

## University Meets Microfinance How can microfinance contribute to fight energy poverty?

# The role of energy in development processes

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## *Energy poverty and demand modeling for the case of Arequipa (Peru)*



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1. The Energy Poverty Penalty
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## Energy Poverty (1)

### *What is Energy Poverty?*

Mostly used:

- Mere access to electricity & dependency on biomass (IEA 2010); ext: intermittent electricity supply
- Development of energy access criteria: ranking DCs in their progress toward modern energy access – EDI (IEA 2011):
  1. Per capita commercial energy consumption
  2. Per capita electricity consumption in the residential sector
  3. Share of modern fuels in total residential sector energy use
  4. Share of population with access to electricity

## Energy Poverty (2)

### *What is Energy Poverty?*

Mostly used:

- definition of a basic energy need minimum / an energy poverty line over amount of energy consumed (Practical Action 2010)
- energy expenditures as a proportion of total income bigger than 10% (Barnes 2005)
- threshold point at which energy consumption begins to rise with increases in household income (Khandker et al. 2012)

## Energy Poverty (3)

Energy service	Minimum standard
1 Lighting	300 lumens at household level
2 Cooking and water heating	<p>1 kg woodfuel or 0.3 kg charcoal or 0.04 kg LPG or 0.2 litres of kerosene or ethanol per person per day, taking less than 30 minutes per household per day to obtain</p> <p>Minimum efficiency of improved wood and charcoal stoves to be 40% greater than a three-stone fire in terms of fuel use</p> <p>Annual mean concentrations of particulate matter (<math>PM_{2.5}</math>) &lt; 10 <math>\mu\text{g}/\text{m}^3</math> in households, with interim goals of 15 <math>\mu\text{g}/\text{m}^3</math>, 25 <math>\mu\text{g}/\text{m}^3</math> and 35 <math>\mu\text{g}/\text{m}^3</math></p>
3 Space heating	Minimum daytime indoor air temperature of 12°C
4 Cooling	<p>Food processors, retailers and householders have facilities to extend life of perishable products by a minimum of 50% over that allowed by ambient storage</p> <p>All health facilities have refrigeration adequate for the blood, vaccine and medicinal needs of local populations</p> <p>Maximum indoor air temperature of 30°C</p>
5 Information and communications	<p>People can communicate electronic information beyond the locality in which they live</p> <p>People can access electronic media relevant to their lives and livelihoods</p>
6 Earning a living	<p>Access to energy is sufficient for the start up of any enterprise</p> <p>The proportion of operating costs for energy consumption in energy-efficient enterprises is financially sustainable.</p>

*Reproduced from Practical Action, 2010, p. 33.*

## Concept of Energy Poverty Penalty (1)

- Hypothesis:

***The existence of an energy poverty penalty implies that poorer people tend to spend more on energy relative to their total income than comparatively richer people.***

Additional penalties:

- poor quality: not taken into account
- hazardous to health: not taken into account

## Concept of Energy Poverty Penalty (2)

### Potential reasons:

- urban bias: limited choice/ access (capabilities)
- no affordability
- higher cost of decentralized technologies vs. centralized technologies
- less production potential (controversial)
- lack of energy literacy (not addressed)

## Research methodology

### ■ Hypothesis:

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**Table 13: Regression outputs for (relative) energy expenditure determinants**

VARIABLES	(1) OLS rel_en_exp_inc	(2) OLS2 rel_en_exp_inc	(3) OLS3 tot_en_exp_mix	(4) OLS3 tot_en_exp_mix
z_assetind_100			21.54*** (4.950)	22.11*** (5.015)
Credit	-0.00147 (0.00163)	-0.00153 (0.00164)	10.10 (12.10)	10.08 (12.23)
Elec	-0.00959*** (0.00287)	-0.00955*** (0.00266)	-21.37 (22.75)	-21.94 (23.34)
Cay			-40.39** (19.09)	-35.90** (14.76)
Cas	-0.00522*** (0.00187)	-0.00519*** (0.00178)	-49.97*** (16.25)	-47.75*** (12.76)
Lau			-62.48*** (18.93)	-65.77*** (15.60)
Arq			-7.616 (25.98)	
Microbus	-0.00129 (0.00178)	-0.00133 (0.00175)	19.85** (10.07)	19.95** (9.992)
mob_cov	-7.88e-05 (0.000816)		8.192 (6.073)	7.805 (5.827)
Distance	0.00148 (0.00139)	0.00149 (0.00137)	-7.953 (14.53)	
tech_adap	-0.000866** (0.000433)	-0.000867* (0.000446)		
produc_pot	0.000948* (0.000526)	0.000931* (0.000522)		
energy_lit	-8.65e-05 (0.000416)			
Constant	1.010*** (0.00494)	1.009*** (0.00364)	-2,050*** (496.7)	-2,116*** (501.3)
Observations	261	261	269	269
R-squared	0.118	0.118	0.131	0.130

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Findings (I)

- People spend on average approx. S/. 22 more on energy per month if the asset index is increased by one unit and almost S/. 20 more if they represent a micro-business.
- Electricity only accounts for 40% of total energy expenditure
- La Unión with comparatively high rate of off-grid population paired with high income levels
- only 5% of the micro-businesses stated to use energy for work purpose: intangible nature? vs. higher exp (OMV?)

## Findings (II)

- Mobile phone coverage is empirically tested to serve as a proxy for the degree of remoteness (strong qualitative analysis results, weak quantitative results)
- Statistically significant and robust evidence for existence of an Energy Poverty Penalty
- sample percentage of dependency on biomass (43%) doubles the total Arequipan average
- S/.64 per month on fuel wood
- opportunity cost is computed to amount to one hour per day

## Findings (III)

- no preferences revealed with regard to a large demand for alternative lighting

Type of back_up	Overall	Off-grid
Photovoltaic	3.8%	14.3%
Diesel Generator	2.0%	3.2%
Candles	88.3%	82.5%
Petroleum	0.0%	0.0%
Gas	0.0%	0.0%
Car batteries	2.6%	7.9%
Small batteries	40.4%	34.9%
Other	1.2%	0.0%

- Anecdotal evidence for appliance breakages as a consequence of load shedding

## Energy Inclusion

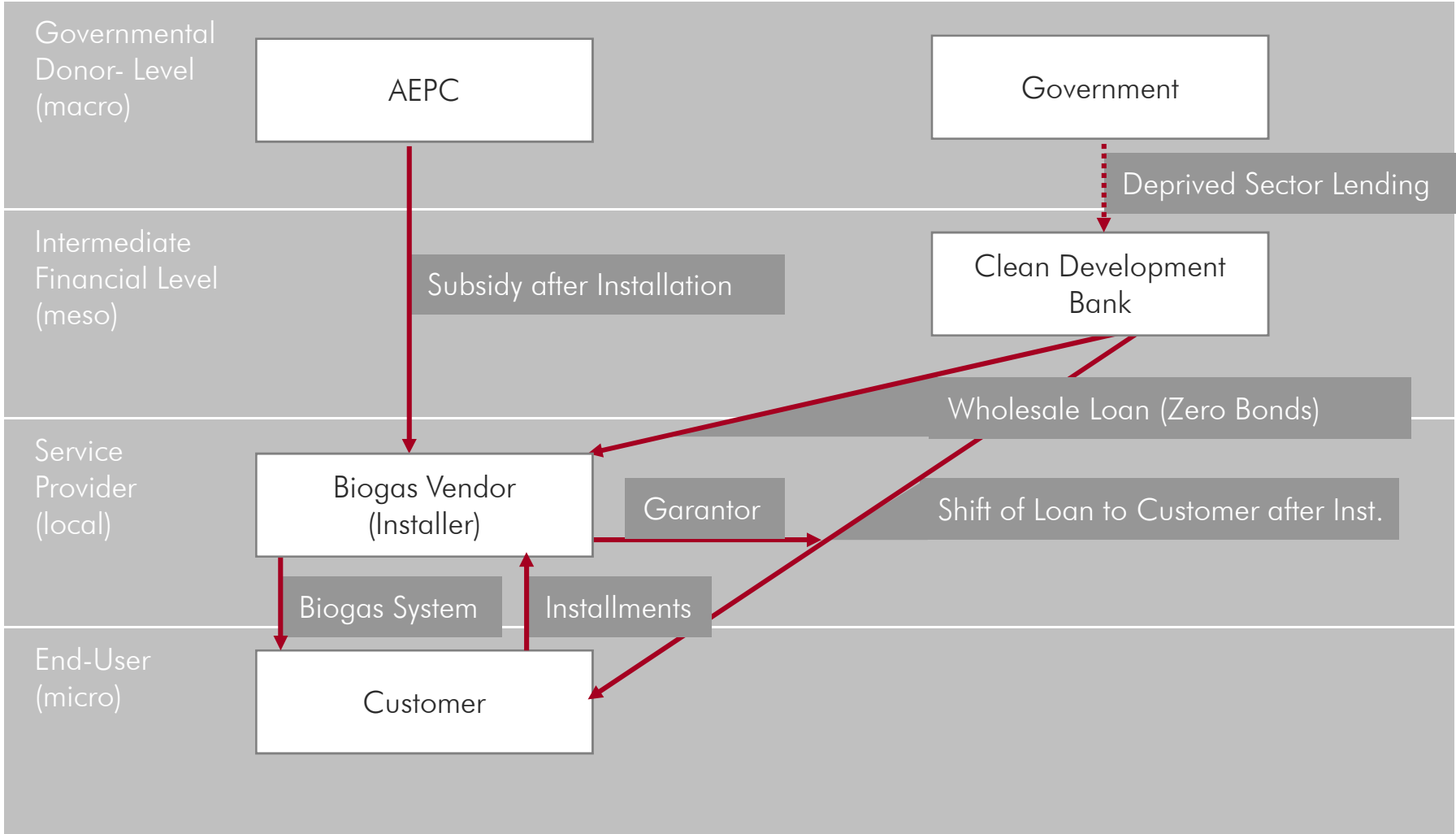
*Energy inclusion may be defined as a process of ensuring access to clean and reliable energy services for vulnerable groups such as weaker sections and low income groups at an affordable cost.*



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# Clean Development Bank – Biogas Vendor Model Nepal





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**Thanks a lot for your attention.**

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Int. Conference, Berlin, Feb 27.- Mar 1 2013:  
Microperspective for decentralized energy supply  
<http://www.microenergysystems.tu-berlin.de/conference/>



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