



**NATIONAL ADVANCED SCHOOL OF ENGINEERING  
(NASE) YAOUNDE CAMEROON**

# **STATE OF THE ART ON RENEWABLE ENERGY RESEARCH AT THE NASE YAOUNDE, CAMEROON**

**PIERRE MEUKAM.**

Teacher/Researcher, University of Yaounde I



# **PLAN OF PRESENTATION**

## **INTRODUCTION**

### **I. DIFFERENT FORMS OF BIOMASS**

### **II. SOME EXAMPLES OF PROJECTS**

## **CONCLUSION**

# INTRODUCTION



**Area: 474 422 km<sup>2</sup>**

**Population: 19 Millions**

**Density of population:**

**36hab/km<sup>2</sup>**

❖ CAMEROON HAS THE 2<sup>nd</sup> LARGEST RESERVE OF TROPICAL WOOD IN CENTRAL AFRICA (**forest potential=21 millions ha**),THE 2<sup>nd</sup> WOOD LARGEST RESERVE AFTER AMAZONIA ;





**❖ FIRST AND SECONDARY WOOD PROCESSING FACTORIES PRODUCE LARGE QUANTITIES OF WASTE SUCH AS SAWDUST, BARK AND FALLS;**

**❖ THESE WASTES ARE ABANDONED AND CONTRIBUTE TO POLLUTING THE ENVIRONMENT.**



# I. DIFFERENT FORMS OF BIOMASS

- Biomass: Two main forms:
  - The dry Form
  - And the wet Form



# I.1 DRY FORM

The dry form of biomass come from:

- **Forest**
- **Wood processing industries**
- **Agricultural and food industries**
- **Woody Crops Short Revolution**
- **Herbaceous formations**
- **Scrap wood**



## **1.2 Examples of dry biomass in CAMEROON**

### **Wood**

- 20-25% of the volume out of the forest
- PCI (average): 18,400 kJ / kg
- Light wood: 400 kg/m<sup>3</sup> Heavy Wood: 700 kg/m<sup>3</sup>
- Ash: varies between 0.2 and 2.4%



## Peanut Hulls

- 20 à 32 % of the weight of pods → 75 - 850 kg/ha
- PCI peanut shells = 17 800 kJ/kg
- low ash(3,9%)



## Residues of oil palm

- Yield = 11-13 bunches per ha
- Raids = 0.22 t / t Engineered plans
- Roundups PCI = 21,600 kJ / kg<sub>v</sub> (anhydrous) or 6300 kJ / kg (= 63.2% moisture HBH)
- PCI fiber = 18,400 kJ / kg (anhydrous) or 9900 kJ / kg (H<sub>BH</sub> humidity = 40%)
- PCI shells = 19,600 kJ / kg (anhydrous) or 13 400 kJ / kg (H<sub>BH</sub> humidity = 35%)



## The husks and coffee husks

- PCI (anhydrous) coffee shells = 14.4 à 17.8 kJ/kg
- PCI (anhydrous) coffee husks = 18.3 kJ/kg
- $H_{BH}$  coffee shells = 8 - 14 %
- $H_{BH}$  coffee husks = 10 %
- Ash (shell) = 7,6 %
- Ash (husks) = 2,0 %



## The sugar cane bagasse

- Humidity = 45-55% (by weight) and fiber content = 11-20%
- Ash = 4.9%
- mean PCI moyen = 17 700 kJ/kg

## The cotton stalks

- PCI (anhydrous) = 17,200 kJ/kg
- $H_{BH} = 14\%$
- Ash = 3.4%



## **I.2 WET FORM**

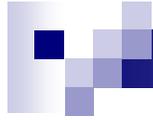
The wet form of biomass come from:

- **Manure**
- **Liquid effluents of agro-industries**
- **Domestic wastes**

# □ Examples of wet biomass in CAMEROON

Quantities of manure produced annually by type of animal

Type of animal	stables System	Annual Quantity
Cattle	Tied	8 - 10 t
Cattle	Loose housing	11 - 18 t
Horses	Loose housing	15 t
Sheep and goats	Stabling	15 t
Pigs (by place of fattening pigs)	Stabling	0.7 – 1.2 t
Poultry (per 100 seats laying hens)		2 t



## **II. SOME EXAMPLES OF PROJECTS RELATED TO RENEWABLE ENERGY MADE IN CAMEROON**

# II.1 Biogas production

## Two realities

- ❖ Cameroon is going through a deep electric crisis (several power cuts, non-electrification of rural zones),
- ❖ Household wastes pose a crucial cleaning up problem.



600 tonnes of waste are produced and collected daily by the company HYSACAM which flows into landfills.

## One solution

- Valorise the biodegradable wastes in order to produce energy.

## □ PROCESS

Natural process of anaerobic digestion of organic matter .

3 almost-simultaneous stages:

- ❖ Hydrolysis
- ❖ Acetogenesis
- ❖ Methanogenesis



*Bio-digester*

## □ Biogas composition:

- Methane: from 50 to 80 %
- Carbon dioxide : from 25 to 40 %
- Hydrogen sulphide: from 10 to 15 %



*Combustion Engine*

# 11.2 MIXT SOLAR/WOOD DRYER



In this kind of drying, Solar Energy is combined with the energy due to combustion of wood when there is not enough sun particularly in case of bad meteorology.

# 11.3 DENSIFICATION OF THE SAWDUST



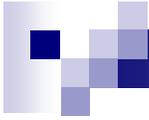
**The sawdust is found in abundance in Cameroon. It was used to make bricks with better thermal and energetic performance than those currently used in the construction of houses.**

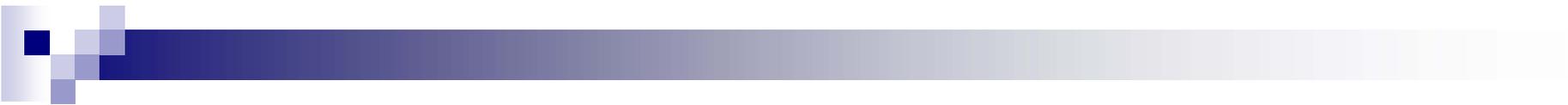
**On the economic use of these materials helps to reduce the quantity of imported materials and environmentally to reduce the emission of carbon dioxide.**

# III.4 ENERGY USE OF FIBER PALM NUT



	moisture	PCI (kcal/kg)	density (Kg/m <sup>3</sup> )	size (mm)	oil content
Fiber	40%	2700	100		7%
Hul /Shells	20%	4200	350	20x10x10	





# 11.5 GASIFICATION

## □ Presentation of the gasifier NPHS

### Project Goal

The project aims to replace oil in an internal combustion engine by the gas from the gasification of biomass.

### Facility Features

- Maximum power: : **3MW**
- Type of biomass used: corn cobs, walnut shells, palm, charcoal, wood residues.
- Maximum Size: 5cm diameter.

## Type of biomass used



# Main points



**Crane**



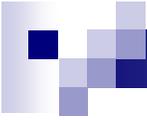
**Hopper**



**Gasifier**



**cyclone**



**Scrubber**



**Granular filter**



**The air cooler**



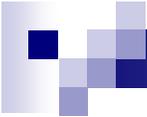
**Regulator to Zero**



**Blower Internal**



**Combustion Engine**



# CONCLUSION

Cameroon has real potential in renewable energy

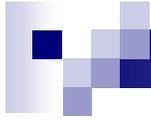
✓ Biomass Energy

✓ Hydro

✓ Solar Energy

✓ Wind Energy

But valorisation in not yet effective



**THANK YOU FOR  
YOUR ATTENTION**