UGANDA: COUNTRY LEVEL LIFE CYCLE ASSESSMENT

An assessment of impacts on health, ecosystems and resource use of the transition to e-cook.

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The transition to e-cook from traditional cooking fuels can deliver a range of benefits (and possible impacts) to human health, ecosystems and resource use. Using a Life Cycle Assessment approach, these have been analysed across the full life cycle of cooking, from raw material extraction to final disposal of the cooking devices and the different fuels used. This analysis takes into account the split between rural and urban populations, and their access to electricity.

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BACKGROUND INFORMATION

Taking 2019 as the base year, Uganda had a population of 43 million, with an average family size of 5 people. The population was split 76% rural and 24% urban, with 31.8% of the rural population having access to electricity and 72% of the urban population able to access electricity (World Bank). The main fuels used for cooking were firewood, charcoal, with a very small percentage of the urban population using LPG and electricity, see Table 1

	% Rural pop	% Urban pop	% Total pop
LPG	0	0.1	0
Electricity	0	0.1	0
Firewood	84.9	37.3	73.5
Charcoal	14.5	62.1	25.7

(WHO: Primary reliance on fuels and technologies for cooking, 2021)

Table 1: Fuel type used per % of population

Table 2 shows the daily fuel consumption per household, assuming no fuel stacking.

	Per HH per day
LPG	0.37 Kg
Electricity	1.34 kWh
Firewood	4.44 Kg
Charcoal	2.43 Kg

(Calculated from cooking diaries)

Table 2: Daily single fuel consumption per household

31.8% RURAL ACCESS TO ELECTRICITY

72% URBAN ACCESS TO ELECTRICITY

ASSUMPTIONS

Eleven different scenarios were analysed in comparison to the base case (S0) using the following assumptions:

(a) it was assumed that each household utilised a single fuel for cooking (i.e. no fuel stacking),
(b) access to electricity is synonymous with suitable supply to use electricity for cooking,
(c) for rural population, if 31.8% have access and only 0% currently use electricity for cooking, then there is capacity for a further 31.8% of rural population to transition to electricity,
(d) for urban population, 72% have access and only 0.1% currently use electricity for cooking, then there is capacity for a further 71.9% of the urban population to transition to electricity,
(e) two hypothetical scenarios have been evaluated: 100% LPG cooking and 100% electric cooking. These are not realistic scenarios and have been included to provide an indication of the maximum possible benefits that could be achieved
(f) this analysis was undertaken using a model generated from IEA figures for Uganda's specific energy generation sources.

SCENARIOS EVALUATED

- Base case, in 2019 (S0)
- Shift all charcoal to electricity (S1)
- Shift rural charcoal to electricity (S2)
- Shift urban charcoal to electricity (S3)
- Shift all firewood to electricity (S4)
- Shift rural firewood users to electricity (S5)
- Shift urban firewood users to electricity (S6)
- Shift urban charcoal and as many firewood users as possible to electricity (S7)
- Shift rural charcoal and as many firewood users as possible to electricity (S8)
- Shift urban wood and as many urban charcoal users as possible to electricity (S9)
- All LPG cooking (S10)
- All electric cooking (S11)

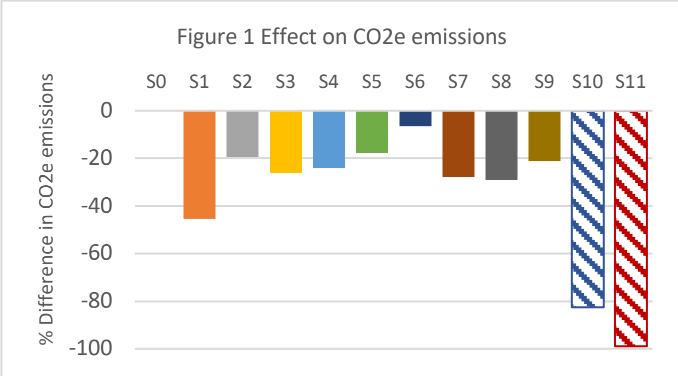
IMPACTS ASSESSED

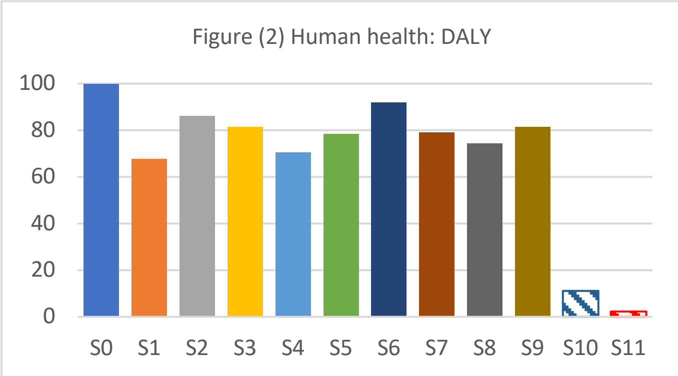
The impacts evaluated were improvement in CO_2 emissions, effect on human health, ecosystems and resource use. These are defined as:

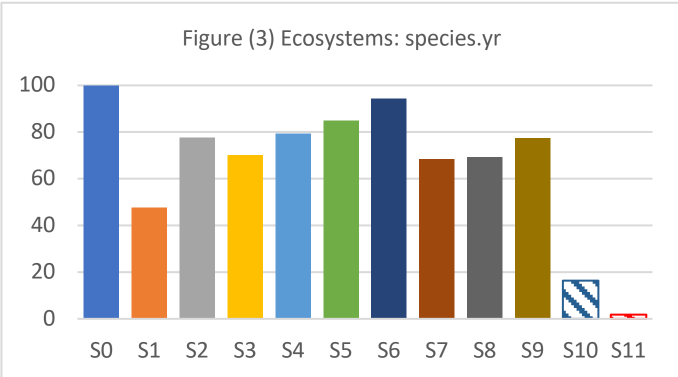
- **CO_2e emissions,** expressed as the change in CO_2 equivalent emissions for the country as a whole. Negative change suggests an improvement in CO_2 emissions, a positive change suggests an increased impact from CO_2 emissions
- **Human Health,** expressed as the number of year life lost and the number of years lived disabled. These are combined as Disability Adjusted Life Years (DALYs). The unit is years.
- **Ecosystems,** expressed as the loss of species over a certain area, during a certain time. The unit is years.
- **Resource scarcity,** expressed as the extra costs of future resource production over an infinitive timeframe (assuming constant annual production), considering a 3% discount rate. The unit is USD2013.

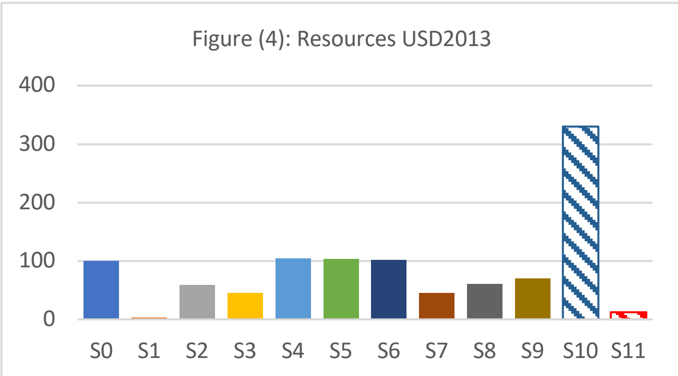
FINDINGS

1) The effect of the cooking devices was seen to be negligible, and the results are dominated by the fuel type.
2) Shifting charcoal users results in a greater than 40% improvement in CO_2e emissions, (S1); in this case the transition is driven slightly more by the urban (S3) rather than the rural (S2) community. Health, ecosystem and resource use outcomes are all improved.
3) Shifting firewood users results in a smaller improvement (approximately 25%) in CO_2e emissions, (S4), but in this case it is driven more by transitioning the rural community (S5). Whilst health and ecosystem outcomes are improved, this scenario results in little change to the resource use.
4) Scenario S7 and S8 suggest that a focus solely on either urban or rural communities, would deliver CO2e improvements, but it is not as rewarding as focussing on transitioning charcoal users in both communities (S1).
5) Comparing the hypothetical scenarios of all LPG (S10) or all electric cooking (S11) shows that both options would deliver improved outcomes for CO_2e emissions, health and ecosystems. However, for resource use, moving to LPG cooking would result in a 3 -fold increase, whereas electric cooking results in a significant drop in resource use.
6) The results normalised against global damage shows that human health impacts







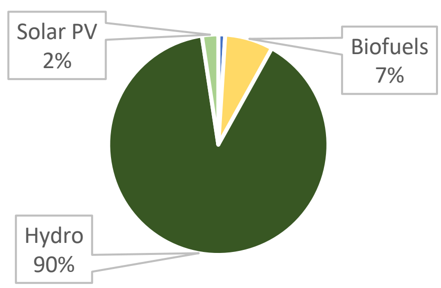


For figures (2), (3) and (4): Base case (S0) = 100 are more significant than those for ecosystems or resources.

CONCLUSIONS

Uganda generates its domestic electricity predominantly from hydro resources, and thus electric cooking is a low carbon option (IEA: https://www.iea.org/countries/uganda/electricity) . This suggests that connectivity to the grid for rural and urban communities would result in improved CO_2e emission outcomes.

From the outcomes of this assessment, it would suggest that an initial focus on charcoal users in both rural and urban locations would deliver the greatest benefits for CO_2e emissions, health, ecosystem and resource outcomes. The second focus area should be transitioning rural firewood users to electric cooking, and where possible, via a grid connection.



Domestic electricity generation sources 2021, IEA

How to use the data

This analysis uses a number of very broad assumptions that are not necessarily representative of all situations; no fuel stacking, that access to electricity is synonymous with a supply that is suitable and can support electric cooking, and that access will be to the grid system. In addition, it is assumed that the grid supply will expand using similar sources for energy generation, e.g. if electricity is mainly produced by hydro sources, then the increase in supply needed to match the uptake in electric cooking will also be supplied from hydro sources.

The results themselves are a combination of influencing factors: access to electricity (the number of households that can transition), and carbon intensity of the fuels.

As such, these results should be viewed as generic trend data, as opposed to specific values for the country assessed. The results aim to provide a broad brush assessment of the likely direction of travel for the impact categories chosen (CO_2e emissions, human health, ecosystem degradation, and resource use), as a result of a transition to electric cooking.

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