Evaluation of the economic impacts of efficient stoves and cooking fuel substitution for urban households in Dar es Salaam, Tanzania

The Role of Renewable Energy for Poverty Alleviation and Sustainable Development in Africa

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Objetive and focus

To verify quantitatively the economic impacts of:

- Improving efficiency in production and consumption of charcoal,
- Substitution of charcoal by LPG

- Criterias
  - Unit cost of useful energy – US$/MJ
  - Proportion in the importation values
  - Tax exemptions and loss in Government revenues
  - Cost of subsidy

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Structure

1. Introduction
   a) Cooking fuels
   b) Cooking energy consumption per capita
   c) Cooking energy efficiency
   d) Energy transition
2. Cooking energy access and use in Dar es Salaam
   a) Efficient stoves programmes
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   a) Use of efficient charcoal stoves
   b) Substituting charcoal by LPG
      i. Tax exemption on LPG
      ii. LPG use, imports and exports values
      iii. Tax exemption and loss in government revenues
      iv. Direct subsidies to LPG
4. Conclusions

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Cooking Fuels: characteristics

Traditional fuels: chacoal, firewood, animal dung, farm residues

- Low combustion efficiency in traditional stoves:10-25%
- Emission of GHGs: CO_2, CH_4, N_2O
- Elevated emission of CO and TSP
  - Emits up to 20 times more than the recomended limits of WHO and EPA
  - Causes *ARI*
- Contributes to deforestation

Modern Fuels: GLP, kerosene and Electricity

- High combustion efficiency: 30-60%
- Increases emission of GHGs (CO_2)
- Expensive in rural areas
  - Imported: fuels and the stoves
  - High distribution costs
- Variable price: price of petrol

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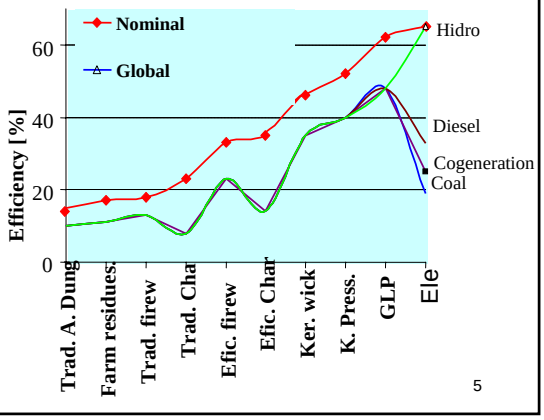
Cooking energy: consumption efficiency

Nominal efficiency increases in the following order: animal dung, farm residues, firewood, charcoal, kerosene, GLP and electricity

- There is exception nominal>global
- Notably for charcoal and electricity
- Maximum Efficiency in charcoal production ~35%, diesel generator:~40, Cogeneration: ~70,
- Transmission losses: 85%



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Cooking energy: consumption per capita

Depends on
- Stove efficiency
- Type of fuel

Typical consumption values *per capita* varies from 11.5 to 49 MJ/day
- Woodfuel: 1.6-8.1 GJ/year: Bangladesh (1970-1982)
- Woodfuel 8.0 GJ/year: South India (begin of 80's)
- LPG: 1.5-2.0 MJ/day: United States (70's)

Average useful cooking energy per capita: 1GJ/year

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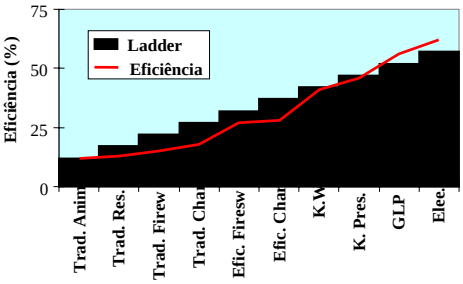
Cooking energy: energy transition

Energy Transition

- Increase in the consumption of modern fuels
- Decrease in consumption of cooking energy per capita
  - *Use of efficient fuels and stoves*

Energy ladder

- Describes the energy transition as if going up the ladder
- The transition is impulsioned by family income



Costs >>>

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Cooking energy: fuel choice

Energy transition and fuel choice

Does not depend only on family income, there are many other factors and the choice is multidirections

Examples:

Supply

- Prices and initial costs
- Availability
- Time and labor requires in the collection and consumption

Demand

- Climate
- Culture (diet, mode of food preparation)
- Stove's efficiency

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Cooking energy access and use in Dar es Salaam

***Focus:* Dar es Salaam**

- Major city, Pop. 2,7 millions (7% of Tanzania)
- Many uses charcoal as the principal fuel.
  - 40% traditional stoves
  - 30% efficient stoves
- 25% Kerosene,
- 4% with Electricity
- ~1% with LPG
- Consumes about half of the charcoal produced in the country: ~360 thusands t/year,
- Consumption *per capita*: 168 kg/year (~5 GJ/year)
- Small use of LPG 3.6 thousand t/year

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Interventions

Features	**Interventions**
Charcoal	
○ Low efficiency in the production and consumption	○ More use of efficient charcoal stoves
○ Contribution in deforestation, areas surrounding cities	○ Substituting charcoal by LPG
○ Emissions of TSP, CO and CO_2	
LPG	
○ High costs: US$ 1300 – 1500/t of which 35-40% are taxes	○ Tax exemptions ○ Subsidies

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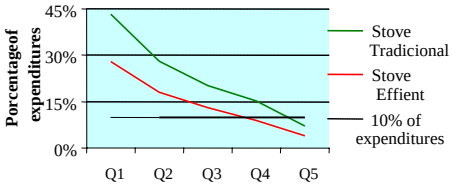
3: Energy costs and economic burdens

Percentage of energy in family expenditures

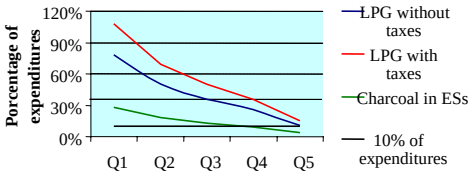
Efficient Charcoal Stoves

- Expenditure decrease significantly in Q1, Q2 and Q3
- Q4 and Q5 spends less than 10%



Substituting charcoal by LPG

- With or without taxes constitutes large part of family expenditures.
- Energy expenditures less than 10% only for Q1



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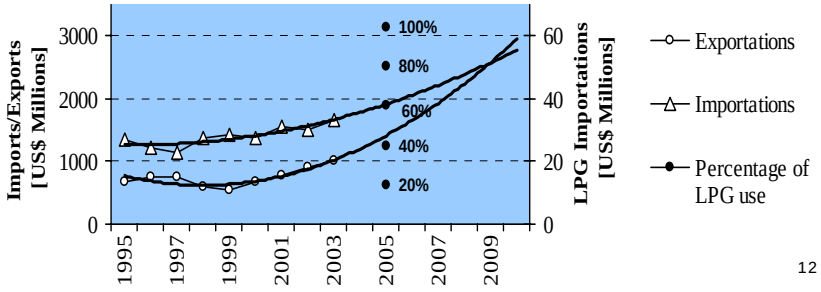
3. Energy Costs and Economic burdens

LPG use, imports and exports values

- Extrapolate Export/Import: Importation value in 2005 = US$ 1913
- LPG consumption estimated at 5,000 tons in 2005 (US$ 2.5 Mil) equiv. to 0.13% - LOW
- LPG use at 20% in Dar: US$ 12.6 mil, equiv. 0.66%
- LPG use at 100%: equiv. 3.3% - LOW?



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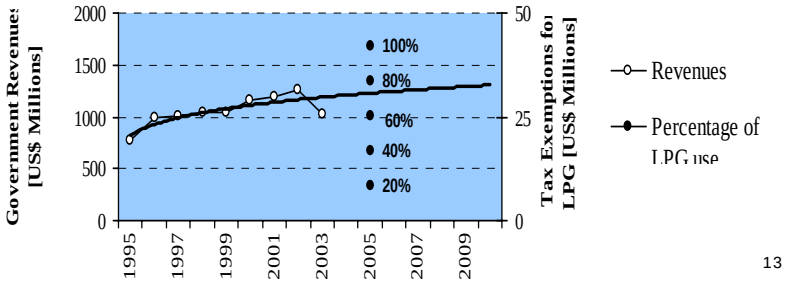
3. Energy Costs and Economic burdens

LPG use, Loss in Government Revenues

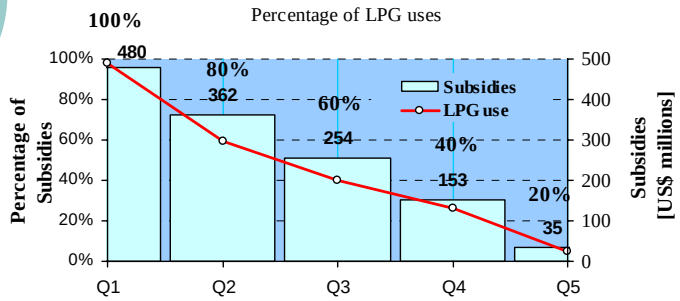
- Government revenues projected at US$ 1300 in 2005
- LPG consumption at 5,000 tons, 2005
- Full tax exemption in 2005: loss of US$ 0.4 mil (0.003%) - LOW
- 20% LPG use: loss of US$ 8.4 mil, 0.06% - STILL LOW



3. Energy Costs and Economic burdens

Subsidies to LPG

- to reduce LPG costs to 10% of family expenditures



- Necessary for more than 80% of the population
- Families in Q1 will need 98% subsidy
- Subsidizing LPG for 100% of the population costs US$ 480 millions, equivalent to 18% of the recurrent government expenditures –HIGH.

Conclusions

Criteria	Efficient charcoal stove	LPG
Cooking energy demand	Low	High
Unit cost of useful energy	Low	High
Proportion in the import values	n/a	Low
Tax exemption and loss in Government revenues	Low	Low
Cost of subsidy	Low	High
Others (not analyzed here)		
Uncertainty in supply of fuel	Low	High
Emission of GHG	Low	High
Creation of employment - local	High	Low
Indoor air pollution	High	Low
Wood demand and deforestation	Low	Low

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Conclusions

Large use of LPG is unlikely in short term
- High costs: up to 3 times more expensive
- Tax exemption alone is not sufficient to make LPG affordable
- Subsidies: too expensive
- Uncertainty in supply

Develop and promote use of other efficient fuels from domestic resources (liquid and gaseous biofuels), hydro, coal and natural gas

Transitional measures: increasing use of efficient stoves

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