

BIOMASS FUEL SUPPLY

**OTJIKOTO BIOMASS
POWER STATION**

Introduction and Background

Electricity generation and the harvesting of encroacher bush falls in line with national and local development priorities, serving to provide employment opportunities, skills development, local economic growth and importantly an improvement in the agricultural carrying capacity of farmland. The harvesting of encroacher bush further provides huge potential for added economic value and socio-economic benefits which addresses key national policy objectives through:

- Direct, indirect and induced job creation throughout the biomass supply chain;
- Improved livestock carrying capacities through increased rangelands and agricultural productivity;
- Increased groundwater within the harvested areas; and
- Displaced carbon dioxide emissions to the benefit of the region.

Electricity generation from encroacher bush also has the added advantage that it is not considered an intermittent energy source. The ability to dispatch the energy generated from a biomass power station on demand allows it to be used as a base load station or for peaking power. In summary, the objectives of the Encroacher Bush Biomass Power Project are as follows:

- Enhance security of supply by introducing a renewable, dispatchable energy supply option;
- Improve electricity security to the customer;
- Increase environmental sustainability;
- Stimulate and promote the biomass fuel supply in Namibia;
- Address the issue of bush encroachment with benefit to Namibian farmers; and
- To prove the concept for future project duplication across Namibia and its bush encroached areas.

It is against this background that NamPower proposes to construct and operate the 40 MWe Otjikoto Biomass Power Station near Tsumeb that will generate electricity by the combustion of woodchips from encroacher bush growing in its surroundings. The scope of the Encroacher Bush Biomass Power Project comprises the complete value chain from bush to energy, which includes all activities from harvesting the encroacher bush to the evacuation of electricity to the transmission grid.

Fuel Supply Strategy and Purpose

Biomass Power Station will be developed, owned and operated by NamPower, where NamPower will appoint an EPC contractor to construct the power plant. The execution period of the project from contract award to completion date is expected to be approximately thirty-six (36) months.

The biomass fuel will be procured by two categories of contractors.

Long Term Fuel Suppliers

- Provide the bulk of the Fuel (Large volume allocations 20 000- 50 000 tonnes per annum)
- Expected to provide performance guarantees and subjected to stringent penalties
- Significant investment required
- Bankable Fuel Supply Agreement (7 years)

Ad Hoc Fuel Suppliers

- Extended opportunity for farmers
- Smaller volume allocations (2000- 7000 tonnes per annum)
- Simplified Fuel Supply Agreement (3 years or less)
- Less stringent guarantee and penalty regime

The formulation of the Long-Term Fuel Suppliers component has advanced and is nearing the end of its procurement stage. The Long-Term Fuel Suppliers will contribute 180 000 tons of woodchips, to fuel the power station Fuel requirement.

The Adhoc Fuel Supply program will contribute 65 000 tons of woodchips, with shorter contracting terms. The Adhoc program is currently under development by NamPower. The Adhoc supply strategy aims to collect encroacher bush species in the form of wood logs, which will be further processed at the Power Station. Adhoc suppliers able to supply fully processed woodchips will also be accepted.



Figure 1: Typical Encroacher species wood log harvesting scheme

Biomass Resource

Extensive research and testing were completed throughout Namibia to assess the availability, quantity and quality of encroacher bush biomass wood chips as a fuel source.

As stated earlier, it has been established that approximately 26 million hectares of Namibia is severely bush encroached. The results from the field sampling and the related laboratory testing clearly indicate that the biomass wood chips produced from encroacher bush can be treated as standard wood chips according to European norms.

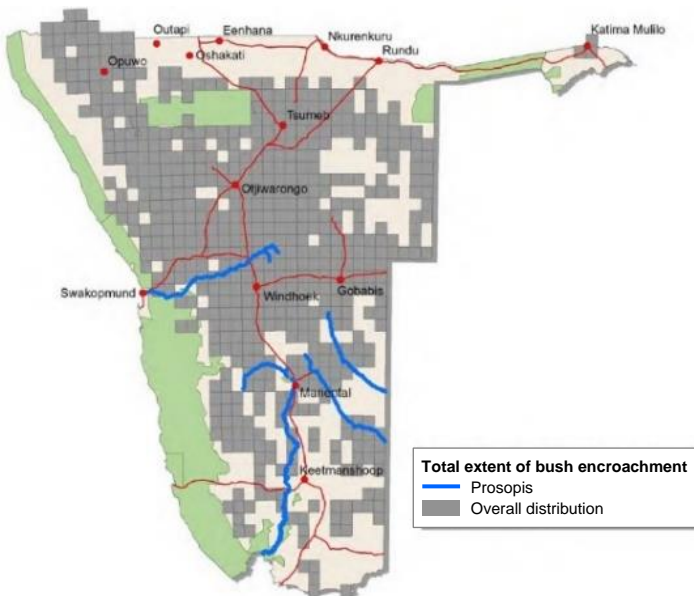


Figure 2: Extent of bush encroachment in Namibia (SAIEA, 2015)

Comparing Namibian wood chips to European wood chips revealed the following differences:

- Slightly higher chlorine content;
- Significant higher silica content; and
- Substantially lower moisture content.

The results from the laboratory testing show that the calorific value (CV) of Namibian biomass and more specifically the samples taken from the Oshikoto region have an average net CV of 14.7 MJ/kg (as received 15% Moisture Content and 5% Ash Content).

Power Station Fuel Requirements

The Otjikoto Biomass Power Station is expected to operate at capacity factor of between 60-85%. Factors that will increase the capacity factor of the Power Station are the following:

- Prolonged droughts when access to the farmland is not restricted due to weather and

output- from Raucana is limited.

- Favourable pricing from harvesting contractors and Farmers.

Factors that will decrease the capacity factor of the power station are as follows:

- Prolonged Rainy Seasons and Floods where access to land is restricted due to weather conditions.
- Times of high output of Ruacana Hydro Power Station
- Unfavourable pricing from fuel suppliers

NamPower plan to accept deliveries of wood logs or woodchips from suppliers between 08h00-16h00 Monday to Friday. It is expected that fuel deliveries will be limited during the rainy season.

There will be a strategic stockpile of 45 days on site to assist in times of supply interruptions and Namibian holiday periods.

Table 1: Yield estimate input assumptions

Description	Unit	Value
Installed capacity	MWe	±44
Daily Fuel Requirement	tonnes	±750
Days of Storage on site	Days	45
Tonnes of fuel in on site store	tonnes	±33,750
Annual area of bush thinned	ha	±16,975
Annual Fuel requirement (at 70% CF)	t/a	±204,000
Fuel density	t/m ³	0.25



Figure 3: Typical load delivery of wood logs by small-scale harvesters

Environmental Considerations

Two (2) ECCs, for the power station and the related harvesting activities for the fuel supply security, were issued by the Ministry of Environment, Forestry and Tourism (MEFT) and are to be maintained by complying to the Environment Management Plans (EMPs).

The national harvestable area identified during the EIA was found to be approximately 3.1 million hectares, which excluded protected areas, slopes greater than 12.5% and ecological sensitive areas.

The area extending beyond a 100 km harvesting radius, which was assessed during the EIA is indicated within Figure 4.

A conservative harvesting yield assumption of 12.65 t/ha was used for the Oshikoto region for the purpose of fuelling the Power Station. Without taking the requirements for operating the 40 MWe power station into account, it was determined that a total of 39.2 million tonnes of biomass wood chips can be conservatively extracted from a 100 km radius from the Project Site.

This implies that the 40 MWe Otjikoto Biomass Project can be sustained for ± 200 years' operating a Capacity Factor of 70% without considering any regrowth of the biomass resource.

NamPower have elected to apply Forest Stewardship Council standards to this project. NamPower will develop an FSC group scheme which will govern the environmental compliance of the biomass harvesting activities. NamPower as group Scheme owner aim to cover the certification costs of its members that adhere to the FSC standards.

An important consideration is that although NamPowers primary objective is electricity generation the project has an important secondary goal of savannah restoration. Therefore, farmers will have to commit to an aftercare program that is tailored to their harvesting methods applied. The Environmental management plan indicates several options available to farmers for aftercare such as the use of livestock and browsers or the application of arborocides.

NamPower's group scheme managers will assist farmers with training and capacity building to ensure that all group scheme members are aware of the relevant standards, procedures and processes required.

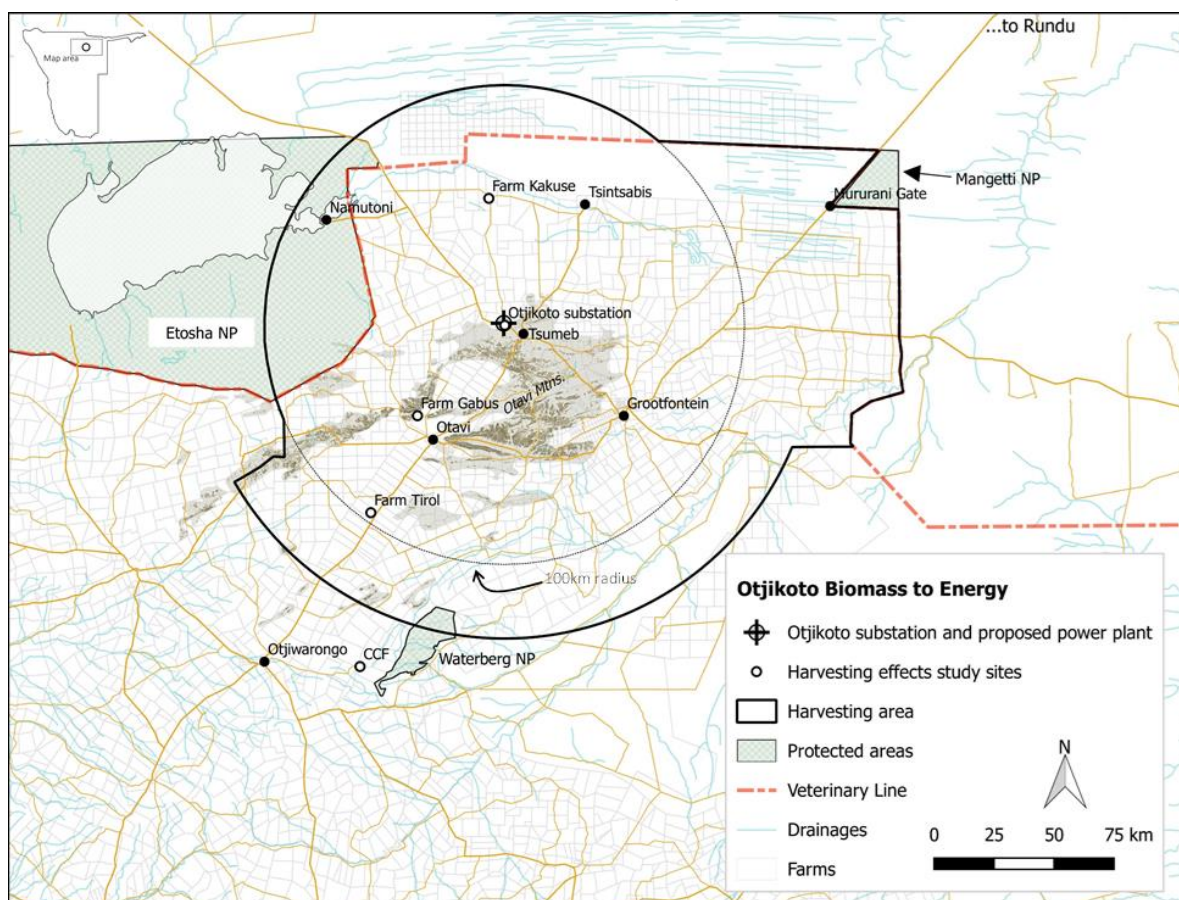


Figure 4: Harvesting Area for the Project

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