

https://dspace.org/

Life cycle assessment of maize cobs and othe energy crops for energy production compared to conventional methods

Mohlala, Faith Tokologo

2019

https://hdl.handle.net/10539/26837

Mohlala, Faith Tokologo (2018) Life cycle assessment of maize cobs and other energy crops for energy production compared to conventional methods, University of the Witwatersrand, Johannesburg, <http://hdl.handle.net/10539/26837>

Downloaded from a DSpace repository. https://dspace.org/



LIFE CYCLE ASSESSMENT OF MAIZE COBS AND OTHER ENERGY CROPS FOR ENERGY PRODUCTION COMPARED TO CONVENTIONAL METHODS

MSc RESEARCH REPORT

Prepared by

Faith Tokologo Mohlala (301245)

Submitted to

School of Chemical and Metallurgical Engineering, Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, South Africa

Supervisor: Professor Kevin Harding

October, 2018

DECLARATION

I ___**Faith Tokologo Mohlala**_____; Student Number: ___ **301245**_____
am a student registered for the course CMHT300 in the year 2018. I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is against University Policy.

- I confirm that the work submitted for assessment for the above course is my own unaided work except where I have explicitly stated otherwise.

- I have followed the required conventions in referencing the thoughts, ideas, and visual materials of others.

I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work, or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature: _____ Date: _____

ABSTRACT

Coal is currently the most widely used feedstock for electricity generation in the world. According to Eskom, about 77% of South Africa's energy needs are met by coal power. Emissions related to this energy source include nitrogen and sulfur oxides, heavy metals, radioactive elements, organic compounds, greenhouse gases and a significant amount of ash. This results in pollution of air, water and land. The demand for electricity continues to increase with rapid economic development and population growth. It is therefore necessary to explore and assess alternative methods of energy production.

The conversion of biomass to electricity could play a vital role in reducing the dependency on coal power in South Africa. As such, the use of maize cobs, as well as other agricultural residues, could offer promising opportunities for renewable energy production. However, there are few environmental impact studies in South Africa addressing the production or preparation phase of energy feedstocks for such purposes.

This study used Life-cycle Assessment (LCA) to evaluate the environmental burdens associated with the production of maize (and wheat) and extraction of maize cobs/stover (and wheat stalks) for the purpose of producing electricity through gasification. The assessment includes the entire life cycle of the energy feedstocks, agricultural activities, transportation and conversion into electricity, but excludes seed production, electricity distribution and waste management. The impacts associated with the production and use of maize cobs in electricity production are compared with those of maize stover and wheat stalks. The study also compares the environmental impacts of these processes with coal power.

The results show that the areas of environmental concern for the production of biomass electricity include fossil depletion, climate change, particulate matter formation and land occupation. Transportation and gasification of biomass feedstock contributes the most towards all environmental impacts. The impacts associated with wheat stalks and maize stover production are higher than those of maize cobs production. The environmental burdens associated with the conventional method of electricity generation in South Africa are over 90 % higher than those from producing electricity through gasification of maize cobs. The results

also suggest that generation of electricity form maize cobs has less environmental impacts than the generation of electricity using maize stover or wheat stalks; and coal power.

To improve the environmental performance of the biomass energy sector, improvements in agricultural practices must be implemented. For this, further research on fertilization, water use, agricultural practices, land transformation, biomass conversion technologies and transportation must be conducted.