

Homework 6 Solar Power Africa Due Monday October 2, 2023

Botswana (a country of 2.3 million about the size of Texas (29 million)) just opened Morupule B which is a fluidized bed coal power plant that cost around 1B USD to build. The plant was scheduled to open in 2012 so it is about 10 years behind schedule due to extreme design and construction flaws. China is celebrating this as an example of Chinese contribution to African development making Botswana a net electrical power exporter since the plant was largely financed and built by China.

- a) **Make rough sketches** of a pulverized coal power plant and a fluidized bed coal power plant.
- b) The two main types of coal power plants, pulverized coal, and fluidized bed boilers can use subcritical, supercritical, ultra-supercritical steam. (Integrated gasification combined cycle IGCC is a third type of plant.) The plant can also involve cogeneration using waste heat for domestic or institutional heating (UC's power plant does this as do the nuclear power plants in Villigen Switzerland which supply domestic heating to two towns). Look over the reports for the African Development Bank and World Bank which mention the reasoning for the choice of coal, the reasoning for the choice of the type of coal plant, and the assessment of the viability of this project. **Comment on their approval of this project** including the Chinese involvement and experience with this type of plant and motivations, the disadvantages of the chosen generation method, the missing costs associated with coal as a fuel. Why wasn't an IGCC plant considered?
- c) **Why do you think** solar, hydro or wind power not chosen?
- d) **Why was plant operation for Morupule B delayed** by more than a decade leading to brown/blackouts in Botswana (similar to Texas but for different reasons, both political)?
- e) Botswana's next mega project also involves coal, coal liquification. This can involve the Fischer-Tropsch reaction (made famous by Germany in WWII and by South Africa during Apartheid), methanol synthesis, hydrogenation, or pyrolysis/carbonization. Give a description of these four methods, their advantages, and disadvantages. Many people see unaccounted for costs in the production of liquid fuels from coal, countries like Germany, for instance (which originated these methods) are looking to an electric transportation future. **Comment on the logic of basing Botswana's energy future on coal.** Consider that Botswana contains the Kalahari Desert which is one of the sunniest places on earth and borders on the Zambezi River the third largest in Africa.