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# Ngodwana Biomass Energy Project: Can wood sourced from industrial timber plantations ever be sustainable?

Increasingly around the world pulp and paper mills are installing over-sized, dedicated biomass boilers alongside more traditional cogeneration units to take advantage of strong support and incentives for producing electricity from burning wood.

These developments are essentially stand-alone power stations that require more biomass than the waste produced by the pulp mills they are built next to, meaning that additional wood must be brought into the mill to be burned. Sappi's Ngodwana Mill and biomass plant in Mpumalanga Province, South Africa, is due to begin operating in March 2022, and is a good example of this trend.<sup>1</sup> Operators claim that the "renewable" electricity they produce replaces electricity produced from fossil fuels and so helps to reduce emissions. However, the false assumption that burning wood from "sustainably managed" forests or plantations is carbon neutral means that carbon dioxide emissions from combustion aren't accounted for. This is despite the large body of evidence<sup>2</sup> clearly showing that electricity generation from forest biomass is highly emissive.

At the same time, these developments often depend on destructive processes that harm ecosystems and increase the demand for wood. Ultimately, wood that will be burned in the Ngodwana mill will be sourced from vast areas of industrial eucalyptus and pine plantations that have profoundly negative impacts on the region's biodiverse grassland habitats.

<sup>1</sup> For another example, please see Arauco's Valdivia biomass power station: carbon emissions and conflicts with Indigenous communities in Chile. <sup>2</sup> For numerous resources on the climate and other impacts of forest biomass, please see the Biomass Energy, Forests and Climate Library.



# Introduction: Hungry for energy

Africa produces only a quarter as much electricity as the EU's 27 member states combined, despite having a population size more than two and a half times greater.

Around 640 million Africans do not have access to any form of electricity, and approximately one billion lack access to clean cooking, having to rely on fire wood and charcoal for all of their daily cooking needs. This has serious health implications and impacts women and girls in particular.

Due to Africa's relatively low energy consumption, it contributes just 4% of global greenhouse gas emissions. Despite this, the continent is impacted disproportionately by climate change and several African countries lack the capacity to manage these impacts appropriately, rendering their citizens particularly vulnerable.

Due to greater access to education and opportunities across the continent, there is a growing middle and upper class and growing urbanization. These factors combine to increase the demand for energy, which could double in the next two decades.

The bulk of Africa's energy is currently from fossil fuels, but there is a rush to renewables as a solution to Africa's power generation problems, with wind and solar farms being rolled out and advocated for by many institutions.

An additional 'renewable' energy which is being proposed for Africa is the burning of biomass for electricity production, which is already occurring on a large scale in countries in the EU, the USA, UK, South Korea and Japan.

#### "Renewable" energy potential in Africa

According to the African Development Bank in 2017



# Sappi's Ngodwana Pulp Mill

Sappi (South African Paper and Pulp Industries Ltd.) is a multinational corporation with facilities in Africa, Europe and the USA, and customers in more than 150 countries. It is one of the world's leading producers of wood fibre products, dissolving pulp, packaging, and speciality papers, and the company has access to 264,000 hectares of owned and leased industrial pine and eucalyptus plantations in South Africa.

The Sappi Ngodwana Pulp Mill was established on the banks of the Elaands River in Mpumalanga province, South Africa in the 1960's, starting operations in 1966. There have been several 'upgrades' over the years, and currently the mill produces 320,000 tons of paper pulp, 255,000 tons of dissolving pulp and 380,000 tons of paper (newsprint and Kraft linerboard for packaging).



Burning biomass is presumed to be carbon neutral as it is assumed that new tree growth will reabsorb the carbon released. However, wood takes seconds to burn and years to grow back, creating a 'carbon debt' which we can no longer afford.

In addition, burning wood on a large scale creates an additional demand for wood which, in the African context, will essentially lead to the establishment of more monoculture timber plantations. These plantations are impoverished from a biodiversity perspective and should not be referred to as 'forests'.

On top of this, research shows that timber plantations hold little more carbon, on average, than the land cleared to plant them, and that newly established timber plantations are actually a contributor to carbon emissions due to disturbances caused by modern forest management practices. It takes several decades for mature and stabilized forest systems to develop carbon sequestration capacity, and this relies on a functioning and diverse living ecosystem, not merely the planted trees. In contrast, plantations are harvested and cleared at regular intervals, releasing what little carbon has been sequestered in the short life time of the trees.

Burning biomass for electricity generation is being considered in projects across Africa. The African Development Bank estimates that it has a potential production capacity of 520 Gigawatts (GW), a substantial increase from the current installed capacity of less than one GW.

In South Africa, the national electricity provider (ESKOM) is

struggling to meet the electricity demand of its customers. It has become the 'new normal' to experience 'load shedding' where electricity gets cut in certain areas for specified times, in order to distribute the load more equitably. This is highly inconvenient to all users of the national grid, impacting on households and businesses of all scales.

As a result, the South African government has developed a "Renewable Independent Power Producer Program" (REIPPP), in order to incentivize renewable energy developments that add capacity to the public grid. This opportunity has led local timber giant Sappi, to become involved in the development of a biomass power station at the Ngodwana Mill, Mpumalanga Province, South Africa.

## The Ngodwana Biomass Energy Project<sup>3</sup>

The Ngodwana Biomass Energy Project is a 25MW biomass electricity generating unit at the Ngodwana Mill which will feed into the public grid.

The power plant was initially scheduled to be operational in 2020, but due to several issues, including delays brought on by the pandemic, it is now likely to become operational in 2022.

Despite the project being initiated in 2014, construction only started in 2018 when a Power Purchase Agreement (PPA) was signed with the South African government, which provides a public subsidy through the REIPPP initiative.<sup>4</sup> The PPA covers a 20-year period and is exclusive to the South African government, whereby electricity is sold to the public grid at a favorable rate. Ultimately, consumers in South Africa will bear the brunt of this subsidy through increased energy bills.

The project will cost 1.5 Billion ZAR (100 Million USD), which is primarily being financed by local banks ABSA and Nedbank. The project also has three major shareholders, each with a 30% stake. These are Sappi, Korean company KC Green Holdings (who are also involved in the

construction and operation of the plant), and African Rainbow Energy and Power (AREP), which is a renewable energy investment platform operated by ABSA and Nedbank. Employee and local community trusts also each have a 5% stake in the project.



### Generation capacity and biomass requirements

The biomass power plant has a target output of 25 MW of electricity, to be produced in addition to the 100 MW of heat and electricity already generated by existing boilers at the mill, which is used for on-site requirements. Some 250,000 to 270,000 tons of biomass will be required annually, equating to approximately 35 tons of biomass per hour.

The project will take advantage of the 100,000 – 170,000 tonnes of residues such as bark and sawdust that are produced by the pulp mill annually and which, according to Sappi, would normally be disposed of in a waste dump. The power station has also been deliberately

oversized to burn additional biomass, most of which will come from surrounding pine and eucalyptus plantations.

It is common to see large amounts of residues left in the plantations after harvesting, due to the fact that a significant proportion of the harvested trees (such as bark, branches and sometimes even sections of trunk which are not collected) do not get transported to the pulp mill, but remain at the harvesting site. These are often burned in piles in order to dispose of them and, according to Sappi, it is this woody biomass which will be the primary fuel consumed by the biomass plant.

A requirement of the PPA is that all the biomass utilized will be from "sustainable" sources, however it is unclear whether this refers to the sustainability of the wood supply, or to ecological sustainability. It is also unclear how the PPA will be able to verify that this requirement is being complied with. Sustainability criteria for biomass are often inadequate and ineffective, often allowing any type of wood to be classified as waste or a residue and therefore qualify as "sustainably sourced". Furthermore, as is discussed in detail below, wood sourced from industrial timber plantations in the region can never truly be considered sustainable.

<sup>3</sup> Unless otherwise indicated, the information in this section has been provided by Sappi.
<sup>4</sup> The Ngodwana biomass plant is the only biomass project within REIPPP nationally, and the only REIPPP project in Mpumalanga province. In other parts of the country there are projects focused on wind and solar, some of which have considerably higher capacity (70 - 100MW).

### Potential environmental impacts of the biomass plant<sup>5</sup>

#### Climate change and air quality

The electricity that the plant will produce is assumed to be renewable and so CO<sub>2</sub> emissions produced from the combustion of the wood will be ignored. However, a growing body of scientific evidence shows this approach to be flawed, and that the immediate carbon emissions associated with burning woody biomass are greater than for burning coal. Further still, carbon payback periods vary greatly depending on what type of wood is being burned and where it has come from.

The climate impacts of wood burning at Ngodwana will therefore be different for each type of feedstock used (whether sawdust, bark, thinnings, whole trees or a combination of them all), with the impact increasing in correlation with the increasing diameter of the wood. Once the plant is operational, verifying the type of feedstock that the plant is using will be vital to accurately assessing the climate impacts of the electricity generated. For example, it is plausible that whole trees could be burned alongside pulp mill residues, given the large volumes of roundwood that already enter the pulp mill and the fact that it could be economically viable to do this given the favorable terms of the PPA.

Even if this is not the case, burning genuine residues results in significant climate impacts too, and cannot be considered carbon neutral. A recent study looking at biomass power stations that burn forestry residues in the US, under comparable circumstances to South Africa, concluded that after 10 years the net emissions impact (NEI) for plants burning forest residues ranges from 41%-95%. This means that if the wood had been allowed to decompose naturally rather than burned, after 10 years there would be 41%–95% less carbon in the atmosphere, due to the fact that decomposition releases carbon much more slowly than combustion and leaves some carbon behind in the soil. Another recent study in the US showed that burning wood pellets made primarily from pine plantation thinnings (which Sappi would class as residues), results in a negative impact on the climate for more than 40 years.

The operation of the biomass boiler will also cause local air pollution, such as by increasing the concentration of fine particulate matter in the air, which is capable of entering the lungs. Other pollution emitted includes nitrous oxide, sulphur oxide, volatile organic compounds, dioxin and mercury. Trees are good at absorbing toxins out of the environment and when they are burnt those toxins are released back into the atmosphere. This is very much a health concern, particularly to communities living in close proximity to the biomass facility.



<sup>5</sup> Unless otherwise stated, the information in this section has been collated through interviews with representatives of the TimberWatch Coalition, the Mpumalanga Water Caucus and the Women's Leadership and Training Programme.

#### Impacts of biomass extraction on soil quality and erosion

Monoculture timber plantations are by nature unsustainable. They act like 'nutrient mines' by literally extracting fertility from the soil. The past few decades have also seen escalating soil erosion in areas planted with industrial timber plantations in South Africa. This is due to their inherent impact on the natural environment which, in the case of Ngodwana, is primarily biodiverse grasslands.

As well as holding significant carbon stocks that are easily degraded during plantation establishment, grasslands have a 'water retention' function, acting like 'sponges' to hold water back and allow it to slowly filter into groundwater aquifers. This characteristic also prevents soil erosion. The transformation of grasslands to monoculture timber plantations has compromised the water retention capacity of the affected catchment areas, increased soil erosion, and resulted in noticeable river degradation.

The removal of a huge amount of additional biomass from plantation areas will impact soil quality further, as there will be less decomposing organic matter to act as a natural fertilizer. This was recognized as a problem during the Environmental Impact Assessment process, and proposed mitigation measures were suggested, such as leaving at least 30% of harvesting residues to break down in situ. A commitment was also made by the operators to monitor changes in soil health.

A reduction in soil quality would require more chemical fertilizer to be used in the plantations,



with disastrous consequences for the environment. Plantations are established in the upper catchments of water courses, and the resulting chemical leaching from plantation sites into rivers and streams, could have consequences which have not been properly quantified by the project.

Current land management practices often require harvesting residues to be burnt, to reduce fire hazard and to facilitate re-planting. Burning this 'slash' often results in the soil being 'baked', which kills the organic matter in the top layer of the soil and increases hydrophobicity, making it more difficult for water to penetrate and making soils more prone to erosion. This practice also depletes carbon that could eventually break down to enhance soil fertility.

It is therefore argued that removing the bulk of the biomass to burn in a power station, rather than burning it in the field, is the better of the two options. However, given the current climate and biodiversity crises the world faces, neither practice is acceptable, and rather than being incentivized to burn the wood in a different location, the forestry industry should be forced to change its management practices. Methods of enabling on-site decomposition whilst limiting fire potential do exist, such as chipping material in the plantation and leaving it to break-down naturally. However, they are less economically attractive to the forestry industry compared to burning.



#### Transport

Around two-thirds of the biomass utilized by the project will be sourced from plantations and will therefore have to be transported to the biomass plant, resulting in additional carbon emissions and a considerable amount of additional truck traffic.

Current transport infrastructure, including local, national and

provincial roads, is already under pressure due to excessive truck traffic associated with the mining and timber industries. In many cases, provincial governments lack the capacity to regularly maintain and repair deteriorating roads.

Another aspect of this is the timber industry's dependency on

a sprawling network of dirt road infrastructure. These dirt roads in mountainous areas are prone to soil erosion, and removing biomass from timber plantations after harvesting could compound this impact, especially in wet weather.

# Impacts of the industrial timber plantation model

A primary concern regarding the burning of biomass for large scale energy production is that it creates the demand for more biomass which, in the South African context, implies sourcing from large scale monoculture timber plantations.

Diversity is the key to soil sustainability, so by establishing large scale timber monocultures we jeopardize the ability of soils to be biologically active and fertile, making it more difficult to sustain functional ecosystems in future.

Plantations are a 'high impact' land use resembling commodity agriculture. In South Africa, grassland habitats have been heavily fragmented and irrevocably transformed by plantation expansion. Grassland is the 'climax' vegetation type for the region (referred to as the North-eastern Mountain Sourveld) and is incredibly biodiverse in insects, birds, reptiles and mammals. More than 4000 different indigenous plant species can also be found in local grasslands. However, few species of indigenous fauna and flora can survive in timber plantations. Pine and eucalyptus trees are evergreen and utilize scarce water resources excessively. This is particularly impactful in the dry winter months, when there is no rainfall. Eucalyptus, in particular, are deep rooting and can penetrate to, and extract, groundwater up to 60 meters into the soil profile. Most indigenous trees have far shallower root profiles.



Year	Rainfall (mm)	Run-off (m <sup>3</sup> )
1935 - 1940	1729	143.07 million
1941 - 1945	1122	48.72 million
1946 - 1950	1332	38.43 million
1955 - 1960	2060	28.72 million
1961 - 1964	1308	16.56 million

This table was published in 1971 and shows how timber plantations impact on water resources. The measurements were taken from the Klaserie River, which is in a similar geographical location to the Elaands River. According to the authors of the study, the only major change to the catchment over this time period was the progressive establishment of large areas of pine plantations.

### Conversion of pine plantations to eucalyptus

Sappi's Ngodwana Mill used to produce primarily pulp and paper, for which pine fibre was utilized, but since 2014 the mill has also started producing cellulose, primarily for export to the east, for which eucalyptus is required. As a consequence, significant numbers of plantation areas have been and are being converted from pine to eucalyptus.

Local residents have expressed concern over these conversions, due to eucalyptus' high water use and faster rotation rate, which compound environmental impacts and have knock on effects for the local community.

Forestry South Africa (FSA), an industry body representing producers that control 93% of South Africa's plantation forestry, asserts that the differences in stream flow between the two species are 'statistically insignificant'. FSA even managed to convince a judge in a high court case, fought between the industry and government regulators, to allow them to convert plantations at a 1:1 ratio, despite government and water use experts testifying that eucalyptus can typically use 25-45% more water than pine. Conversions to eucalyptus should at the very least involve reductions to the total planted

area to compensate for the increased impact on water resources, but the industry has so far not been required to reduce plantation size.

The impacts of climate change and the extreme heat that it brings are expected to result in significant reductions in streamflow,<sup>6</sup> caused in part by a predicted 20% decline in rainfall in the region with 2 degrees celsius of global warming. Given this context, it is irresponsible of the timber industry to be utilizing even more water in its quest to maximize production.

<sup>6</sup> Information provided by Sharon Pollard, Association for Water and Rural Development (AWARD), 2022.

### Community benefits of the Ngodwana Biomass Energy Project<sup>7</sup>

In the South African historical context, where racial discriminatory policies inhibited black economic empowerment, it is imperative that large scale, profit-orientated projects such as the Ngodwana Biomass Energy Project take Corporate Social Responsibility (CSR) seriously.

However, these financial benefits are difficult to manage and can lead to community 'discontent', if perceived as being distributed in an inequitable manner. For example, the local community (currently defined as the district of Waterfall Boven) will benefit as 'shareholders' of the company, but there are disputes over who the beneficiaries should be, and suggestions that the funds be distributed across four local districts in order to benefit the larger community.

The project has also committed to spend around 1 billion ZAR (70 million USD) on Small and Medium Enterprise (SME) development, with 140 Million ZAR (10 million USD) specifically aimed at women-owned businesses. This expenditure is a signed commitment as part of the PPA, and will be reported on quarterly.

The project is expected to provide approximately 150 jobs once operational, the bulk of which will focus on biomass collection from plantations, and will most likely be outsourced to local contractors. In terms of procurement, the project is committed to employing local operators and managers and supporting local businesses, with an expressed multiracial and non discriminatory racial dynamic, but favoring black Africans in line with government aims of black economic empowerment.

Whilst the project does appear to take CSR seriously, it is also important to consider that the financial benefits for local communities come at a cost to water resources, soil health, air quality and biodiversity. These costs have not yet been comprehensively quantified, and they impact the entire region and communities that will not benefit financially from the project.

<sup>7</sup> The information in this section has been provided by Sappi.

A drought-affected river in northeastern South Africa. Abspires40/Flickr

### Conclusion

The burning of biomass to produce energy on a large scale has numerous and varied impacts. It is not 'carbon neutral' as claimed, but in fact immediately increases the amount of carbon in the atmosphere, which then remains over critical timescales for tackling climate change.

It also increases the demand for wood, which in turn exacerbates the impacts of industrial timber plantations. This is a highly extractive process, leading to biologically impoverished landscapes and compromised ecosystem services.

It is a major concern therefore, that burning biomass for energy production could generate a dependency on woody biomass at an industrial scale, which in turn would further entrench the high impact monoculture plantation model in the region, whilst also increasing emissions. Once the project starts operating, it will be necessary to examine the impacts of the additional biomass extraction required, and to determine if the project can sustain the 25MW it has committed to producing without reverting to burning 'non waste' materials, such as whole trees.

In the debate over the best available approaches for clean power generation in the African context, it is important not to build a dependence on any one form of energy production but to implement a diverse range of locally appropriate technologies, whilst phasing out fossil fuel use. There is currently little consensus on which 'renewable energy' option is the better solution to providing energy in an ecologically responsible way.

However, it is also clear that large scale burning of biomass for electricity generation has severe implications for the health of our environment and society. It is not carbon neutral, and should not be promoted as a solution to meeting Africa's growing energy needs.

