | 0.055   |
| <i>Some Secondary Education</i>                                               | 0.3011***                                 | 0.09598   | 0.002   | 0.2908***         | 0.10271   | 0.005   |
| <i>Completed secondary education</i>                                          | 0.3118**                                  | 0.13942   | 0.025   | 0.2749**          | 0.12839   | 0.032   |
| <i>Post-secondary education</i>                                               | 0.5945***                                 | 0.10281   | 0.000   | 0.5889***         | 0.11127   | 0.000   |
| <i>Ref: No formal Education</i>                                               |                                           |           |         |                   |           |         |
| Sector of employment of the HHH                                               |                                           |           |         |                   |           |         |
| <i>Industry</i>                                                               | 0.1022                                    | 0.06354   | 0.108   | 0.0288            | 0.07416   | 0.698   |
| <i>Services</i>                                                               | 0.1503                                    | 0.06382   | 0.019   | 0.1449**          | 0.06197   | 0.019   |
| <i>Ref: Agriculture</i>                                                       |                                           |           |         |                   |           |         |
| HH Adult Composition                                                          |                                           |           |         |                   |           |         |
| <i>Only Male Adults</i>                                                       | 0.2930**                                  | 0.13124   | 0.026   | 0.3606**          | 0.14779   | 0.015   |
| <i>Female and Male Adults</i>                                                 | -0.0289                                   | 0.08829   | 0.744   | -0.0382           | 0.10280   | 0.710   |
| <i>Ref: Only female adults</i>                                                |                                           |           |         |                   |           |         |
| HH Labour force                                                               | 0.0600***                                 | 0.01610   | 0.000   | 0.05057***        | 0.01825   | 0.006   |
|                                                                               | <b>R-squared:</b>                         |           |         | <b>R-squared:</b> |           |         |
|                                                                               | Within =0.6888                            |           |         | Within =0.6336    |           |         |
|                                                                               | Between =0.8007                           |           |         | Between =0.8662   |           |         |
|                                                                               | Overall =0.6191                           |           |         | Overall =0.6056   |           |         |
|                                                                               | <b>Hausman specification test</b>         |           |         |                   |           |         |
|                                                                               | <b>Ho:</b> The RE model is well specifies |           |         |                   |           |         |
|                                                                               | Chi-sq. stat. = 169.60 ( p = 0.000)       |           |         |                   |           |         |

Source: Compiled by the author from empirical regressions. \*\*\*p<0.01; \*\*p<0.05; \*p<0.1

## KEY FINDINGS- 5: REGRESSION ANALYSIS

1. Electricity access and Energy consumption have significant positive and individual effects on HH welfare in Uganda.
- 2. Other insights;**
  - i. HH size is associated with negative and significant coefficients.
  - ii. Some HH level education impacts positively on HHW.
  - iii. HH composition with only male adults is associated with improved welfare relative HH with female adults only.
  - iv. Larger HH labour force increases HH welfare.

# DISCUSSION & IMPLICATIONS



- Both access to electricity and energy consumption expenditure have a positive and significant casual effect on welfare as measured by CPAE.
- **Policy implication,** Increasing HH access to electricity and higher energy consumption levels have the ability to increase HH welfare
- Other findings from the regression estimates:
  - i. Large HH size potentially reduces HH welfare
  - ii. HH of HH heads with formal education experience better welfare compared to those without.
  - iii. HH whose adult composition consist of only male adults tend to enjoy a better HH welfare than their female counterparts .
  - iv. HH welfare increases with increase in the size HH labour force (HH members ages 14-64).

# CONCLUSION & RECOMMENDATIONS

- The study establishes that both Electricity access and energy consumption levels, positively impact on HH welfare.
- To improve HH welfare, Governments need to increase HH access to electricity by directing public investments to Electricity consumption and access programs in the country.
- Governments should enhance access and consumption enhancement policies/interventions for environmentally friendly energy mix e.g. subsidy on *(fumba ne yaka)*, energy consumption, price regulation in the energy sector.
- Enhance HH expenditure policies like PDM to stimulate HH consumption expenditure on clean energy mix.

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