

PROJECT FACT SHEET

OTJIKOTO BIOMASS POWER STATION

Introduction and Background

In 2018, Namibia Power Corporation (NamPower) crafted its new Corporate and Strategic Business Plan for the period 2019-2023. In-line with the new corporate strategy and business plan, the NamPower Board of Directors approved the implementation of new generation projects in June 2018 under the Strategic Pillar, "Ensuring Security of Supply."

These projects were later considered by the Minister of Mines and Energy and a determination was made in October 2018 by the Minister that 220 MW of Power Generation should be developed where:

- 150 MW would be allocated to NamPower;
- 70 MW would be allocated on a competitive procurement basis to IPPs for implementation.

At a Board Meeting on 8 November 2018, the NamPower Board ratified the implementation of the following projects as part of NamPower's 150 MW allocation.

- 20 MW PV Power Project;
- 40 MW Wind Power Project;
- 40 MW Biomass Power Project; and
- 50 MW Firm Power Project.

NamPower is thus advancing the development of its proposed 40 MWe Otjikoto Biomass Power Station. The proposed power station will be developed as an Engineering Procurement and Construction (EPC) project and will be owned and operated by NamPower where the majority of the costs for the project will be leveraged from NamPower's balance sheet.

The development of this project is a clear indication that NamPower is committed to supporting and achieving the Government objectives as set-out in the National Planning Policies, the National Integrated Resource Plan (NIRP) and the 5th National Development Plan (NDP5).

Namibia faces the challenge that its open savannah, characterised by a mixture of trees, bushes and extensive grass plains, are increasingly changing into a dense bushy landscape by the intrusion and intensification of aggressive and undesirable wooden plant growth,

more commonly known as encroacher bush.

This phenomenon is commonly referred to as bush encroachment and affects more than 26 million hectares of land in Namibia. This imbalance in the proportion of grassland to bush leads to a deteriorating biodiversity, a low carrying capacity of the farmland and a decrease in the recharge of Namibia's aquifers.

The abundance of encroacher bush and the national shortfall of electricity creates an economic opportunity for bush-to-electricity generation. Electricity generation and the harvesting of encroacher bush are both listed activities that fall in line with national development goals such as the NIRP and NDP5 listed above.

It is against this background that NamPower proposes to construct and operate the Otjikoto Biomass Power Station, which will generate electricity by the combustion of wood chips from encroacher bush, which is harvested from the surrounding areas of the proposed project site.



Figure 1: Image of typical portion of bush encroached land vs a portion of restored savannah (Gys Joubert, Dordabis; In de Wet, 2015 Puttick) taken from NamPower GHG study conducted by Unique Forestry and Land Use

Project Structure and Rationale

The primary objective of the first 40 MWe Otjikoto Biomass Power Station to be constructed, owned and operated by NamPower is to address energy security, affordability and environmental sustainability, as well as to stimulate the biomass fuel supply in Namibia.

The Project and its economic drivers using encroacher bush as a fuel source to assist and alleviate bush encroachment will promote a sustainable harvesting industry that will not only generate the required harvesting volumes to run a biomass power station but will potentially stimulate other spin-off markets and act as a catalyst for other de-bushing applications.

In summary, the Encroacher Bush Biomass Power Project objectives are to:

- Enhance security of supply by introducing an alternative dispatchable electricity supply option;

- Support renewable commitments prescribed in the National Renewable Energy Policy and National Energy Policy of 2017;
- Stimulate and promote a local biomass fuel supply chain in Namibia;
- Increase environmental sustainability and biodiversity;
- Assist with combating bush encroachment with benefit to Namibian agricultural sector; and
- Prove the concept for future project duplication across Namibia and its bush-encroached areas.

SWOT Analysis

The Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis for the Otjikoto Biomass Power Station is summarized in the figure below:

Strengths

Key National Policy goals: Addresses government targets set out in key National Policies and increase Namibian renewable energy supply options while providing important socio- and other economic benefits

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Biomass as fuel: Renewable, indigenous, sustainable and abundant biomass fuel source with limited exchange rate risk or commodity price exposure, such as with imported fuel sources.

Transmission benefits: Transmission benefits included in reduced transmission losses and reduced load on transmission backbone as generation takes place closer to the load required.

Weaknesses

Funding requirements: Significantly, high CAPEX for both the harvesting operations and the power station compared to other renewable technologies, of which, majority of the equipment for harvesting and the power station will be sourced from international markets, with limited opportunities for local expenditure.

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Biomass as fuel: De-bushing efforts may require long term commitments to ensure its sustainability, reap the environmental advantages and to protect the biodiversity

Opportunities

Biomass as fuel: Although the main objective of the Encroacher Bush Biomass Power Project is to generate energy from encroacher bush, there is a significant opportunity for stimulation of the biomass supply industry and its associated market spin-offs.

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Agricultural benefits: the single biggest opportunity may accrue to the agricultural sector, by restoring bush encroached areas through the sustainable removal (harvesting/thinning) of some of the woody plants to yield more balanced rangeland ecosystems. This will result in an improvement in grass production and therefore also grazing which in turn strengthens various agricultural upstream and downstream industries. In addition, the harvesting of encroacher bush will realise a positive effect on the local groundwater resources.

Socio-economic Development: Socio-economic enhancement through local employment opportunities are presented within the harvesting and fuel supply chain.

Threats

Biomass as fuel: The biomass fuel supply industry is not mature and is still in its infancy stage, posing a degree of uncertainty in security of fuel supply which may result in supply inconsistencies

Fuel supply security: Fuel supply interruptions during the rainy season, or harvester's and farm owner's unwillingness to participate in biomass harvesting due to reputational risks, onerous contractual requirements, or lack of financial viability to participate in the fuel supply chain.

Aftercare liabilities: Legacy liability concerns, associated with the re-establishment of encroacher bush.

Other biomass uses: The increased activity in biomass harvesting creating attractive revenue streams for farm owners from other biomass resource uses (i.e., charcoal production).

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Project Site Details

As a result of the Feasibility Study and Environmental Impact Assessment (EIA) scoping the Oshikoto region (near Tsumeb) emerged as the preferred location for the proposed biomass power station.

The selection was mainly driven by the larger socio-economic impacts, sufficiently available biomass fuel resource and existing infrastructure requirements.

In addition, the Oshikoto region will have the largest agricultural benefit from harvesting of the bush encroached areas, however this region was also identified as the most challenging option in terms of harvesting and aftercare of the encroacher bush. As such and when successfully implemented, the Otjikoto Biomass Power Station will prove the concept for future project duplication across Namibia and its bush encroached areas.

The Project Site, which is owned by NamPower and which measures ± 44 hectares, is located within the Oshikoto Region of Namibia, along the B1 national road, close to the existing NamPower Otjikoto Substation as seen in Figure 2. The closest town, Tsumeb is approximately 12 km to the South-East of the Project Site.

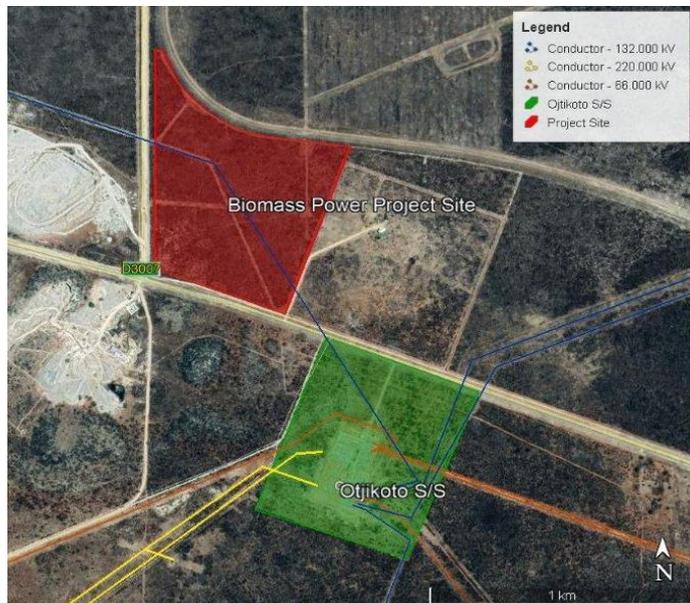


Figure 2: Project Site location relative to Otjikoto Substation

Technical Description

Subsequent to the approval of the business case, and a technology Market Sounding exercise, grate-fired boiler technology (i.e., moving grate, step-grate, vibrating grate, chain grate or traveling grate) was selected favouring the broader Fuel Specification. This allows the boiler to burn a larger wood chip particle size and inherently assists in ensuring a lower Fuel Price as opposed to a fuel specification that requires significantly more processing. Currently, technical specifications for two boiler configurations are under development, namely:

- 1 x 40MWe boiler; and
- 2 x 20MWe boilers.

Both the boiler configurations will feed into a single steam header and power block (turbine and generator) to maintain the economies of scale. The biomass wood chips will be used as fuel for the combustion process in the boiler to produce steam that will drive the steam turbine and the electrical generator. As part of the Project, the complete Otjikoto Biomass Power Station will be developed including all access roads, fuel receiving and storage and handling facilities. As well as all power station-related infrastructure and administration buildings and ash disposal facilities. The key technical description is as per Table 1:

Table 1: Key technical description details

Description	Unit	Value
Export Capacity:	MWe	40
Boiler Technology	-	Grate-fired boiler
Lifetime	Years	25
Availability	%	± 92
Cooling system	-	Dry Cooling
Fuel type	-	Namibian Encroacher Bush Wood Chips
Fuel Specification	-	P100 (as per ISO 17225 Solid biofuels)
Fuel energy content	MJ/kg	14.7
Fuel moisture content	%	5 ~ 15
Fuel density	t/m ³	0.25

NamPower's Transmission Business Unit for connection of the power station to the Namibian grid;

- Consultants – NamPower have procured consultants to assist in providing the following specialised knowledge and expertise on the development and execution of the Otjikoto Biomass Power Station:
 - Technical Advisor and Owner's Engineer will provide technical support and assistance in managing the EPC contract to NamPower;
 - Environmental Assessment Practitioner (EAP) to compile the EIA and obtain the Environment Clearance from the Ministry of Environment, Forestry and Tourism (MEFT);
 - Geotechnical Consultant to assess the geotechnical, hydrogeological and topographical conditions for the site in order to mitigate possible subsoil risk.
- EPC Contract – NamPower will procure an EPC Contractor to engineer, procure and construct the power plant through a transparent and open international competitive bidding process. The procurement of the EPC Contractor will follow the Public Procurement Act;
- Fuel Suppliers – NamPower will enter into agreements with Fuel Suppliers following a transparent and open national competitive bidding process. The procurement of the Fuel Suppliers will follow the Public Procurement Act.
- LTSA – NamPower will enter into a Long-term Service Agreement (LTSA) with the Original Equipment Manufacturer (OEM) to conduct major maintenance and overhaul activities on main equipment.
- Power Purchase Agreement (PPA) – NamPower will be required to enter into a PPA with its Modified Single Buyer (MSB) Business Unit and subject to the modified single buyer market rules and regulations

Procurement Methodology

The Procurement of an Engineering, Procurement and Construction (EPC) Contractor for the Otjikoto Biomass Power Station will be done within the provisions of the Namibian Public Procurement Act, Act No.15 of 2015, administered through the Central Procurement Board of Namibia (CPBN) on behalf of NamPower.

The contract between NamPower and the successful bidder (EPC Contractor) will be based on the FIDIC Conditions of Contract for EPC/Turnkey Projects (Silver Book), 2017 edition.

The EPC procurement process will be through open advertised bidding, advertised internationally and in two (2) phases. Phase I was a Prequalification process (completed in October 2021) and Phase II a single-stage EPC/Turnkey bidding process. During Phase II, more detailed requirements and technical specifications will be provided to the Prequalified Applicants for bidding purposes.

The scope of the EPC Contractor will include:

- The engineering, procurement and construction of the Project under a turnkey contract (FIDIC Silver Book);
- Subcontracting of local works/services to Namibian companies and the local employment of all unskilled and semi-skilled labour;

Supervision of (as required) the O&M of the Power Station during the first two years of operation.

Operation and Maintenance

NamPower intends to operate the Otjikoto Biomass Power Station. As part of the Engineering, Procurement and Construction (EPC) Contract, key NamPower staff will be trained during the construction period in order to ensure that the necessary knowledge and operating and maintenance skills have been transferred.

NamPower will operate and perform the first-line maintenance on the power station. The OEM will be responsible for major maintenance on the plant for the duration of the LTSA.

The EPC Contractor will be responsible to achieve the annual performance guarantees and hence deploy requisite supervision and support services as required in order to meet the annual performance guarantees under the EPC Contract, during the Defects Notification Period (DNP) until the issuance of the Performance Certificate.

Yield Estimate and Operations

The Otjikoto Biomass Power Station is expected to operate between a maximum (100% MWth) and minimum thermal capacity (approximately 35% MWth) while complying with the environmental performance guarantees. Table 2 provides a summary of the assumed operating parameters at the maximum and minimum thermal capacities expected.

Table 2: Yield estimate input assumptions

Key assumptions	Unit	Properties	
Thermal load operating capacity	%	35% Load	100% Load
Net power station capacity	MWth	±46.93	±134.09
Net power station capacity	MWe	±9.56	40
Power station Net Eff. (LHV)	%	±20.00	±29.00
Fuel heat input (LHV)	MJ/s	±47	±134
Fuel flow (LHV)	kg/s	±3.20	±9.10
Fuel requirement	t/h	±11.50	±32.85

Although the baseload capacity factor/ load factor of 85% is preferred for a thermal power station, NamPower intends to operate the Otjikoto Biomass Power Station at a capacity factor of at least 70%. The 70% capacity factor can be achieved by operating the following dispatch regime:

- Full capacity from Monday to Friday;
- Reduced capacity of ±35% thermal load on Saturday and Sunday.

The proposed weekly operating profile based on these assumptions are depicted in the figure below. It should also be noted that for the Capacity Factor calculations, the planned and unplanned outages of the power station are assumed at 11%.

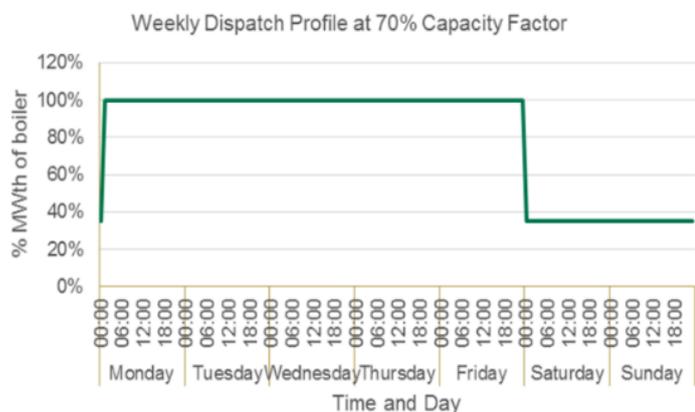


Figure 5: Capacity Factor dispatch profile of 70%

The yield estimate based on the proposed operating profile and listed Fuel Calorific Value (CV), is shown in the Table 3:

Table 3: Yield estimate input assumptions

Description	Unit	Value
Installed capacity	MWe	±44
Annual Capacity Factor	%	70
Operating hours per year	h/a	±5,950
Annual energy production	MWh	±211,550
Annual area of bush cleared	ha	±16,200
Fuel requirement	t/a	±204,000
Fuel density	t/m ³	0.25

Environmental Considerations

NamPower completed its EIA process for the construction and operation of the proposed Otjikoto Biomass Power Station and the associated harvesting activities as per the Environmental Management Act, Act No.7 of 2007, in order to apply and obtain an Environmental Clearance Certificate (ECC).

The two (2) ECCs, for the power station and the related harvesting activities, were issued by the Ministry of Environment, Forestry and Tourism (MEFT), after approval of the EIA Report and 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 6.

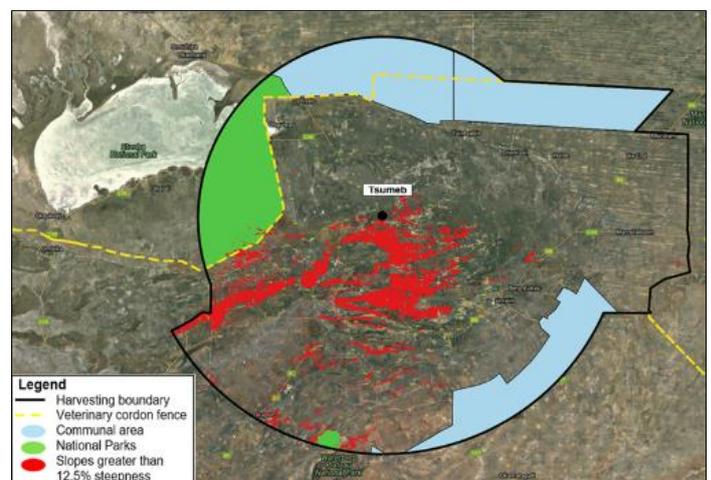


Figure 6: Harvesting Area for the Project

A conservative harvesting yield assumption of 12.65 t/ha was used for the Oshikoto region and the

Otjikoto Biomass 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 well after its planned lifetime considering the existing resource volumes.

The project's Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) conforms to the International Finance Corporation's (IFC) performance standards; as well as the emission limits of the Otjikoto Biomass Power Station, which are the guiding requirements for most DFIs. The Otjikoto Biomass Power Station will be designed to adhere to the Industrial Emissions Directive (IED) through Best Available Techniques (BAT) which will entail the continuous monitoring of the following emission limits:

Table 4: IED emission limit values

Pollutant	Units	Emission Limits (Daily average)
Nitrogen Oxides (NO _x)	mg/Nm ³	< 500
Sulphur Oxides (SO _x)	mg/Nm ³	< 683.5
Dust	mg/Nm ³	<50

In addition, the project's EIA and EMPs was fully aligned to the Forest Stewardship Council (FSC) Principles and Criteria. NamPower is considering applying for certification and managing its fuel supply under a group scheme.

Impact on Climate Change

A Greenhouse Gas (GHG) Emission Assessment for the project were carried out by an independent consultant, UNIQUE Forestry and Land Use GmbH, in 2021. The assessment represented a footprint analysis and covered the direct emissions of the power plant and its related biomass fuel harvesting and transportation activities, as well as indirect emission sources and sinks from the considered land.

Considering a 70% operation capacity factor, the project is expected to offset approximately 0.308 million t CO₂eq per year, which equates to a total mitigation of 7.71 million t CO₂eq over the project's 25 years lifetime. Considering an 85% operation capacity factor, the project is expected to offset approximately 0.395 t CO₂eq per year, which equates to a total mitigation on 9.87 million t CO₂eq over the project's 25 years lifetime.

A Vulnerability and Adaptation Assessment carried out for the project, by Namibia Nature Foundation (NNF) in 2021, outlines that the project contributes to key climate change adaptation benefits of enhanced water availability, improved land productivity, enhanced resilience and adaptive capacity of local communities through the rehabilitation of bush encroached land.

As a low-carbon energy project, the project notably contributes to achieving Namibia's international commitments under its Nationally Determined Contribution (NDCs), National Biodiversity Strategy and Action Plan (NBSAP II) and Third Programme under the United Nations Convention on Combatting Desertification (UNCCD).

Macro-economic Benefits

NamPower, the MEFT and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH– Bush Control and Biomass Utilisation (BCBU) Project, with the support of Namibia Biomass Industry Group (N-BiG), commissioned a macroeconomic study in 2018 to quantify and assess the microeconomic and macroeconomic impact of a 20 MWe (nett) Otjikoto Bush Biomass Project. The study was recently (2021) updated for the 40 MWe (nett) capacity with the assistance of N-BiG.

Although there are assumed biomass- based power generation costs associated with operating and maintaining a biomass power station, there are significant economic benefits:

- The net present value (NPV) of the microeconomic benefits totals NAD 4.965 billion (discounted at 5.5% p.a.), or NAD0.81/kWh.
- The net present value of macroeconomic benefits (discounted at 5.5% p.a.) totals NAD 16.1 billion, or NAD2.67/kWh.

These figures also vary slightly, depending on the type of harvesting arrangement (i.e., whether a combination of fully mechanised, semi- mechanised and manual labour).

The larger scale of this 40MWe power plant vis-à-vis the 2018 study on a 20MWe power station result in a significantly larger macroeconomic benefit.

Risk Assessment

NamPower invited key stakeholders to participate in a risk assessment workshop to identify key risks associated with the Project. The summary of the critical risks identified at the workshop are listed below:

High priority risks to the Power Station:

- Potential delays could occur as the result of bureaucracy associated with the national public procurement process or the COVID-19 pandemic;
- The fuel supply industry may have insufficient capacity to provide the requisite fuel quantities to the power station; and
- Foreign exchange exposure causing an increase in original projected capital cost and impacting electricity tariff financial model.
- Various restrictions forthcoming from potential funders' procurement policies and its related impact on the Project.

High priority risks to the fuel supply chain:

- Fuel supply agreement not conducive for raising capital for potential fuel suppliers;
- Agreements with fuel suppliers not in place prior to loan effectiveness (assumed to be required by international financial institutions);
- Legacy liability associated with the aftercare of harvested land; and
- Environmental degradation as a result of poor harvesting methods being adopted.

NamPower, through the Environmental practitioner and various technical advisors, has developed risk mitigation measures that are explained in more detail in the following documents:

- Fuel Supply Strategy;
- Funding strategy;
- Procurement strategy;
- Technical specifications of the power station; and
- EMPs for both the power station (construction and operation) and for the harvesting activities.

The following risks were identified and added to the risk register as the high priority risks that should be managed positively for the project to reach Financial Investment Decision (FID).

High priority Project risks:

- Insufficient Debt Funding – the risk that the Biomass Project does not get funding, or does not get favourable funding (additionally);

- Insufficient NamPower Funding - inability to make the equity contribution (budget constraints);
- Under-recovery of tariff – the risk that the Biomass Project will not recover its full costs/ tariff (final tariff approval from the ECB);
- Security of Fuel Supply - the risk is that the fuel source is not secured (Fuel Supply Agreements and related contracting chain not sufficient to meet the dispatch requirements of the Power Station).

NamPower through the project development strategy have sought to mitigate all the aforementioned risks.

Project Schedule and Progress

The completed tasks of the Project are summarised in Table 6.

Table 6: Completed Tasks

Completed Tasks	Completion Date
NamPower Board approval of Project Business Case.	Aug 2018
NamPower Board and Ministerial approval on final Project capacity.	Nov 2018
Market Sounding on the proposed technical description of the power station.	Jan 2019
Acceptance of the Transmission Connection Offer	Feb 2019
Appointment of a Technical Advisor to commence with the compilation of the technical specifications for the power station.	Feb 2019
Procurement of the Project Site	Jun 2019
Finalisation of the Geotechnical and Geohydrological subsoil investigations on the Project Site.	Jul 2019
Completion of the final confirmation review for the International Finance Corporation (IFC) compliance audit on the EIA.	Dec 2019
Launch of the formal Expression of Interest (EOI) for the shortlisting of the Owners Engineering consultants.	Feb 2020
Appointment of a Legal Advisor to assist in the finalisation of the Fuel Supply contracting structure and development of the Fuel Supply Agreements (FSA).	Jun 2020
Appointment of a Forest Stewardship Advisor to assist NamPower in aligning its harvesting EIA and EMPs to the Namibian FSC Standard.	Jun 2020
Market Sounding on the proposed fuel supply related to potential fuel suppliers, land and farm owners.	Nov 2020
Completion of the FSC gaps analysis and full alignment of the FSC Principles on the EIA and EMPs	Nov 2020
Launch of the formal RFP to the shortlisted consultants for the procurement of the	Dec 2020

Completed Tasks	Completion Date
Owners Engineer.	
Finalisation of the first draft Fuel Supply Agreement (FSA) with the assistance from the appointed Legal Advisor	Dec 2020
Launch of the formal Phase I: Prequalification process to prequalify EPC Contractors and Boiler and Grate System Suppliers.	Jan 2021
Appointment of the French Development Agency (AFD) as preferred project lender	Mar 2021
The Environmental Clearance Certificates (ECCs) for both, the Biomass Power Station and the related fuel supply activities was received	Apr 2021
Appointment of the Owners Engineering Consultant	May 2021
Conclusion of the Prequalification Phase by the CPBN with 15 EPC companies prequalified.	Oct 2021

Project Key Milestones

The key milestones of the Project are summarised in Figure 7.

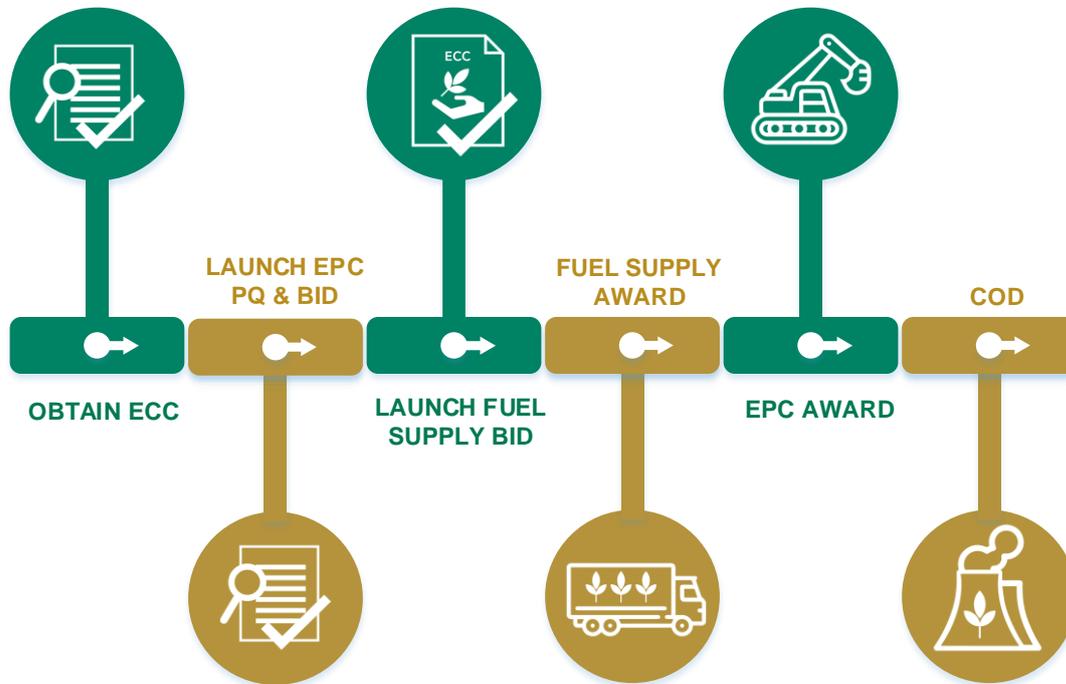


Figure 7: Project Development Timeline

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