Average amount of Biofuels needed by one person per day in developing countries

WOOD FUEL: 1 Kg / day x capita

CHARCOAL: 0.287 Kg / day x capita

BIOGAS: 0.8 m^3 / day x capita

BIO-SYNGAS: 1.37 m^3 / day x capita

BIOETHANOL: 0.260 li / day x capita

(Av. in Africa, India, Indonesia, China, Mexico)

Biomass Resources of major interest for conversion into gaseous cooking fuel

- Straw
- Corn stalk
- Bagasse
- Agriculture residues (any type)
- Forestry residues
- Herbaceous crops

Economics (estimation)

COST OF BIOSYNGAS (in Developing Countries)
based on biomass cost of 20 €/t (moisture 10%)
and capacity of plant ~ 130 t BioSynGas/y

250 €/t BioSynGas
(~ 500 €/TOE)

SPECIFIC INVESTMENT COSTS (indicative)

~ 2,800 €/t x year (Europe)
~ 950 €/t x year (Developing Countries)

In Dev. Countries after transfer of technology the investment and BioSynGas production cost could be reduced considerably

BioSynGas main characteristics

HEATING VALUE: 4,500 Kcal/Kg (0.45 Kg OE/Kg)

SPECIFIC WEIGHT: 0.67 Kg/Nm^3

CHEMICAL COMPOSITION: (steam reforming at 850°C)
(average values)

H_2	51.8% in volume
CO	45.1% in volume
CO_2	2.7% in volume
CH_4	0.4% in volume

M.H.V. gas generator-stove (China)

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LATIN AMERICA THEMATIC NETWORK ON BIOENERGY

LAMNET

Biomass Gas Generators

to supply

Low pollution Cooking Fuels

(in villages or small towns)

Concept developed by Dr. Ing. Giuliano Grassi, EUBIA - Brussels.

Project & Experimental activity: Prof. Leonetto Conti, University of Sassari and Dr. Raffaele Ostan, Saronno (Milano).

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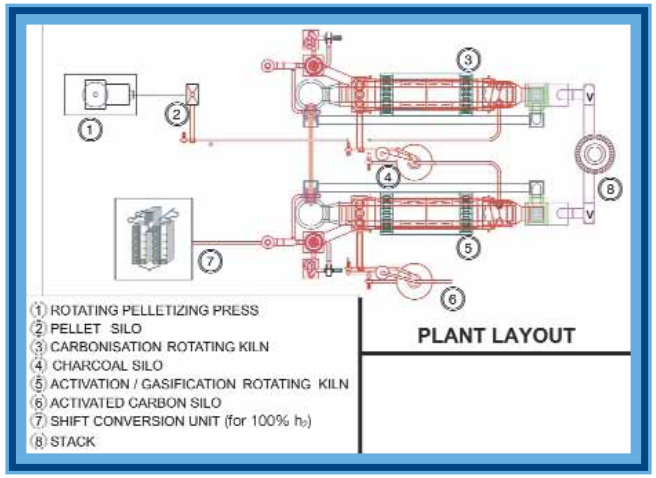

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Only a portion of the energy content of the fuel is absorbed by the food to be cooked

Cooking fuel efficiency
(Typical Useful Energy / Input Energy)

BIOFUELS	% OF HEAT UTILISED FOR COOKING
Wood Open Fire	5 - 10%
Brick - Stoves	12 - 15%
Charcoal	20 -25%
Biogas / BioSynGas	30 - 40%
Vegetal Oil	40%
Bioethanol	40%

CONVENTIONAL FUEL	
Natural Gas (0.8 Kg OE/m^3)	43%
Kerosene (1 Kg OE/Kg)	30 - 40%
L.P.G. (1.1 Kg OE/Kg)	40 - 60%
1KW Electricity (0.086 Kg OE)	65%

Biomass can be converted into modern cooking fuel (BioSynGas)

Conversion of solid Biomass into cooking BioSynGas

TECHNOLOGY: 3 steps process

1st drying & pelletisation of biomass
2nd Carbonisation of pellets
3rd Steam reforming of charcoal pellets

MASS CONVERSION EFFICIENCY

~ 0.6 Kg BioSynGas / Kg of pellets
(0.280 Kg OE / Kg of pellets)

ENERGY CONVERSION EFFICIENCY (from Humid Biomass)

BioSynGas energy content / energy content of biomass

η = 68%

The importance of cooking fuels

The availability of an adequate amount of cooking energy is a vital element for a correct nutrition of human being.
Thereby the energy utilisation efficiency depends on the type of fuel and of the cooking systems.
The useful food input energy for cooking varies considerably and the dietary (cooking) habit changes from continent and among countries.
In industrial countries the most used cooking energy sources are: Natural – Gas / Town – Gas / L. P. G. / electricity.
In many Developing Countries the most usual cooking fuels are: solid, gaseous, liquid biofuels like:

- Wood fuels (30% moist.) 0.28 Kg OE/Kg
- Residues (briquettes – pellets) 0.45 Kg OE/Kg
- Dung wastes (15% moist.) 0.34 Kg OE/Kg
- Charcoal (0.7 Kg OE/Kg)
- Biogas (0.5 Kg OE/m^3)
- M.H.V. (gas average 0.31 Kg OE/m^3 - 0.67 Kg/m^3)
- Vegetal oils (1 Kg OE/Kg)
- Low grade (96°) Bioethanol (0.65 Kg OE/Kg)
- Bioelectricity (0.085 Kg OE/KWhe)
- Bioethanol (95°) (0.665 Kg OE/Kg)

Wood fuel had been, for a long period, the only source of energy for cooking.

Cooking Energy needs (per person)

DEVELOPING COUNTRIES (INDIA)

Firewood Energy Input: 150 Kg OE/y
(corresponding to ~ 1 dry Kg/day pro capita)
Modern Energy Input: ~ 40 - 50 Kg OE/y

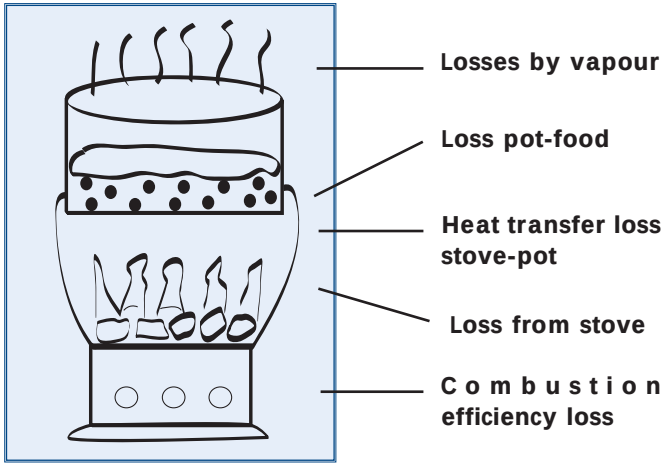
INDUSTRIAL COUNTRIES:

Input Energy ~ 50 Kg OE/y

INPUT OF USEFUL ENERGY INTO FOOD

15 Kg OE/y

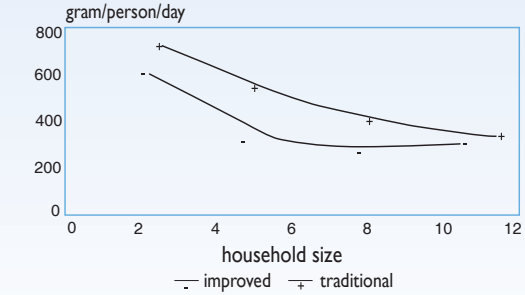
Energy losses during cooking
(Conventional Stove and Pot)



Influence of the type of cooking pot on the fire wood consumption

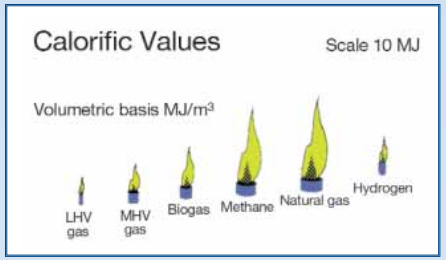
	Kg wood/Kg food
CLAY POT	1,5
ALUMINIUM POT	1

CHARCOAL CONSUMPTION
for improved and traditional stoves



80 households in Kigali households were visited daily during a two week period

Source: W.B.



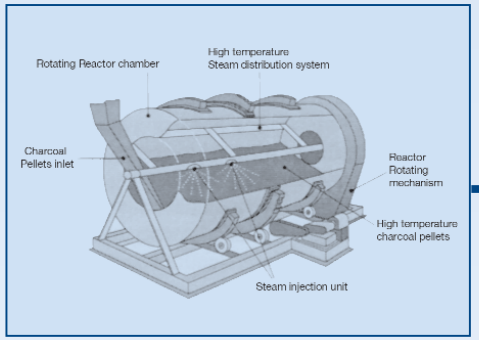
MODERN GASEOUS FUELS COMPARISON

BIOMASS PELLETS

PELLETS CARBONISATION PLANT (second step process)

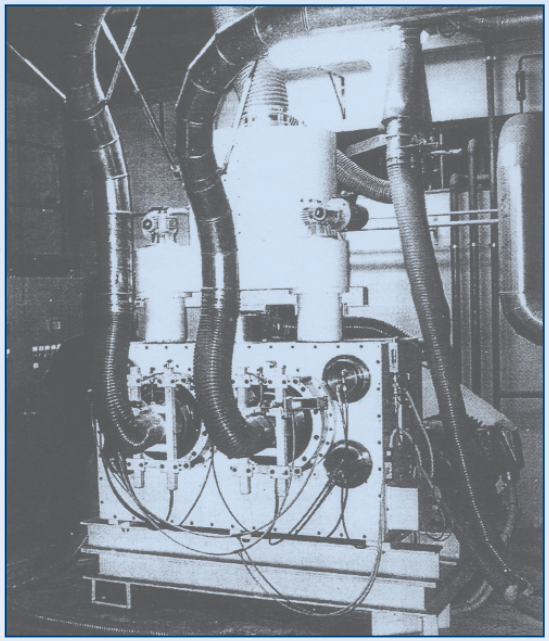
STEAM REFORMING OF CHARCOAL PROCESS (third step process)

CHARCOAL PELLETS



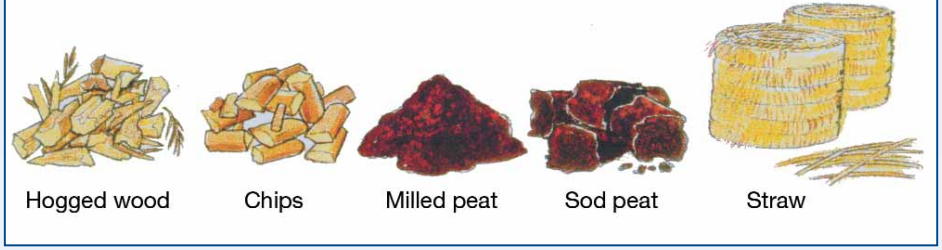
BIOSYNGAS

TYPICAL GAS STOVE



DRYING & PELLETING MILL (first step process)

TYPICAL SOLID BIOMASS RESIDUES



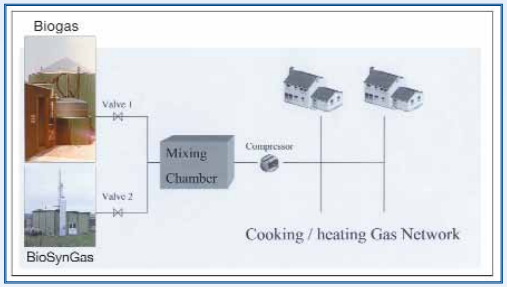
ECONOMIC ANALYSIS OF PRODUCTION (Europe)

Sorghum Bagasse (moisture 30%) 45,000 t/y (1€ = 1.25$)

		CHARCOAL	BIOSYNGAS
Output	t/y	11,690	21,300
Total Investment	M€	3.156	5.155
Yearly Costs	M€	1.915	2.426
Market price	€/t	215	138
Sales	M€/y	2.141	2.931
Gross Profit	M€/y	0.503	0.505
Net profit (taxation 45%)	M€/y	0.276	0.277
Spendable Profit	M€/y	0.592	0.792
Payback time	years	5.3	6.5
Return of investment	%	18.8	15.4

From the economic analysis it appears that it is possible by large capacity plants to produce Charcoal at 160 €/t - BioSynGas at ~ 500 €/TOE).
In Developing Countries better economic results are expected

Scheme of BIOGAS+BIOSYNGAS DISTRIBUTION (in villages)



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The activities of LAMNET include the analysis of available bioenergy technologies and systems as well as the development and implementation of policy options for the promotion and deployment of bioenergy.

Should you wish to receive more information on this Thematic Network, please contact the project coordinator:

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