CAMBODIA: COUNTRY LEVEL LIFE CYCLE ASSESSMENT

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

UKaid from the British people

MECS Modern Energy Cooking Services

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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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www.mecs.org.uk

BACKGROUND INFORMATION

Taking 2019 as the base year, Cambodia had a population of just over 16 million with an average family size of 5.45 people. The population was split 76% rural and 24% urban, with 80% of the rural population having access to electricity and 96.9% of the urban population able to access electricity (World Bank). The main fuels used for cooking were LPG, electricity, firewood and charcoal, see Table 1.

	% Rural pop	% Urban pop	% Total pop
LPG	8.8	60.6	21.2
Electricity	1.0	4.6	1.9
Firewood	81.7	22.2	67.4
Charcoal	6.3	10.7	7.4

(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.

	Per HH per day
LPG	0.5 Kg
Electricity	3.31 KWh
Firewood	5.77 Kg
Charcoal	2.33 Kg

(Based on data from Ecook reports)

Table 2: Daily single fuel consumption per household

80% RURAL ACCESS TO ELECTRICITY

96.9% 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 a suitable supply to use for electric cooking,
(c) for rural population, if 80% have access and only 1% currently use electricity for cooking, then there is capacity for a further 79% of rural population to transition to electricity,
(d) for urban population, if 96.9% have access and only 4.6% currently use electricity for cooking, then there is capacity for a further 92.3% 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.

SCENARIOS EVALUATED

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

IMPACTS ASSESSED

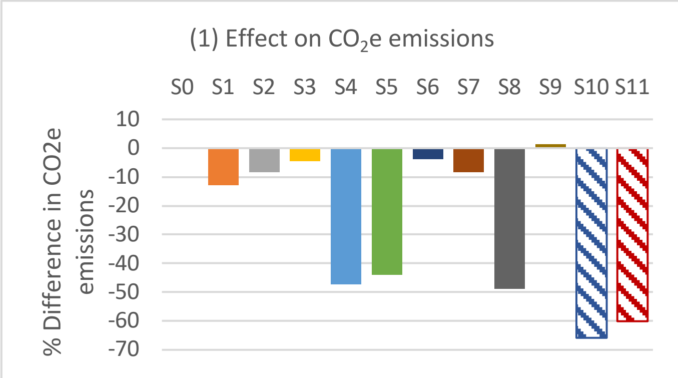
The impacts evaluated were improvement in CO_2 emissions, effect on human health, ecosystems and resource use. These are defined as:

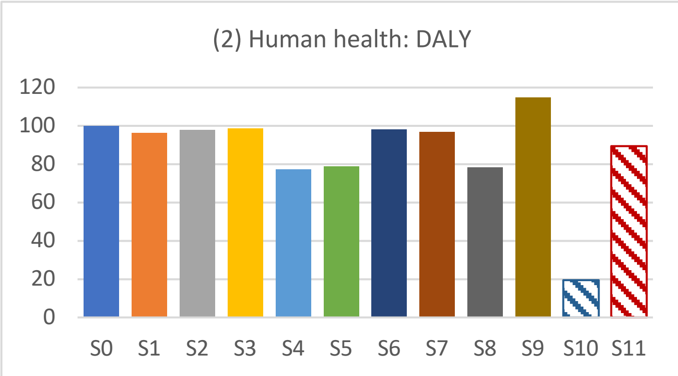
- **CO_2e emissions,** expressed as the change in CO_2 equivalent emissions for the country as a whole. Negative change suggests an improvement in CO_2 emissions, a positive change suggests an increased impact from CO_2 emissions

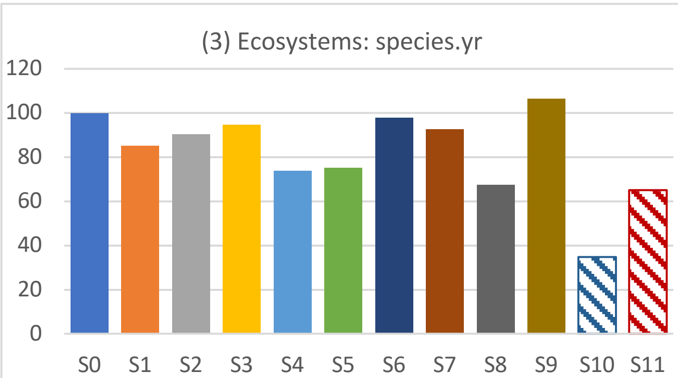
- **Human Health,** expressed as the number of year life lost and the number of years lived disabled. These are combined as Disability Adjusted Life Years (DALYs). The unit is years.
- **Ecosystems,** expressed as the loss of species over a certain area, during a certain time. The unit is years.
- **Resource 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

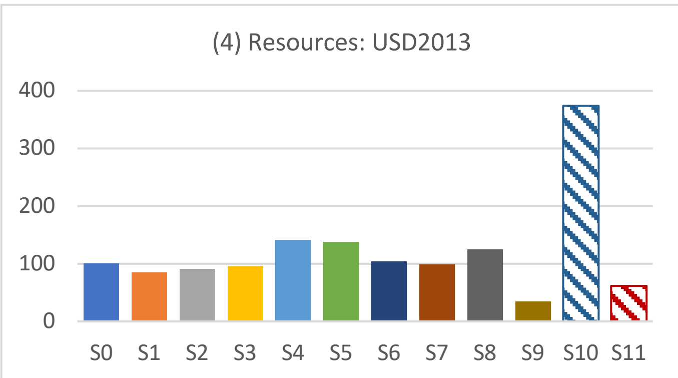
FINDINGS

1) The effect of the cooking devices was seen to be negligible, and the results are dominated by the fuel type.
2) Switching charcoal users (S1) to electric cooking delivers around 10% CO2e emissions benefits, alongside improvements in health ecosystems and resource use. The benefits are mainly driven by the transition of the rural communities (S2).
3) Switching wood users (S4), and especially rural wood users (S5) delivers a significant improvement in CO_2e emissions (approximately 45%), human health and ecosystem, but an increase in resource use.
4) The increase in resource impact that results from the shift to electric cooking from firewood could be explained by the assumption in the model that firewood is essentially a ‘free’ resource, i.e.: it is collected via natural wood harvesting (fallen wood) as opposed to a system where wood is managed and harvested in an plantation type environment as part of a business, (with associated material and energy inputs). Thus, shifting from the ‘free’ resource to that of resources needed for electricity production (infrastructure, materials and fuels) leads to the negative impact for resource use.
5) Scenario S7 assesses the impact of a focus on the transition of urban users to electric cooking. In this case, a modest improvement in CO_2e emissions (<10%) with small improvements in health and ecosystems could be expected. There is no appreciable change to resource use.
6) Scenario S8 assesses the impact of a transition focussing on rural communities. This scenario delivers the best outcomes for CO_2e emissions (nearly 50%), health and ecosystems, but does result in a small increase in resource use. The









For figures (2), (3) and (4): Base case (S0) = 100 main driver for the benefits from the transition of the rural community are from the switch away from firewood (S5).

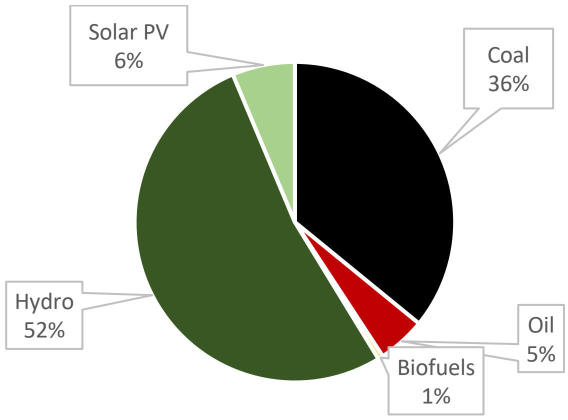
7) Switching existing LPG users to electricity (S9) results in a slight increase in CO_2 emissions, and an increase in damage to human health and ecosystems, but a significant reduction in resource use.
8) Exploring the effects of a hypothetical switch to all LPG (S10) and all electric cooking (S11), the assessment shows there is a marginal benefit in CO_2e emissions, and significant health and ecosystems outcomes for LPG use, over that for all electric cooking. All electric cooking delivers better resource use than all LPG cooking (all LPG cooking delivers a near 4-fold increase in resource use).
9) The results normalised against global damage show that the human health impacts are more significant than those for ecosystems and resource use.

CONCLUSIONS

Domestic electricity supply in Cambodia relies on fossil fuels for about 40% of its generation (IEA: https://www.iea.org/countris/cambodia/electricity). This results in a moderately carbon intensive grid system, similar to the carbon intensity of LPG.

The results suggest a focus on the rural community, initially shifting firewood users to electricity, and then charcoal users. Moving existing LPG users to electricity could deliver a worsening impact for all impacts except resource use.

Given the moderately high carbon intensity of grid electricity production, it could be potentially useful to assess the possibility of utilising renewably sourced mini-grids in the rural areas, as an interim measure until the national grid is decarbonised. This would reduce CO2e emissions and improve health and ecosystem impacts.



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 via 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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