Offset Project Plan Form:
Sundance Biomass Energy Generation project

Project Developer:

Edson Forest Products, a division of West Fraser Mills Ltd.

Prepared by:

West Fraser Mills Ltd.,

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1.0 Contact Information

Table 1: Project Contact Information

Project Developer Contact Information	Additional Contact Information
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Authorized Project Contact (if applicable)
N/A

2.0 Project Scope and Site Description

Table 2: Project Information

Project title	Sundance Biomass Energy Generation Project
Project purpose and objectives	The Thermally Heated Fluid ("THF") Biomass Burner Project ("The Project") is located at the Edson Forest Products, a division of West Fraser Mills Ltd. a sawmill facility in Edson, Alberta. The THF burner is a biomass combustion system designed and installed to burn some of the wood waste generated by the facility that was previously considered waste. The thermal energy generated by the combustion of the biomass heats a hot oil system. The hot oil is used for drying the dimensional lumber and space heating. Prior to the project, the lumber was dried in kilns by a natural gas forced hot air system, and part of the sawmill property was heated using natural gas. The installation of the project reduces the consumption of natural gas used for space heating and drying of the dimensioned lumber in the kiln. The reduced natural gas consumption creates an associated reduction in GHG emissions resulting in the ability to generate offset credits. The offset project requirements are defined in the CCIR and protocol scope. The project meets all the requirements. **Not be required by law:** No law required Edson to construct and commission the THF biomass burner project. This criterion is met. **Results from actions taken on or after January 1, 2002:** The project had officially started in April 2005. This criterion is met. **Have occurred in Alberta:** The project is physically located in Edson, AB. All the energy generated by the project is used on the sawmill premises. This criterion is met. **Be real, demonstrable, quantifiable:** This requirement is defined in the protocol. The project meets all of the required criteria. **Be verified by a qualified third party:** The project will be verified by a third party before any of the offsets are serialized. **Eligible biomass waste is used:** The offset project uses wood bark as a fuel which is a biomass waste. This criterion is met. **Biomass waste is combusted to produce heat:** The offset project uses wood bark as a fuel to produce heat. This criterion is met. **Energy generated from the combustion of the waste biomass partially offsets fossil fuel based energy:** The energy generated from the combustion of biomass is partially offsetting the fossil fuel based energy. This criterion is met. **The emissions from bioenergy production are less than would have occurred in the absence of the project:** The emissions from combustion of wood waste are less than would have occurred in the absence of the project. This criterion is met. The offset project does not use any flexibility mechanism criteria set in the protocol.

Activity start date	The project activity was started in April 2005
Offset crediting period	Initial offset crediting period: October 1, 2005 - September 30, 2013 A five-year extension was granted on May 27, 2014. The extension was granted from October 1, 2013 - September 30, 2018. The extension letter is attached in Appendix-A
Estimated emission reductions/capture/sequestration	Initial credit period reduced emissions by: 124,976 tCO_2e Actual Emission Reduction, 2005 : 3,229 tCO2e Actual Emission Reduction, 2006 : 12,972 tCO2e Actual Emission Reduction, 2007 : 15,667 tCO2e Actual Emission Reduction, 2008 : 16,657 tCO2e Actual Emission Reduction, 2009 : 16,882 tCO2e Actual Emission Reduction, 2010 : 15,801 tCO2e Actual Emission Reduction, 2011 : 13,518 tCO2e Actual Emission Reduction, 2012 : 12,057 tCO2e Actual Emission Reduction, 2013 : 7,823 tCO2e (Jan 1 – Sep 30 2013) Actual Emission Reduction, 2014 : 10,370 tCO2e (Oct 1 2013 – Dec 31, 2014) Estimated reductions from the project extension: 54,904 tCO2e Estimated Emission Reduction, 2015 : 12,392 tCO2e Estimated Emission Reduction, 2016 : 14,823 tCO2e Estimated Emission Reduction, 2017 : 14,189 tCO2e Estimated Emission Reduction, 2018 : 13,500 tCO2e Estimated Emission Reduction, 2019 : 0 tCO2e Estimated Emission Reduction, 2020 : 0 tCO2e Due to changes made in the regulations, the emissions reduction resulting from natural gas are no longer eligible. Hence, Sundance Biomass Energy Generation project will not be generating any more credits in 2019 and 2020. Therefore, they are entered as zero.
Unique site identifier	Latitude: 53° 33' 41.1" N Longitude: 116° 34' 40.4" W Edson Forest Product is located in the town of Edson, AB
Is the project located in Alberta?	Yes
Project boundary	**Physical Boundary:** Appendix-A, Figure-1, shows the map of the physical boundary of the biomass energy generation plant. The plant is located in the left-hand corner of the property. **Geographical Boundary:** The geographical boundary of the project is Edson, AB **Operational project boundary:** From the operation perspective, the biomass energy plant is separated from other parts of the mill. The

	operational boundary of the energy plant starts from the hog conveyor that feeds debarked hog from the sawmill to the energy plant.
Ownership	West Fraser Mills Ltd. is a sole owner of the offset project. Edson Forest Products holds the business license and the land title certificate issued by the Government of Alberta. The offset credits are managed by West Fraser Mills Ltd, the parent company of Edson Forest Products. West Fraser Mills Ltd. Will claim entitlements to the environmental attributes and other benefits associated with the project.

2.1 Project Description

The THF Burner Project ("The Project") is an energy substitution project at the Edson Forest Product sawmill facility (" Edson "), located near Edson, Alberta. The opportunity for generating carbon offsets with this project arises from direct GHG emission reductions as a result of a reduction in the consumption of natural gas used at the facility.

Figure-2, in Appendix-A, shows the simplified process flow diagram. In essence, the Project involves the design and installation of a dual biomass furnace producing a net output of 40 MMBTU/hr of thermal fluid energy. The furnace is equipped with a concentrically wound thermal oil heater mounted directly above the furnace, where the gases from the furnace enter the bottom of the heating coils. The thermal oil is circulated through the heater in parallel and out to the mill's dry kilns by low-pressure centrifugal pumps. Hot oil is also used to heat air used for space heating of buildings on the sawmill property.

The furnace consists of a mechanical moving grate system used to dry and combust green fuel supplied to the furnace. The material enters the furnace grates through a double gate fuel chute arrangement, designed to meter fuel into the furnace grates and at the same time keep a positive airlock to the furnace. As the green fuel is burned, any remaining residue falls through the grates and are removed by a water-filled ash conveyor. An electrostatic precipitator ("ESP") is used to capture particulate matter from the exhaust stream from the furnace. Ash from the furnaces forms a very small percentage of the original feed.

Prior to project initiation, natural gas was combusted to dry dimensional lumber. Under the Project conditions, a new biomass burning system was designed and installed to burn wood waste generated by the facility. The thermal energy generated by the biomass heats a hot oil system. The hot oil is used for the drying of dimensional lumber and for some space heating. The project is expected to last as long as the sawmill remains operational.

2.2 Protocol

The offset project at Edson Forest Product. was developed and quantified in accordance with the energy generation from the combustion of biomass waste protocol (ver 2.0, April 2014), which mainly covers displacement of fossil fuel with biomass waste to generate energy.

The offset project meets the following criteria set out in the protocol scope:

- **Not be required by law:** There was no law that required Edson to construct and commission the THF biomass burner project. This criterion is met.

- **Results from actions taken on or after January 1, 2002:** The project has officially started in April 2005. This criterion is met.
- **Have occurred in Alberta:** The project is physically located in Edson, AB. All the energy generated by the project is used on the sawmill premises. This criterion is met.
- **Be real, demonstrable, quantifiable:** This requirement is defined in the protocol. The project meets all of the required criteria.
- **Be verified by a qualified third party:** The project will be verified by a third party before any of the offsets are serialized.
- **Eligible biomass waste is used:** The offset project uses wood bark as a fuel. This criterion is met.
- **The biomass waste is combusted to produce heat:** The offset project uses wood bark as a fuel to produce heat. This criterion is met.
- **Energy generated from the combustion of the waste biomass partially offsets fossil fuel based energy:** The energy generated from the combustion of biomass is partially offsetting the fossil fuel based energy. This criterion is met.
- **The emissions from bioenergy production are less than would have occurred in the absence of the project:** The emissions from combustion of wood waste are less than would have occurred in the absence of the project. This criterion is met.

The offset project does not use any flexibility mechanism criteria set out in the protocol. The project doesn’t use more than one protocol.

A three-year baseline data is required to quantify the onsite heat generation (B18). The project had only twenty-four months of data. Hence, a request for deviation was made to the Alberta Climate Change Office (ACCO). The request for the deviation was approved through the letter dated, December 14, 2016, which is attached as Figure-7. The project used twenty-four months of baseline data and met the terms and condition outlined in the authorization letter.

2.3 Risks

Potential risks associated with the project are environmental and regulatory risks. The following outlines possible risks and scenarios associated with the offset project.

Environmental risks:

Risk of fire: The project uses thermal oil at a temperature of about 500 $^{\circ}$F. Any leak and subsequent exposure of the hot oil to the outside environment can creat a potential risk of fire. **Strategy and mitigation plan:** The project is engineered to contain the hot fluid without exposing it to the environment. In the case of fire, automated sensors will detect the fire which is then manually extinguished.

Risk of particulate emissions: The project burns biomass residue to generate heat, as a result, it also creates unburnt biomass as a particulate residue which is captured in an Electro Static Precipitator (ESP). If the ESP fails, the particulates will be discharged into the atmosphere.

Strategy and mitigation plan:

1. A preventive maintenance plan is in place to avoid major issues that might trip the ESP.
2. The project is engineered to send alarms to the operator as soon as ESP stops working.

Regulatory risks:

Offset project will be discontinued: Changes made to Carbon Competitiveness Incentive Regulation (CCIR) will stop generating offset credits. There is no strategy to mitigate this risk.

Other risks:

If Edson finds a more economic market for wood residue, there is a possibility that Edson might sell wood residue and start burning natural gas. West Fraser made a significant capital investment in the energy plant. Hence, it is very unlikely that Edson will sell wood waste and start burning natural gas.

Project level additionality assessment is not applicable.

3.0 Project Quantification

3.1 Inventory or Sources and Sinks

	Source and sinks	Comment	Monitoring/tracking
SSs relevant/ applicable to the Baseline of the Project	**B4 – Fuel extraction/processing**	For this project, natural gas was combusted to produce heat. The heat was used to dry the lumber and for the space heating. Since natural gas was extracted and processed for combustion, B4 is included in the offset calculations.	The natural gas invoices from the supplier are used to monitor and quantify B4. The natural gas consumption is tracked using gas flow meter which meets Measurment Canada Standards.
	B12 – Facility operations	Electricity was consumed by fans and blowers to move hot gases around the kiln. There were emissions associated with usage of electricity. Hence, B12 is included in the offset calculations.	A Third party verified 'energy efficiency feasibility study' was conducted to quantify electricity consumption for the kilns. Lumber production is used in conjunction with the electricity intensity to monitor and quantify B12. Lumber consumption is tracked manually and electricity consumption is tracked using electricity meters.
	B18 – On-site heat generation displaced in the project	Natural gas was combusted to produce heat. The heat was used to dry the lumber and for space heating. Since the project displaces onsite heat generation, B18 is included in the offset calculations.	The natural gas invoices from the supplier and heat output quantifications are used to monitor and quantify B18. The onsite heat generation in the baseline was tracked using natural gas flowmeters.
SSs relevant/ applicable to the Project	**P4 – Fuel extraction/processing**	In the project conditions, the natural gas is still combusted to heat part of the sawmill buildings. Since natural gas was extracted and processed for combustion, P4 is included in the offset calculations.	The natural gas invoices from the supplier are used to monitor and quantify P4. The natural gas consumption is tracked using gas flow meter which meets Measurment Canada Standards.
	P12 – Facility operation	Electricity is consumed to operate the THF plant and move the hot oil around the kiln. There are emissions associated with the usage of electricity. Hence, P12 is included in the offset calculations.	Electricity load measurements were taken to quantify P12. The electricity consumption is measured and tracked using electricity loggers.
	P15 – Combustion of Biomass and Fossil Fuels	Biomass is used as a fuel to generate heat in the THF. And diesel is used to run mobile equipment to move biomass. Hence, P15 is included in the offset calculations.	A combination of Process Design Data, measured Higher Heating Value (HHV), and estimated operating hours are used to monitor and quantify P15.

3.2 Baseline and Project Condition

Baseline Condition:

Prior to the implementation of the Project, lumber was dried in the kiln using natural gas. The natural gas was also used for space heating buildings on the sawmill property. Figure-3 outlines the inputs and outputs of the kiln in the baseline conditions. Natural gas is still consumed to provide space heating. The usage is functionally equivalent in the baseline and project conditions.

As such, had the Project not been initiated by Edson, energy requirements for the kiln and the sawmill buildings would not have changed, and natural gas would have remained at baseline levels. Hence, natural gas consumption is used as a baseline (B18)

Specified gas emissions in absence of the project: 25,780 tCO_2e/year (baseline + P15)
Specified gas removal in absence of the project: 0 tCO2e/year

The specific action that was taken to reduce specified gas emission was installing the thermal fluid heater to offset natural gas combustion with biomass combustion. The level of service provided in the baseline and project conditions does not change (both of them are measured in GJ). Hence, the project is functionally equivalent to the baseline condition.

Project Condition:

Since the installation and commencement of the project in April 2005 a substantial portion of the bark component of the mill's wood waste is burned in the new THF system. The energy transferred by the hot oil system completely eliminates the consumption of natural gas in the lumber drying process and offsets the majority of the space heating requirements of the sawmill buildings. In the winter months, some natural gas is still required only for building heat.

Specified gas emissions in absence of the project: 13,192 tCO_2e/year (baseline + P15)
Specified gas removal in the absence of the project: 2,270 tCO_2e/year (P12)

3.3 Quantification Plan

All measurement and estimation procedures are performed with reference to guidelines presented in the protocol.

Net Emission Reduction = $\text{Emission}_{\text{baseline}}$ – $\text{Emission}_{\text{project}}$

Emission $_{\text{baseline}}$ = Sum of emissions under baseline category

- Emission $_{\text{fuel extraction/processing}}$ = emissions under SS B4
- Emission $_{\text{facility operation}}$ = emissions under SS B12
- Emission $_{\text{thermal heat}}$ = emissions under SS B18

Emission $_{\text{project}}$ = Sum of emissions under project category

- Emission $_{\text{fuel extraction/processing}}$ = emissions under SS P4
- Emission $_{\text{facility operation}}$ = emissions under SS P12
- Emission $_{\text{combustion of biomass and fossil fuel}}$ = emissions under SS P15

The quantification of the emission reduction generated by the project will be conducted using the Excel calculator owned by West Fraser Mills Ltd. The calculator follows the guidelines outlined in the Quantification Protocol for Energy Generation Form The Combustion of Biomass Waste (Version

2.0, April 2014). The general quantification method for required sources and sinks are outlined below.

Volume of fossil fuels consumed for facility operation in the project condition (SSP4): The biomass and ash are moved around the energy plant using a series of conveyors and heavy equipment. Based on the time it takes to transfer biomass and ash it is estimated that heavy equipment consumes 600 L of diesel per annum. The associated GHG emissions are accounted for and included in the quantification.

Electricity consumed in project conditions: A series of screw conveyors and fans are used to run the biomass plant. These conveyors and fans are powered by electricity. Electricity measurements were taken and the emissions associated with operating the biomass energy generation plant have been calculated and included in the quantification.

Volume of fossil fuel consumed in the baseline condition: In the baseline scenario, natural gas was consumed to provide thermal heat to the drying kilns and the sawmill property. The site has one main natural gas meter that measures the gas consumption. The natural gas usage that has been displaced by biomass combustion in the project activity is quantified for emission reductions.

Volume of fossil fuels consumed in the project condition for space heating: Natural gas is still used for space heating in the winter months to heat the portion of the sawmill not connected to the thermal oil system, which includes a small portion of the sawmill property. This natural gas usage is functionally equivalent in the baseline and project conditions.

Heat generation: The heat produced by the biomass energy generation plant was determined by calculations carried out by engineers at West Fraser Mills Ltd. The heat calculation is a function of the oil density, the mass flow rate and the specific heat capacity. To complete the calculations the average daily supply and return temperature (in °C), as well as the flow rate for the thermal oil system, were measured.

Heat Output, $Q = \dot{m} \times \rho \times C_p \times \Delta T$

Where:

Density, ρ (lb/ft^3) = -2E08 supply oil^2 (˚F) supply oil (˚F) x (-0.022) + 55.598
Specific Heat Capacity, Cp (Btu/lb ˚F) = 0.0004 x supply oil (˚k) + 0.4249
1 mmBTU = 1.055056 GJ

To determine the on-site heat generation and fuel extraction/processing displaced by project, source and sink B18 and B4 respectively, the lower of (Hgproj – Hcproj)or $Hg\_Historic_{adjusted}$ was used.

Hg_{proj} is considered to be the heat output (Q) of the biomass energy generation plant
Hc_{proj} is considered to be zero since the biomass energy plant does not consume thermal heat
$Hg\_Historic_{adjusted}$ is considered to be $NG_{\text{Displaced by Project}}$ x (current production/historic production)

The heat demand at Edson varies with season. In colder months heat demand tends to be higher as compared to warmer months. When excess heat is produced and heat demand is low, the excess heat is dumped to the atmosphere. The heat that is not used for the process heating has been excluded in the credit calculations.

The calculations carried out by engineers at West Fraser Mills Ltd shows that (Hgproj – Hcproj) produces a smaller value. This value is then multiplied by the CO_2, N_2O and CH_4 emission factors for combustion, extraction and processing to give a total emission tonnage. This emission tonnage is then converted into CO_2 equivalent and is considered to be the baseline emissions.

The project emissions were calculated based on diesel emissions, biomass combustion and electricity consumption. Source and sink P4 was calculated similar to that of B4, in which the amount of diesel was multiplied by the combustion and production emission factor of CO_2, N_2O and CH_4.

Production Emissions for Diesel Consumption within Project = emissions under SS P4

- Emissions of CO_2 = Monthly Consumption (L) x emission factor of Diesel, CO_2/L
- Emissions of CH_4 = Monthly Consumption (L) x emission factor of Diesel, CH_4/L
- Emissions of N_20 = Monthly Consumption (L) x emission factor of Diesel, N_2O /L

Combustion Emissions of natural gas = emissions under SS P4

- Emissions of CO_2 = Monthly Consumption (L) x emission factor of Natural gas, CO_2/L
- Emissions of CH_4 = Monthly Consumption (L) x emission factor of Natural gas, CH_4/L
- Emissions of N_20 = Monthly Consumption (L) x emission factor of Natural gas, N_2O/L

The electricity consumption under the source and sink P12 was calculated based on the equipment such as conveyors and fans which are required to maintain the biomass energy generation plant operation. The total energy consumption for the biomass energy generation plant, was measured. The total energy consumption was then multiplied by the electricity emission factor in CO_2 equivalent per kilowatt hour.

- Energy Consumption (MW.h) = √3 x Voltage (V) x Current (amps) x Power factor x operating hours
- Emissions of CO_2 = Energy Consumption (MW.h) *Alberta Grid Intensity (0.64kg CO_2/MW.h)

The biomass emissions generated under the source and sink P15 were calculated based on the sum of the average monthly biomass consumed by the biomass energy generation plant. This tonnage was then multiplied by the biomass emission factor for N_2O and CH_4.

- Emissions of CH_4 = Monthly Consumption (GJ) x Biomass emission factor g CH_4/GJ of Biomass
- Emissions of N_20 = Monthly Consumption (GJ) x Biomass emission factor g N_20/GJ of Biomass

The final emission value produced by the project was the sum of CO_2, N_2O and CH_4 emissions multiplied by their respective global warming potential. This resulted in net emissions reduction in tonne CO_2e.

- Emissions of CO_2e = Total Project CO_2 emissions x GWP of CO_2 (1)
- Emissions of CO_2e = Total Project N_2O emissions x GWP of N_2O (298)
- Emissions of CO_2e = Total Project CH_4 emissions x GWP of CH_4 (25)

Sample calculations:

Net Emission Reduction = $\text{Emission}_{\text{baseline}}$ – $\text{Emission}_{\text{project}}$

= 17,585.82 – 3,396.75 tCO2e = 14,189.07 tCO2e

Emission $_{baseline}$ = Sum of emissions under baseline category

- Emission $_{fuel\ extraction/processing}$ = emissions under SS B4
  Natural gas consumption = 303,336 GJ
  HHV = 40.9983 MJ/m3

  Volume of natural gas, m^3 = (303,336 x 1000 /40.9983) = 7,398,740 m^3
  CO_2 emissions emitting from combustion of natural gas = 0.133 Kg CO2/m3 x 7,398,740 m^3 = 984 tCO_2 = 984 tCO2e
  CH_4 emissions emitting from combustion of natural gas = 0.0026 Kg CH4/m3 x 7,398,740 m^3 = 19.23 tCH_4 = 480.9 tCO2e
  N_2O emissions emitting from combustion of natural gas = 0.000007 Kg N2O/m3 x 7,398,740 m^3 = 0.1 tN2O = 15.4 tCO2e

- Emission $_{facility\ operation}$ = emissions under SS B12

  Kiln load 321 mfbm
  Heater blower electricity consumption = 1282.1 KWh
  Burner blower electricity consumption = 551.3 KWh
  Total electricity consumption = 1282.1 KWh + 551.3 KWh = 1833.4 KWh

  Energy intensity = 1833.4 KWh / 321 mfbm = 5.71 KWh/mfbm

  Electricity usage under SSB12 = Annual lumber production, mfbm x energy intensity
  = 8,361 mfbm/month x 12 months x 5.71 KWh/mfbm
  = 572.9 MWh
  Emission from the usage of electricity = 0.64 tCO2e/MWh x 572.9 MWh
  = 366.7 tCO2e

- Emission $_{thermal\ heat}$ = emissions under SS B18

Annual Heat Output, Q is calculated using the formula = $\dot{m} \times \rho \times C_p \times \Delta T$

Where:

Density, ρ (lb/ft^3) = -2E08 supply oil^2 (˚F) supply oil (˚F) x (-0.022) + 55.598

Specific Heat Capacity, Cp (Btu/lb °F) = 0.0004 x supply oil (˚k) + 0.4249

1 mmBTU = 1.055056 GJ

Annual heat output, H_{gproj} = 334,548 GJ

Historic heat demand, $H_{ghistoric}$ = 258,397 GJ

If ($Hg_{project}$ – H_{cproj}) < o then:

Displaced emissions on-site = EFHO x (H_{gproj} – H_{cproj})

Otherwise

Displaced emissions on-site = EFHO x lesser of [(H_{gproj} – H_{cproj}), $H_{ghistoricadjusted}$)

$H_{ghistoricadjusted}$ = $H_{ghistoric}$ x (current production / Historic Production)

Displaced emission on-site = 0.04704 tCO_2e/GJ x 334, 548 GJ = 15,739 tCO_2e

Emission $_{project}$ = Sum of emissions under project category

- Emission $_{fuel\ extraction/processing}$ = emissions under SS P4

Emissions from Diesel

Diesel consumption = 600 L
Emission associated with diesel consumption = Diesel consumption, L (Diesel CO_2 emission factor, KG CO_2 x GWP CO_2 + Diesel CH_4 emission factor, KG CH_4 x GWP CH_4 + Diesel N_2O emission factor, KG N_2O x GWP N_2O)

= 0.248 tCO_2e

Emissions from burning biomass

Heat produced by furnace	: 334,548 GJ
Efficiency of the furnace	: 71.56%
Heat input	: heat output / efficiency
	: 467,531 GJ
HHV	: 20.42 GJ/tonne of biomass
Biomass consumption	: Heat input/HHV of biomass
	: 467,531/20.42
	: 22,895 tonnes

Emission associated with natural gas consumption = Natural gas, m3 (Natural gas CO_2 emission factor, kg/m3 CO_2 x GWP CO_2 + Natural gas CH_4 emission factor, kg/m3 CH_4 x GWP CH_4 + Natural gas N_2O emission factor, kg/m3 N_2O x GWP N_2O)

= 215. 98 tCO_2e

Total emissions from SS P4 = emission from diesel + emission from burning biomass = 0.248 + 215.98 = 216.23 tCO_2e

- Emission $_{facility\ operation}$ = emissions under SS P12
  Installed horse power = 150 HP
  Measured amps = 108 A
  Power factor = 0.84
  Full load amps = 147 A
  Voltage = 575 V

Energy consumption = √3 x Voltage (V) x Current (amps) x Power factor x 24 hrs
= √3 x 575 V x 108 A x 0.84/1000000
= 2.2 MWh

- Emission $_{\text{combustion of biomass and fossil fuel}}$ = emissions under SS P15

Emissions from Diesel
Diesel consumption = 600 L
Emission associated with diesel consumption = Diesel consumption, L (Diesel CO2 emission factor, KG CO2 x GWP CO2 + Diesel CH4 emission factor, KG CH4 x GWP CH4 + Diesel N2O emission factor, KG N2O x GWP N2O)

= 1.672 tCO2e
Emissions from burning biomass

Heat produced by furnace	: 334,548 GJ
Efficiency of the furnace	: 71.56%
Heat input	: heat output / efficiency
	: 467,531 GJ
HHV	: 20.42 GJ/tonne of biomass
Biomass consumption	: Heat input/HHV of biomass
	: 467,531/20.42
	: 22,895 tonnes

Emission associated with Biomass consumption = Biomass consumption, GJ (Biomass emission factor, g/GJ CH4 x GWP CH4 + Biomass emission factor, g/GJ N2O x GWP N2O)
= 907.94 tCO2e

The estimation and calculation methods selected above are the best practice/standard methods used in the industry to quantify emissions. Hence, these procedures have been selected for quantification.

GHG Emission Factors	CO_2	CH_4	N_2O	CO2e	Source
Natural Gas (g/m^3)	1918	0.037	0.033	N/A	Carbon Offset Emission Factor Handbook, (March 2015 - version 1.0)
Extraction of Natural gas (kg/m^3)	0.0430	0.00230	0.000004	N/A	
Increased on-site grid electricity use (tCO2e/MWh)	N/A	N/A	N/A	0.64	
Processing of Natural Gas(kg/m^3)	0.0900	0.00030	0.000003	N/A	
Wood Waste (g/GJ)	N/A	30	4	N/A	Emission Factor Wood Waste 0% moisture WCI Table 20-2

	CO_2	CH_4	N_2O
GWP Factor	1	25	298

Appendix-A, Figure-4 and Figure-5 shows supporting data for tracking, monitoring, and quantification of all sources and sinks.

Figure-4 shows the Natural gas consumption, lumber production, and heat production data. Natural gas consumption comes from the supplier invoices, lumber production comes from the divisional controller, and heat production is quantified by an engineer.

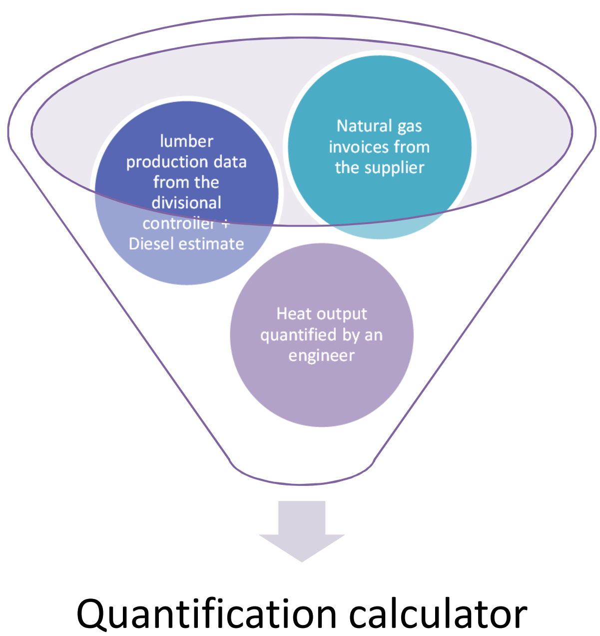
Figure-5 shows the electrical consumption data. This data comes from the electrical supervisor at Edson Forest Products

3.4 Monitoring Plan

In general, the data control process employed for the Project consists of electronic data capture and reporting, and manual entry of monthly total or average values into the quantification calculator developed by West Fraser Mills Ltd. There are two data streams involved in this project:

I. Electronic data captured and reported by metering systems; and

II. Manual data entry



Lumber production: The divisional controller quantifies lumber production in the sawmill based on the physical count of the available inventory. The lumber production is quantified once a month and manually entered into the financial statements. These financial statements are subject to verification on a test basis by a third party financial auditor. After verification, the quantity of lumber production is used in the quantification calculator.

Natural gas: Edson Forest Products purchases natural gas from Gas Alberta Energy. The invoice data from the supplier is manually entered into an excel sheet.

Heat production: Six hour interval data for the supply oil temperature, the return oil temperature, and the oil flow is used to quantify heat output from the furnace.

Diesel estimation: The environmental coordinator estimated the amount of time it takes to move biomass around the energy plant using a loader. Based on the operating hours of the heavy equipment, it was estimated that annually the Edson THF plant consumes 600 L of diesel.

Electricity measurements: The electrical supervisor at Edson measured load on the motors in the energy plant. The load measurements were used to calculate electricity consumption.

Table 3: Sample Monitoring Plan

Parameter	Monitoring Specifications
Fuel extraction and processing	B4
Data parameter	Volume of the natural gas consumed
Estimation, modeling, measurement or calculation approaches	Monitored
Data unit	GJ
Sources/Origin	Direct metering of natural gas by the supplier's meter. The information from the supplier's invoice is manually entered in the excel calculator.
Sampling frequency	Monthly invoice
Description and justification of monitoring method	This is the most accurate method of measuring this parameter assuming that staff is correctly trained and equipment is correctly maintained by the natural gas supplier.
Uncertainty	As per Measurement Canada specifications.

Parameter	Monitoring Specifications
Facility Operations	B12
Data parameter	Lumber production
Estimation, modeling, measurement or calculation	Measurement

approaches	
Data unit	MFBM
Sources/Origin	Physical inventory reconciliation of the product shipped, consumed, and physically present on the property
Sampling frequency	Once a month
Description and justification of monitoring method	This is the most accurate method of measuring this parameter assuming that staff are correctly trained to locate and count the inventory
Uncertainty	Negligible

Parameter	**Monitoring Specifications**
Displace onsite heat generation	B18
Data parameter	Heat output
Estimation, modeling, measurement or calculation approaches	Measurement
Data unit	GJ
Sources/Origin	The supply oil temperature, the return oil temperature, and the oil flow are measured using the Resistance Temperature Detectors (RTDs). These instruments are calibrated to Measurement Canada specifications.
Sampling frequency	Six hours
Description and justification of monitoring method	This is the most accurate method of measuring this parameter.
Uncertainty	As per Measurement Canada specifications.

Parameter	**Monitoring Specifications**

Fuel extraction and processing	P4
Data parameter	1) Natural gas consumption 2) Diesel consumption
Estimation, modeling, measurement or calculation approaches	1) Measurement 2) Estimation
Data unit	1) GJ 2) L
Sources/Origin	1) Direct metering of natural gas from supplier's meter. The data from invoice is manually entered into excel calculator. 2) The calculations are based on the knowledge of an operator and the environmental coordinator.
Sampling frequency	1) Once a month 2) Once a year
Description and justification of monitoring method	This is the most accurate method of measuring this parameter.
Uncertainty	1) As per Measurement Canada specifications. 2) Negligible

Parameter	**Monitoring Specifications**
Facility Operation	P12
Data parameter	Electricity measurements
Estimation, modeling, measurement or calculation approaches	Measurement
Data unit	MWh
Sources/Origin	The electrical supervisor at the Edson facility measured loads on the motors that are part of the energy plant.
Sampling frequency	Once

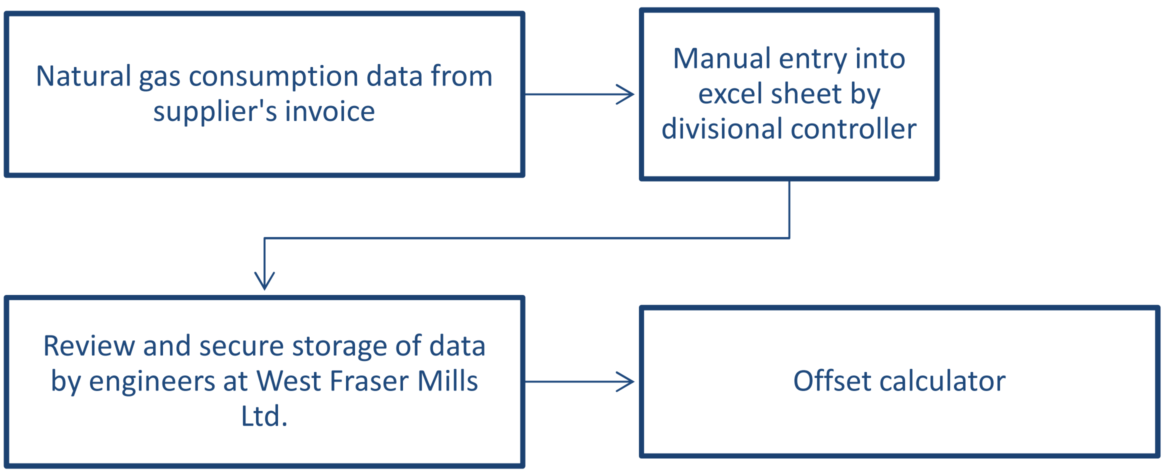
Description and justification of monitoring method	This is a fairly accurate method of measuring this parameter.
Uncertainty	+/-5%

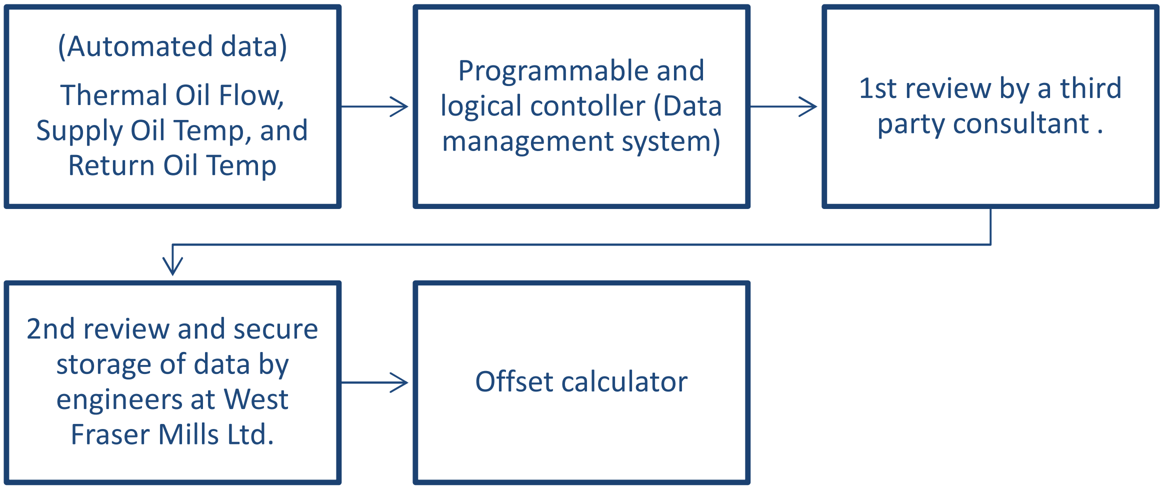
Parameter	**Monitoring Specifications**
Combustion of biomass and fossil fuel	P15
Data parameter	Biomass measurement
Estimation, modeling, measurement or calculation approaches	Estimation
Data unit	Tonnes
Sources/Origin	1. Process design data 2. Measurements from Forest Product Association of Canada (FPAC)
Sampling frequency	Once a year
Description and justification of monitoring method	This is a fairly accurate method of measuring this parameter.
Uncertainty	+/-5%

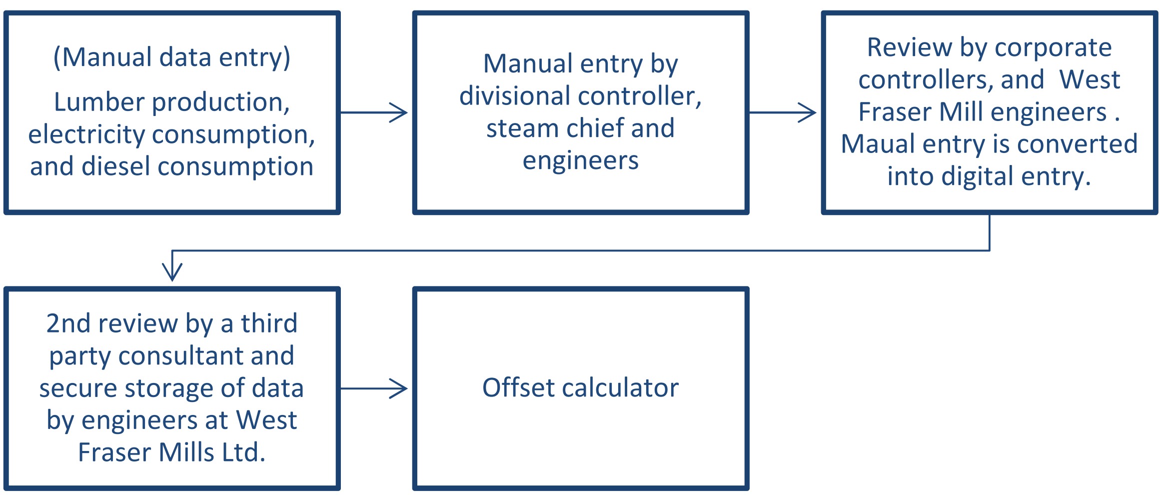
3.5 Data Management System

The data management system used in the offset project is comprised of data from the sensors and manual data entry. To ensure the integrity and completeness of the digital data, a third party professional engineer calibrates and certifies these instruments to Measurement Canada specifications. The electronic records are digitally transferred to West Fraser Mills Ltd., the corporate office of Edson. West Fraser securely stores the data on the server. Lumber production, diesel consumption, electricity measurements, and biomass estimation are manually calculated and stored on the same secured server. To ensure the accuracy and validity of data, it is audited by field personal, divisional controller, corporate controllers, engineer and financial auditors on a test basis.

Once the data is stored on West Fraser Mill's server, the Information Technology (IT) department takes ownership and responsibility for data security. The data is backed up every night and it is retained perpetually. Manual data entry records, invoices, and calibration records are retained for seven years and then destroyed.




(Automated data)
Thermal Oil Flow, Supply Oil Temp, and Return Oil Temp
Programmable and logical contoller (Data management system)
1st review by a third party consultant .
2nd review and secure storage of data by engineers at West Fraser Mills Ltd.
Offset calculator


(Manual data entry)
Lumber production, electricity consumption, and diesel consumption
Manual entry by divisional controller, steam chief and engineers
Review by corporate controllers, and West Fraser Mill engineers . Maual entry is converted into digital entry.
2nd review by a third party consultant and secure storage of data by engineers at West Fraser Mills Ltd.
Offset calculator

4.0 Project Developer Signature

I am a duly authorized corporate officer of the project developer mentioned above and have personally examined and am familiar with the information submitted in this project plan. Based upon reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, I hereby warrant that the submitted information is true, accurate and complete to the best of my knowledge and belief. I understand that any false statement made in the submitted information may result in de-registration of credits and may be punishable as a criminal offence in accordance with provincial or federal statutes.

The project developer has executed this offset project plan as of the 20 day of DEC, 20 18.

Project Title: Sundance Biomass Energy Generation Project

Signature: [signature]

Name: Albert Oliveira

Title: General Manager

5.0 References

Canada National Inventory Report, 1990-2012, Part 2, page 195, Table A8-26
Carbon Offset Emission Factor Handbook, ver 1.0, March 2015.
Western Climate Initiative's Final Essential Requirements of Mandatory Reporting
Technical Guidance for Offset Project Developers, ver 4.0, February 2013
Quantification Protocol for Energy Generation from the Combustion of Biomass Waste, ver 2.0, April 2014

Appendix A: Supporting Information

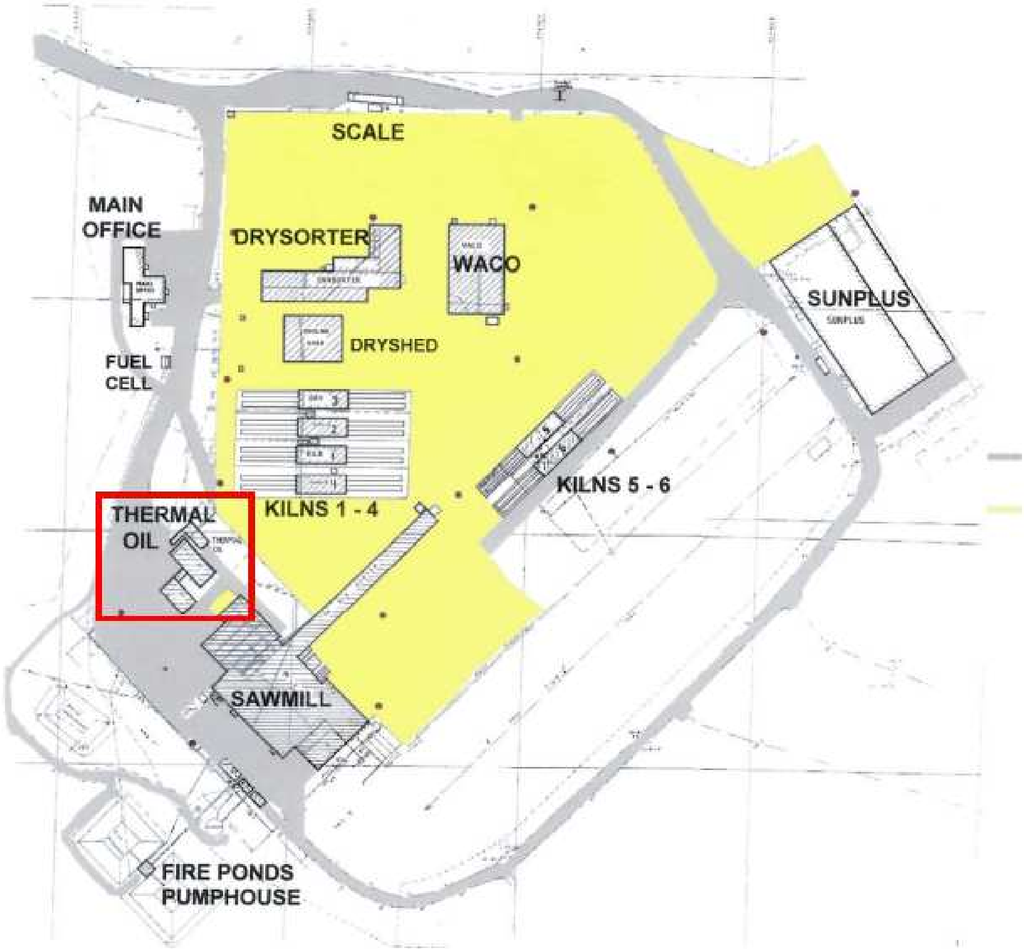


Figure-1: Project boundary of Thermally Heated Fluid furnace at Edson Forest Products

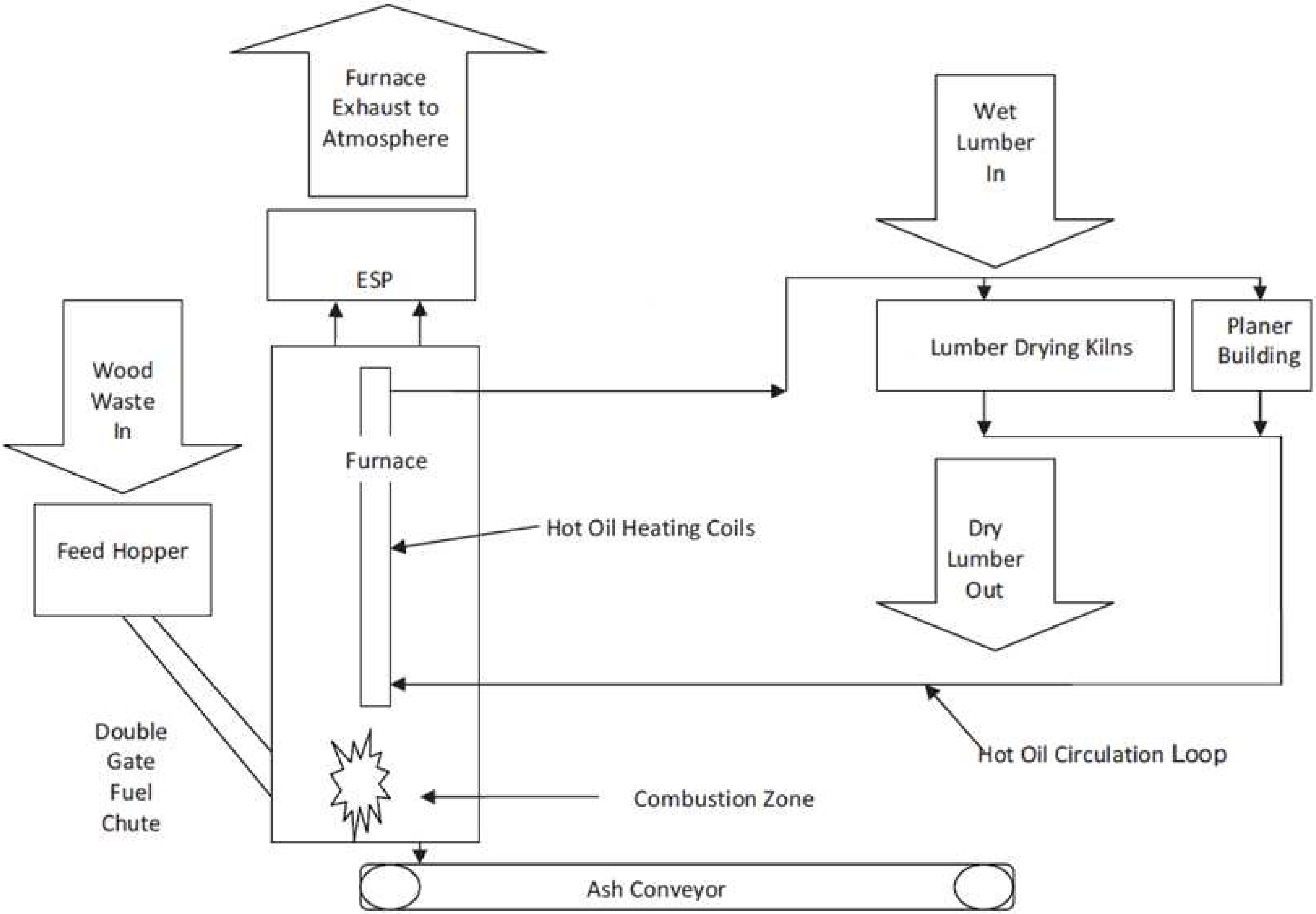


Figure-2: Simplified flow diagram of THF in Edson Forest Products

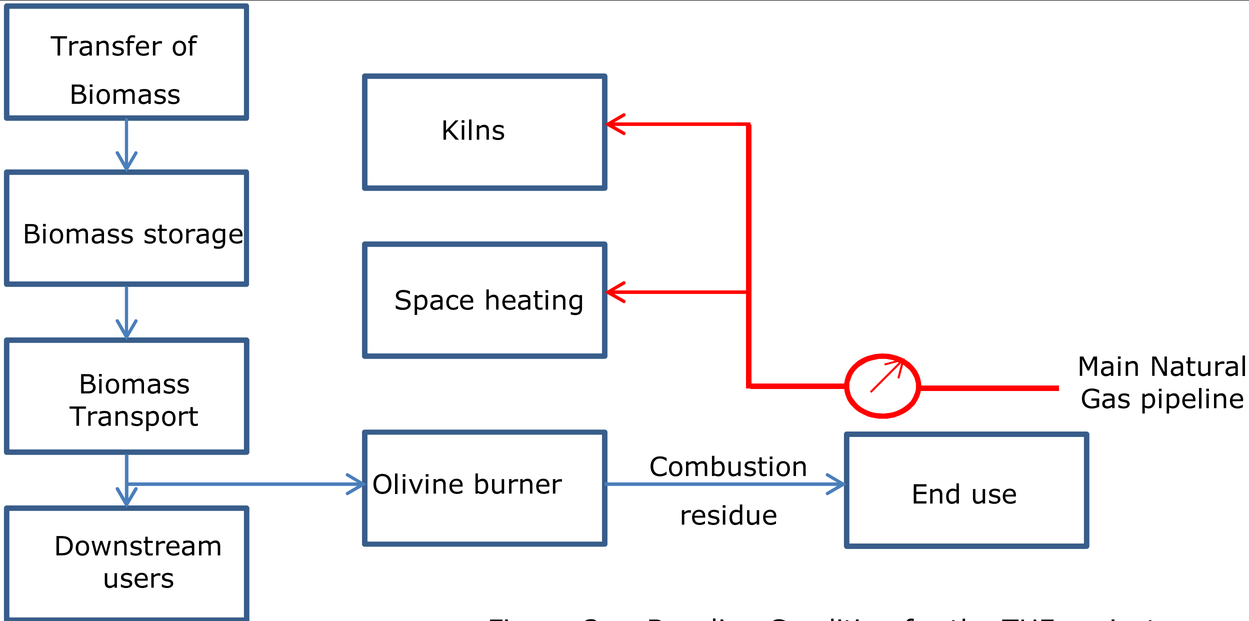


Figure-3a : Baseline Condition for the THF project

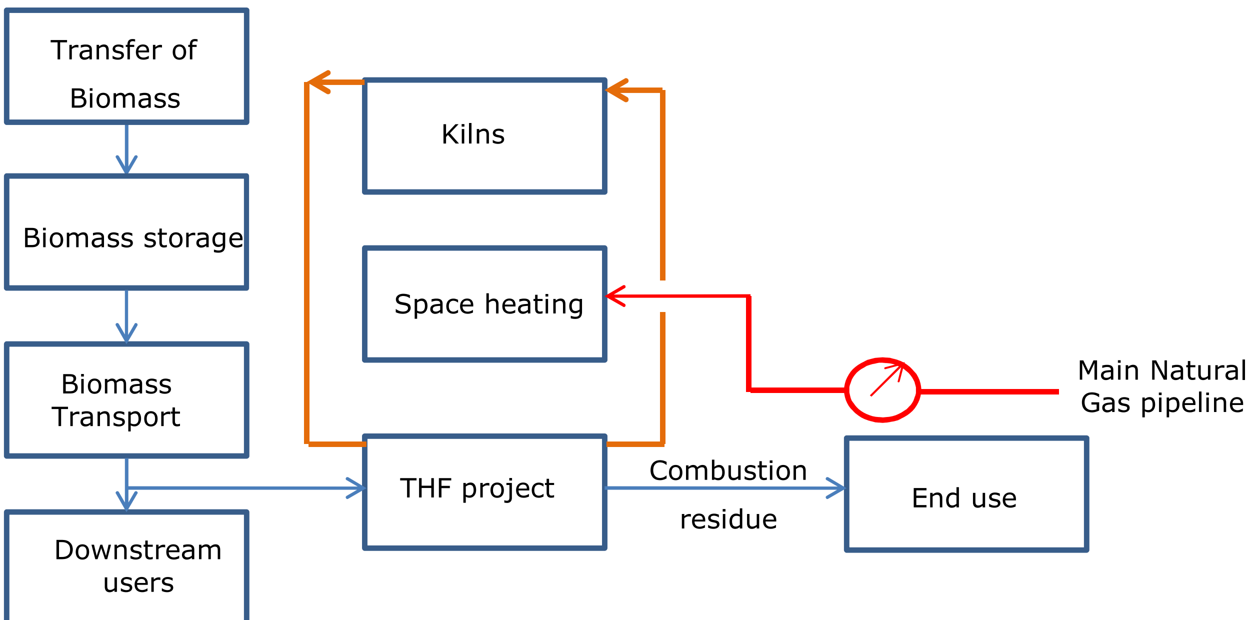


Figure-3: Project Condition for the THF project

West Fraser
1250 Brownmiller Road
Quesnel BC V2J 6P5
Telephone: (250) 992-9244
Fax: (250) 992-

Gas consumption, GJ

	January	February	March	April	May	June	July	August	September	October	November	December	Total, GJ
Gas consumption for entire facility (Data came from ATCO gas)													
2002									17,227	25,290	29,109	27,176	
2003	34,198	30,966	32,975	26,806	18,517	17,679	16,593	15,774	21,265	24,992	32,120	32,278	
2004	33,864	30,455	31,077	25,019	24,088	19,794	20,466	19,917	21,335	27,360	27,129	31,103	
2005	31,777	27,693	29,463	19,669	19,045	16,784	21,477	17,588	19,904				
Average	33,280	29,705	31,172	23,831	20,550	18,086	19,512	17,760	19,933	25,881	29,453	30,186	299,346
2013	4,798	3,715	3,986	2,661	1,082	579	196	5	301	1,504	4,233	6,961	30,020
2014	6,888	7,177	6,957	4,664	1,916	493	1	204	867	2,540	5,850	8,132	45,688
2015	6,879	6,627	5,559	4,094	2,147	537	157	114	1,285	2,827	6,129	8,177	44,532
2016	7,788	5,595	4,791	1,628	520	130	21	22	685	4,178	4,889	8,065	38,312
2017	6,858	6,640	7,472	3,601	718	106	16	3	661	3,108	6,869	7,749	43,801
Project Year	6,858	6,640	7,472	3,601	718	106	16	3	661	3,108	6,869	7,749	43,801
.													
2002													
2003									9,681	9,592	8,352	7,745	
2004	8,532	8,712	9,915	8,973	8,508	8,662	7,952	8,259	8,366	8,137	8,472	7,091	
2005	7,305	8,645	9,269	8,601	7,865	6,973	6,734	8,330					
Baseline average	7,918	8,678	9,592	8,787	8,186	7,818	7,343	8,295	9,023	8,865	8,412	7,418	100,336
2006													
2007													
2008													
2009													
2010													
2011													
2012													
2013										12,307	-	-	
2014	1,508	-	427	250	329	7,877	9,383	8,365	14,779	14,844	12,282	13,102	83,146
2015	15,582	14,494	16,157	17,443	16,344	17,712	18,103	16,169	1,958	17,306	16,323	16,372	183,963
2016	17,169	16,954	18,728	18,864	19,110	19,710	15,678	18,378	18,792	17,260	19,092	14,831	214,566
2017	16,940	16,799	21,422	18,770	22,493	20,167	19,802	20,954	18,012	19,731	19,413	17,466	231,969
2018													
2019													
2020													
Project Year	16,940	16,799	21,422	18,770	22,493	20,167	19,802	20,954	18,012	19,731	19,413	17,466	231,969
Biomass Consumption (Divisional accountants sends this data)													
2003													
2004													
2005													
Baseline Average													
2006													
2007													
2008		This information is not used in calculations											
2009													
2010													
2011													
2012													
2013													
2014						1,209	1,499	882	2,328	2,581	1,719	2,169	12,386.31
2015	3,683	2,970	3,267	3,434	3,291	3,529	3,671	3,006	3,564	3,469	3,172	3,386	40,442
2016	3,386	3,445	3,683	3,564	3,030	3,564	3,564	3,445	3,564	3,624	3,505	3,445	41,820
2017	3,683	3,327	3,683	3,445	3,564	3,564	2,970	3,683	3,089	3,445	3,564	3,493	41,510
2018													
2019													
2020													
Project year	3,683	3,327	3,683	3,445	3,564	3,564	2,970	3,683	3,089	3,445	3,564	3,493	41510
Heat Production													
2013													
2014													
2015													
2016													
2017	30,434	30,875	33,516	27,273	30,056	24,145	20,439	26,193	23,160	26,952	31,746	29,760	334,548
2018													
2019													
2020													
Project Year	30,434	30,875	33,516	27,273	30,056	24,145	20,439	26,193	23,160	26,952	31,746	29,760	334,548

Figure-4: Supporting and tracking data

West Fraser

1250 Brownmiller Road
Quesnel BC V2J 6P5

Telephone: (250) 992-9244
Fax: (250) 992-3027

		Installed power, HP	Operating hours	FLA	Measured amp	Power factor	Voltage	Energy consumption, MWh	Check, HP
Furnace -1	Fuel Bin Unloader Hydraulic Pump#1	30	24	29.39	20	0.86	575	0.4	22.8
	Fuel Bin Unloader Hydraulic Pump#2	30	24	29.39	20	0.86	575	0.4	22.8
	Fuel Bin Unloader cooling fan	0.25	24	0.24	0.5	0.71	575	0.0	0.5
	Fuel Bin Unloader cooling pump	3	24	2.94	2	0.82	575	0.0	2.2
	Fuel Bin Unloader spike roll	3	24	2.94	1.5	0.82	575	0.0	1.6
	Fuel Bin Unloader levelling conveyor#1	7.5	24	7.35	3.5	0.85	575	0.1	4.0
	Fuel Bin Unloader levelling conveyor#2	7.5	24	7.35	3.5	0.52	575	0.0	2.4
	Fuel elevating conveyor	15	24	14.7	7.8	0.82	575	0.2	8.5
	Step grate hydraulic pump#1	7.5	24	7.35	3.4	0.85	575	0.1	3.9
	Step grate hydraulic pump#2	25	24	24.49	8.7	0.86	575	0.2	10.0
	Step grate hydraulic cooling fan	0.25	24	0.24	0.5	0.76	575	0.0	0.5
	Primary forced draft fan	50	24	48.99	18	0.84	575	0.4	20.2
	Secondary forced draft fan	50	24	48.99	15.9	0.84	575	0.3	17.7
Furnace-2	Tertiary forced draft fan	50	24	48.99	15.8	0.84	575	0.3	17.7
	Induced draft fan	150	24	146.97	108	0.84	575	2.2	120.4
	Air compressor	20	24	19.6	9.6	0.80	575	0.2	10.3
	Water cooling pump#1	1.5	24	1.47	1.2	0.75	575	0.0	1.2
	Water cooling pump#2	1.5	24	1.47	1	0.75	575	0.0	1.0
	Water cooling fan	0.5	24	0.49	1	0.80	575	0.0	1.1
	Thermal oil primary pump#1	125	24	122.47	76.6	0.84	575	1.5	85.9
	Thermal oil primary pump#2	125	24	122.47	76	0.84	575	1.5	85.2
	Thermal oil transfer pump	7.5	24	7.35	4.2	0.84	575	0.1	4.7
	Top ash rake air lock	1.5	24	1.47	1.2	0.85	575	0.0	1.4
	ash collection chain conveyor	2	24	1.96	1.6	0.80	575	0.0	1.7
	Convective heater hopper air lock	0.5	24	0.49	0.6	0.77	575	0.0	0.6
	Convective heater ash transfer screw	3	24	0.49	1.3	0.82	575	0.0	1.4
Auxillaries	Air preheater hopper #1 airlock	0.5	24	2.94	0.7	0.80	575	0.0	0.7
	Air preheater hopper #2 airlock	0.5	24	0.49	0.9	0.80	575	0.0	1.0
	air preheater ash transfer screw	3	24	0.49	1.7	0.82	575	0.0	1.8
	multicone hopper airlock	0.5	24	2.94	0.9	0.63	575	0.0	0.8
	multicone ash transfer screw	3	24	2.94	1.6	0.82	575	0.0	1.7
	precipitator hopper #1 airlock	0.5	24	0.49	1.5	0.72	575	0.0	1.4
	precipitator hopper #1 airlock	0.5	24	0.49	1.1	0.76	575	0.0	1.1
	Precipitator ahs transfer screw	3	24	2.94	2.2	0.82	575	0.0	2.4
	ash bin transfer screw	3	24	2.94	1.8	0.75	575	0.0	1.8
	precipitator purge air blower	5	24	4.9	0.9	0.75	575	0.0	0.9
	precipitator transformer rectificer field#1	0.5	24	0.49	20	0.75	575	0.4	20.0
	precipitator transformer rectificer field#2	1	24	0.98	24	0.75	575	0.4	24.0
	percipitator purge air heater	45	24	90	18.5	0.75	575	0.3	18.5
	precipitator hopper #1 heater	45	24	90	8.2	0.75	575	0.1	8.2
	precipitator hopper #2 heater	12	24	21	8.2	0.8	575	0.2	8.8
								9.7	MWh
								0.6	tonnes/MWh
								6.2	Tonnes of CO

The values highlighted in yellow are the average values

Figure-5: Supporting and tracking data

Alberta Environment and Sustainable Resource Development

Policy Division
Air and Climate Change
Policy Branch
12th Floor, 10025 106 Street
Edmonton, Alberta T5J 1G4
Canada
Telephone: 780-427-5200
www.alberta.ca

May 27, 2014

Jim McCormack
Senior Energy Technologist
West Fraser Mills Ltd.
1250 Brownmiller Road
Quesnel, B.C. V2J 6P5

Dear Mr. McCormack:

Alberta Environment and Sustainable Resource Development has reviewed your September 18, 2013 request for a 5 year extension for the Sundance Biomass Energy Generation Project (7048-9023). The department is pleased to inform you that this extension is approved. The credit extension period is from October 1, 2013 to September 30, 2018.

The Quantification Protocol for Energy Generation from the Combustion of Biomass Waste Version 2 (April 2014) has been approved for use in the Alberta Offset System. This protocol replaces the Quantification Protocol for Diversion of Biomass to Energy from Biomass Combustion Facilities (September 2007). The project extension must use the April 2014 version for quantification of offset credits. Please ensure the offset project plan, and project quantification are up-dated to reflect changes in the protocol.

Please direct any questions you may have to Robyn Kuhn at Robyn.Kuhn@gov.ab.ca, or to AENV.GHG@gov.ab.ca.

Sincerely,

Kate Rich, M.Sc., P.Geol.
Executive Director, Air and Climate Change Policy Branch
Alberta Environment and Sustainable Resource Development

Cc – Amanda Stuparyk, Alberta Emissions Offset Registry

Extension letter

Alberta Government
Alberta Climate Change Office

Compliance and Regulatory Branch
12th Floor, Baker Centre
10025-106 Street
Edmonton AB T5J 1G4
Telephone 780-427-5200

December 14, 2016

Mohamed Raza, M.Eng. C.E.M.
Energy Engineer, Corporate
West Fraser Mills Ltd.
1250 Brownmiller Road,
Quesnel, BC, Canada
V2J 6P5

Dear Mr. Raza,

Subject: Request for a deviation from the Energy Generation from the Combustion of Biomass Waste Protocol (v.2) for Edson Biomass Energy Generation Project (7048-9023)

The Climate Change Office received your request for a deviation from the Energy Generation from the Combustion of Biomass Waste protocol (V.2) specifically that the project is requesting that they be allowed to use 24 months (2 years) of gas consumption data to benchmark the onsite heat generation (B18).

Having reviewed the request and in consideration of the nature of the deviation, I am approving the request to proceed with using two (2) years of historic records, as opposed to the protocol's requirement of using three (3) years. This determination was made based on the fact that the timing of the protocol revision in 2014 was such that the requirement of the use of three (3) years of historic data could not be satisfied due to exceeding standard record retention policies.

If you have further questions please do not hesitate to contact our office directly at ESRD.GHG@gov.ab.ca.

Sincerely,

Robert Hamaliuk, P.Eng, MBA
Director, Emissions Inventory and Trading
Alberta Climate Change Office

cc: Alberta Emissions Offset Registry (file)

Deviation approval letter