PRE-FEASIBILITY STUDY ON THE THE CONVERSION TO ENERGY OF AGRICULTURAL AND FORESTRY RESIDUES USING GASIFICATION

TECHNOLOGY IN MEXICO

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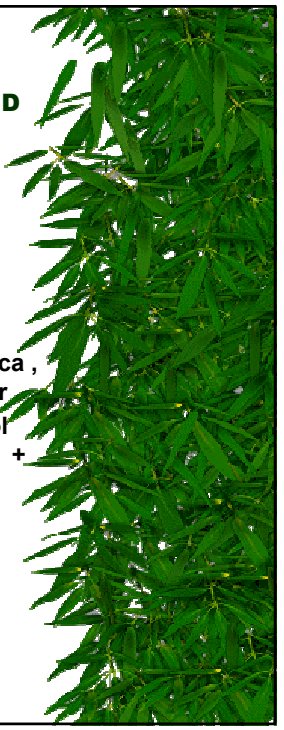


OBJECTIVE:

- To identify main regions in Mexico with the highest production of agricultural and forestry residues and their evaluation to use the residues like biomass material in gasification systems to generate energy.

Introduction

- **The Non-Conventional Energy Unit of the Electrical Research Institute (GENC-IIE) is promoting the application and development of thermal conversion technologies for the production of energy from solid waste in Mexico, considered to be gasification of agricultural and forest residues for the purpose of this work. With this in mind, the main objectives of this work were: To identify the regions of Mexico with high production of agricultural and forestry residues; the evaluation of the bionenergy content of the residues produced in each region; and to outline the schemes of the power plants that could be used for the gasification of the residues.**

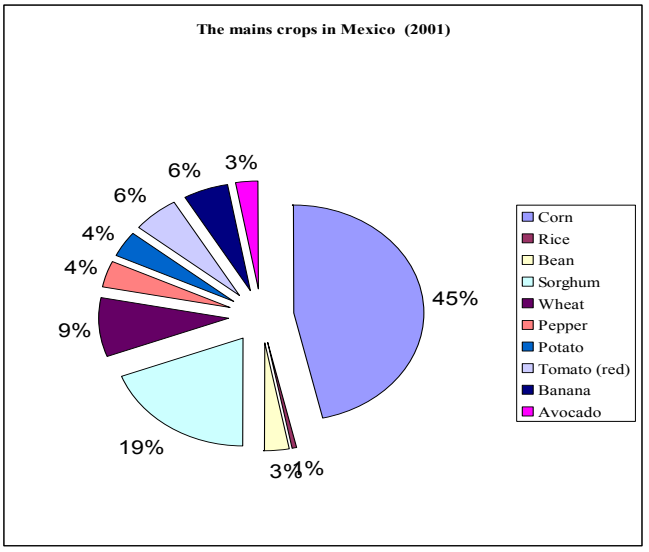
Methodology

- A bibliographic search was carried out to identify the main agricultural crops and forestry products.
- A mathematical model was used to determine the amount of residue from every product and the calorific value thereof
- The THERMOFLEX computer model was used to design the basic schemes of the power plants to be used in the gasification several products, including corn, sorghum and pine tree residues.

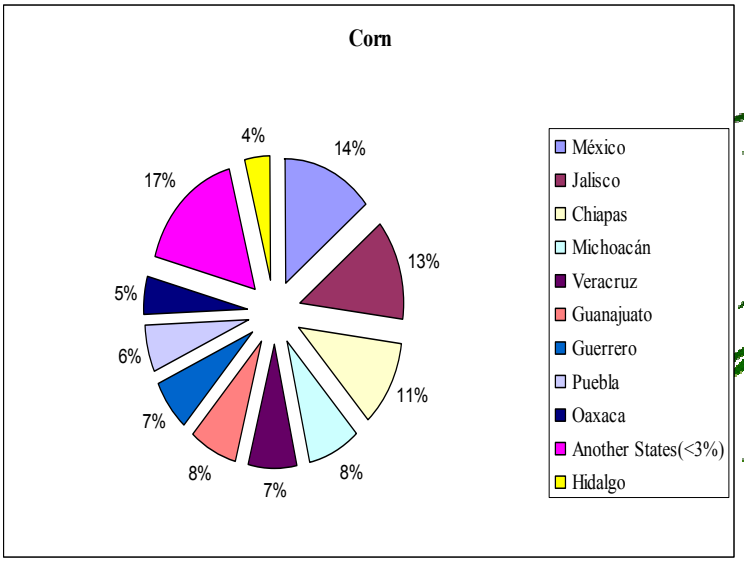
Results

Agricultural residues

- **According with the National Institute of Statistics, Geography and Informatics (INEGI) , the most important crops in Mexico during 2001 were: corn, sorghum, wheat, rice, bean, pepper, potato, red tomato, banana and avocado (Figure 1). The total amount of products was 34.5 million tons. Corn, sorghum and wheat are the three main grain products, whose residues could have the main bionergy contribution. In The total yield of agricultural residues in 2001was estimated to be 54.6 million tons, equivalent to 82.14 PJ of bioenergy About 72.5 PJ of this was from residues of corn, sorghum and wheat, which represents 88.3% of the total bioernergy from the crop residues produced in the country (Figure 2). In Figures 3 and 4 the main producers of corn and sorghum in the country are shown.**



- Figure 1



- FIGURE 2

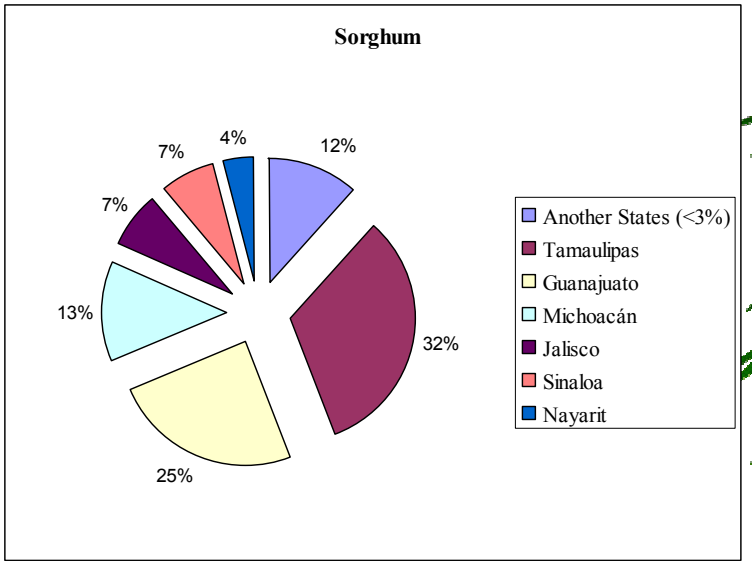


FIGURE 3

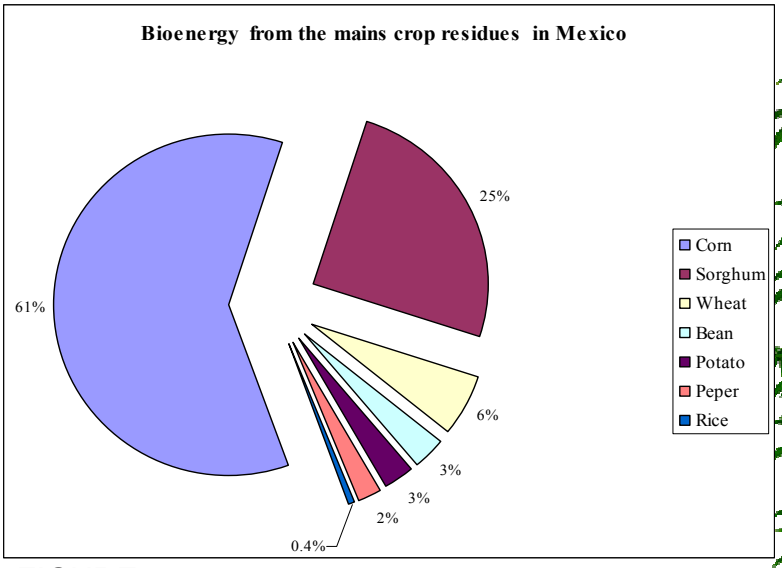
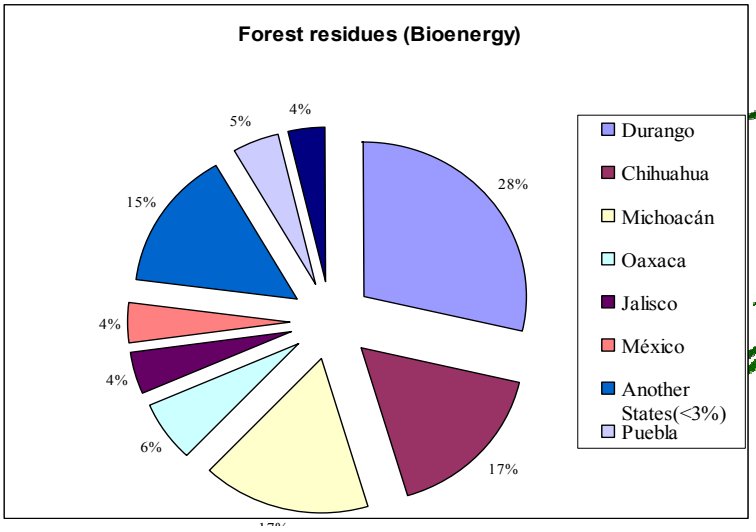


FIGURE 4

Forest Residues

- **According to official statistical data (INEGI, 2002), the yearly yield of industrial roundwood in 2001 was 2.3 million tons, equivalent to an estimated 4.9 PJ. Figure 5 shows the main producer regions of industrial roundwood and their potential contribution as bioenergy.**



- FIGURE 5

Biomass Energy Conversion Technology

- There are several technologies to convert biomass into convenient and clean energy products. These technologies are classified as: anaerobic digestion, alcohol process, briquetting process, efficient burning furnace, saving fuel stoves and thermal pyrolysis. Thermal pyrolysis includes gasification, liquefaction and carbonisation and can be used for treating crop and /or forest residues, as well asindustrial organic waste, to produce gas fuel, biodiesel and coke fuel. In this work gasification technology was selected as an alternative to convert the crop and forest residues into energy.
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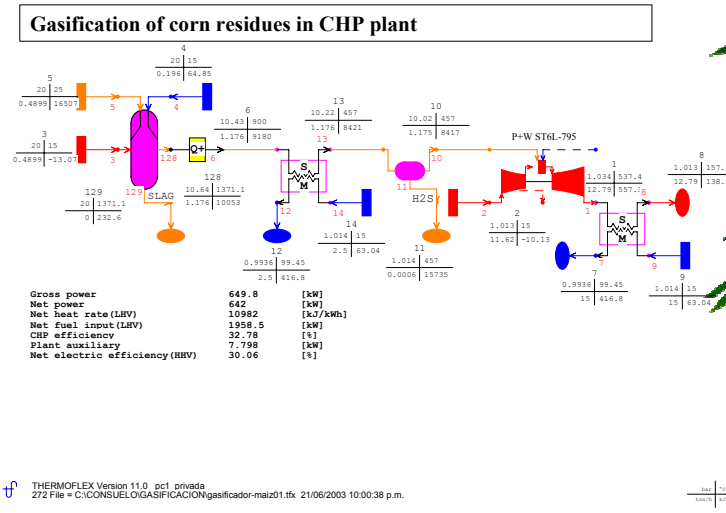
- Figures 6,7 and 8 illustrate the schematic process to generate electricity by gasification of pine tree wood, corn, and sorghum residues, respectively.Table 1 shows the technical parameters for each of the power plants studied.



- FIGURE 6

Table 1. Summary of the main technical parameters from simulations

Biomass fuel (residues)	Fuel Consumption (Kg/hr)	Net Power (KW)	Cost of Electrical Generation ¢ /kWh of USD	Net electrical efficiency (%)
Pine	342.5	642	<8.5	30.0
Corn	489.9	642	≈ 8.5	30.0
Sorghum	505.6	642	≈ 8.5	30.0

Conclusion

- In this work the main regions of Mexico with agricultural and forest resources were identified. The regions with the largest agricultural bioenergy potential are, in decreasing order: the state of Mexico, Jalisco, Chiapas, Tamaulipas, Guanajuato, and Michoacan mainly. The largest potential from forest residues is found in the following regios: Durango, Chihuahua, Michoacan, and Jalisco. New technologies are available to convert biomass into energy. This work was focused on the possibilities of gasification technologies because of their higher conversion efficiencies to electricity. In this analysis only small-scale processes were simulated, for which sensitivity of the model was low. Larger plants could yield higher efficiencies and lower costs. Economic evaluation of these processes was out of the scope of this work.