APPENDIX W

Energy Efficiency Study (R1)

FIBRECO

Fibreco Export Terminal Enhancement
Permit Application Document

APPENDIX W

Energy Efficiency - Executive Summary (R1)

A study by CWA Engineers was performed to baseline the electrical energy used by Fibreco as part of the BC Hydro Power Smart Program. Recommendations are put forward for consideration in the new build. Highlights of energy conservation activities include:

- Removal of (3) 700hp chip blowers
- Motor standard to Variable frequency drives
- New site lighting to become LED fixtures
- Bin vents for dust collection at transfers (allowing less horsepower and fewer units running at any one time
- Control logic to slow down belts when cargo isn't present

The Customer Site Investigation (CSI) identifies the major energy end users of a facility and provides an electrical energy cost baseline for the different processes. The CSI also identifies preliminary electricity cost saving opportunities and provides recommendations for further investigation and implementation.

A site visit in Q1 2016 was conducted to identify any operational conditions that could lead to energy inefficiencies. A lighting inventory was performed, as well as collecting electrical data on motors operating under load. Upon completion of the field investigation, the data and information was analyzed to identify opportunities to help improve Fibreco's energy efficiency.

The largest electrical user at Fibreco is the conveyor systems, accounting for almost 50% of the total electricity cost. Current electrical inefficiencies are primarily due to the age of the existing system, lack of speed control and the rail car dumping system providing inconsistent flow to the conveying system.

The pneumatic chip vessel loading operation has a number of inefficiencies and the blowers account for 25% of the total electricity cost. However, with the introduction of grain handling, Fibreco plans to decommission the blower system, including the removal of (3) 700 hp motors.

In addition, the lighting load at Fibreco makes up for almost 10% of the electricity cost. The existing lights are largely high pressure sodium and metal halide fixtures, which presents an relatively easy retrofit to LED lighting systems.

Reviewing the billing history, there are a number of instances where Fibreco has been billed a power factor surcharge. Installing a power factor correction system would reduce the amount; if not entirely remove these surcharges.

The CSI identified a number of opportunities to improve energy efficiency of the Fibreco facility that can be implemented as part of the Terminal Enhancement Project. The conveyor system warrants further study which can be incorporated with redesign of the conveyors to handle grain. In addition, an upgrade of the electrical system can incorporate the design of a new power factor correction system and include an LED lighting retrofit.

Attached: CWA Port Property Energy Study
BC Hydro Site Investigation

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TECHNICAL MEMORANDUM #001 REV0

Date: December 19th, 2016 Document No.: 16078-TDM-001_0

Project: Fibreco – Port Property Energy Study

From: Elvin Yutuc, P.Eng.

Subject: Port Property Energy Study – Existing and after Terminal Enhancement Project

The Port Property for Fibreco was outlined as parcel areas B, C, E, and F as shown on the *Lease Plan No. 2012-194 Rev.A* drawing. The loads and lighting on port property were identified, and using the BC Hydro Customer Site Investigation data in report *CSI15-301 – Fibreco CSI Report*, CWA indicatively determined the demand and yearly energy use on Port Property. The demand and energy use has been broken down on Table 1 below.

End Use	HP Installed	Demand (kW)	Dist.	Energy Use (MWh/yr)	Dist.
Fans & Blowers - General Purpose	34	11	0.8%	11	0.7%
Fans & Blowers – Shiploader Blowers	2150	996	73.6%	897	57.4%
Material Handling - Large Conveyors	765	237	17.5%	467	29.9%
Process Equipment - Gates	24	13	1.0%	1	0.1%
Process Equipment - Winches	73	39	2.9%	4	0.2%
Pumps - Hydraulic	75	36	2.7%	80	5.1%
Lighting		21	5.2%	103	6.6%
Total	**3121**	**1353**	100%	**1563**	100%

Table 1: Existing Indicative Port Property Electricity Loads

The motor and lighting data in the Customer Site Investigation report was then modified to reflect the most recent Terminal Enhancement Project mechanical equipment list for the equipment on Port Property. The shiploader did not include a motor breakdown for total load, but 350 HP was used for the purpose of this exercise.

End Use	HP Installed	Demand (kW)	Dist.	Energy Use (MWh/yr)	Dist.
Fans & Blowers - General Purpose	34	11	2.9%	11	1.3%
Fans & Blowers - Shiploader Blowers	0	0	0%	0	0%
Material Handling - Conveyors	985	272	69.2%	675	77.2%
Process Equipment - Gates	24	13	3.3%	1	0.1%
Process Equipment - Winches	73	39	9.9%	4	0.4%
Pumps - Hydraulic	75	36	9.3%	80	9.2%
Lighting		21	5.4%	32	11.7%
Total	**1191**	**393**	100%	**874**	100%

Table 2: Expected Terminal Enhancement Project Port Property Electricity Loads

The table above does not reflect any energy saving measures that can be implemented during the detailed design of the Terminal Enhancement Project. These estimated savings are shown in Table 3 below. The figures below represent additional savings for the material handling equipment, and the savings by completing the LED Lighting retrofit for the Port Property lighting.

Energy Conservation Measure	MWh/yr	$/year
Material Handling/Conveyors Efficiency Improvements (Motor sizing, VFD use)	37	15,370
Lighting LED Retrofit	71	21,660

Table 3: Estimated Electricity Cost Savings

***** END OF TECHNICAL MEMORANDUM *****

CSI Savings Report

The goal of this **CUSTOMER SITE INVESTIGATION (CSI)** is to assist the facility staff in defining their electricity usage and to provide a preliminary list of electrical cost savings opportunities within their facility.

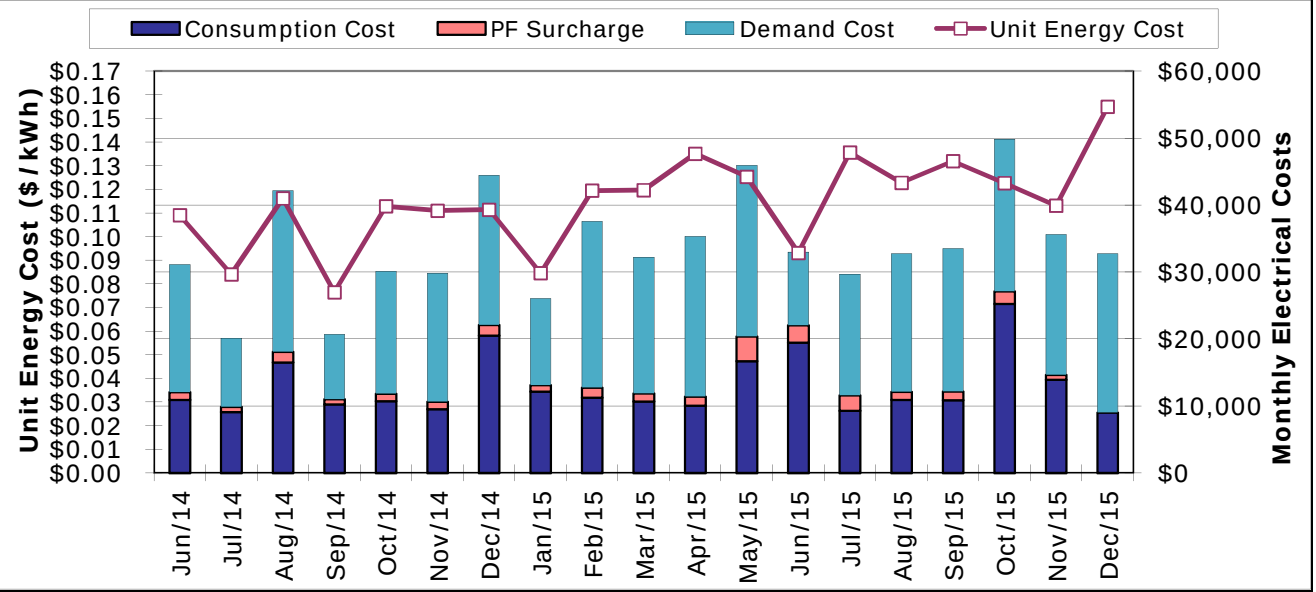
BC hydro powersmart

Company Name:	**Fibreco Export Inc**	Facility Name:	**Fibreco Export Terminal**
Location:	1209 Mckeen Ave	BC Hydro KAM:	Kal Sahota
Contact:	Dan Williamson	Energy Use Model:	Compiled from walk-through audit
NAICS Code:	4190	Walkthrough date:	Thursday, March 10, 2016
Industry Type:	Export Terminal	Completed by:	Rigel Wong

Fibreco is a pellet and wood chip handling terminal. Product is primarily unloaded by rail, handled into different storage areas before being loaded onto ships for export.

Electrical Billing Summary

The facility is billed under BC Hydro's Large General Service rate schedule for annual peak demand greater than 150 kW with trailing rates of $4.51 per kW if the demand is greater than 35 kW and $8.66 per kW for monthly peak demand over 115 kW. A baseline is calculated as a rolling three-year average for each month. The first 14,800 kWh of energy consumption is charged at a rate of 8.85 cents per kWh. Additional consumption up to the baseline is charged at a rate of 4.26 cents per kWh. An adjustment in the form of a credit or charge is applied based on the difference between your actual usage and the baseline. Within +/- 20%, the charge or credit is applied at a rate of 8.85 cents per kWh, beyond +/- 20%, the charge or credit is applied at a rate of 4.26 cents per kWh. The data for the billing period has been normalized to the number of days in the month.



Electricity Summary (not including taxes)

Average billing demand	**2,058**	kW
Yearly Consumption	**3.7**	GWh per year
Annual Electricity Cost	**$431,000**	per year
Demand Cost	**55**	%
Consumption Cost	**40**	%
Other Cost	**4.3**	%
Unit Electricity Cost	**11.6**	cents per kWh

Operating Summary

Facility Load Factor	**21**	**max LF** 0
Operating Hours	**6,000**	hours/year
Production Hours	**2,700**	hours/year

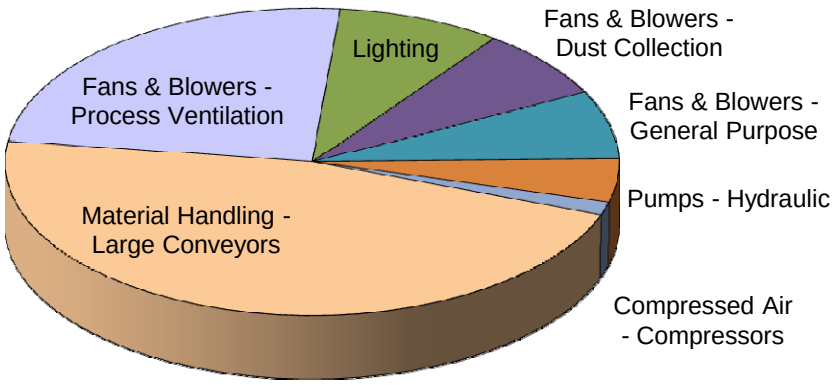
Performance Summary

Annual Production	**900,000**	tonnes/yr
Elec. Use Benchmark	**4.13**	kWh/tonnes
Elec. Cost Benchmark	**$0.48**	$elec/tonnes

A baseline and trend of the plant's utilization index (kWh per unit of production) and the plant's energy cost index ($ electricity per unit of production) should be tracked on a monthly basis corresponding to the billing period. Variations in the energy utilization index can indicate opportunity for improvement.

Basic Electricity Cost Breakdown by Enduse

The electricity use summary by equipment type and cost breakdown is shown below. The load inventory was compiled through measured and typical estimates of motor loads and annual operating hours to derive a basic model of the facility's energy usage. Due to the dynamic nature of the Large General Service rate, a blended rate of 4.80 cents per kWh was used to calculate the costs. Actual costs may be higher or lower based on the monthly consumption relative to the rolling baseline (see Electrical Billing Summary).



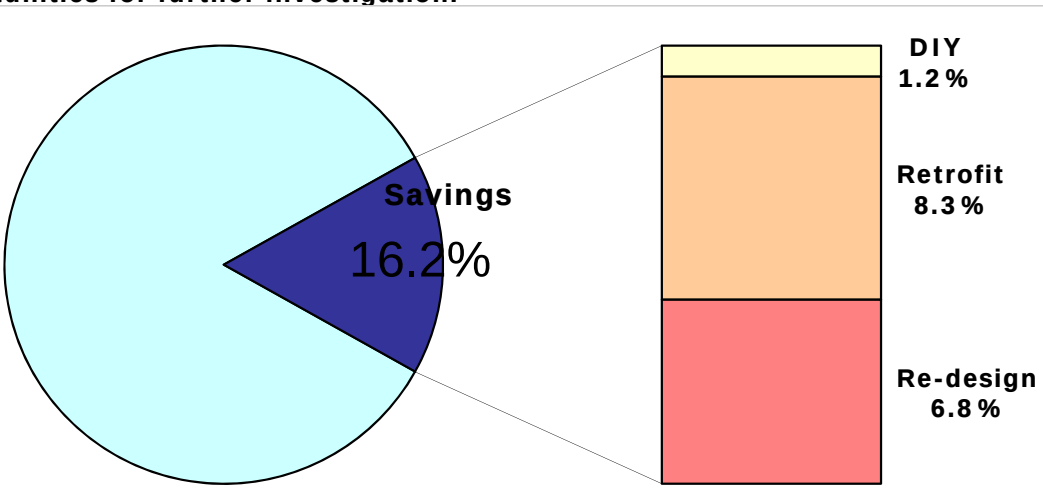
Note	Rank	Enduse Description	Enduse Percent	Elec. Use (MWh/yr)	Elec. Cost ($/yr)
The largest enduse of Material Handling - Large Conveyors equipment accounts for 46% of the total electricity cost.	1	Material Handling - Large Conveyors	46.3%	1724	$186,000
	2	Fans & Blowers - Process Ventilation	24.1%	897	$97,000
	3	Lighting	8.6%	319	$34,000
	4	Fans & Blowers - Dust Collection	7.3%	271	$29,000
	5	Fans & Blowers - General Purpose	7.2%	268	$29,000
	6	Pumps - Hydraulic	4.4%	166	$18,000
	7	Compressed Air - Compressors	1.3%	50	$5,000
	8	Pumps - General Purpose	0.7%	25	$3,000
	9	Process Equipment - Winches	0.1%	4	
	10	Combined Other	0.1%	3	

Note	Rank	Large Energy Using Equipment	Rated Power	Elec. Use (MWh/yr)	Elec. Cost ($/yr)
These Top 10 energy equipment items account for 65% of the total electricity cost.	1	Conveyor 15 Drive	300 HP	420	$47,300
	2	Shiploader Blower 2	750 HP	313	$35,200
	3	Shiploader Blower 1	700 HP	292	$32,900
	4	Shiploader Blower 3	700 HP	292	$32,900
	5	Conveyor 17 Drive	200 HP	271	$30,500
	6	Conveyor 03 Drive	300 HP	241	$27,100
	7	Shed Baghouse Fan	125 HP	198	$22,300
	8	Silo Aeration Fan	15 HP	161	$18,100
	9	Conveyor 72 Drive	200 HP	145	$16,300
	10	Pellet Shed Extraction fan	15 HP	90	$10,200

Preliminary Electricity Cost Savings Opportunities

The following electricity conservation measures are identified as potential cost savings opportunities for energy efficient operations and maintenance, equipment retrofits and system re-design. Due to the dynamic nature of the Large General Service rate, a blended rate of 4.80 cents per kWh was used to calculate the estimates. Actual savings may be higher or lower based on the monthly consumption relative to the rolling baseline (see Electrical Billing Summary).

These energy savings estimates are preliminary and intended to evaluate and prioritize the savings opportunities for further investigation.

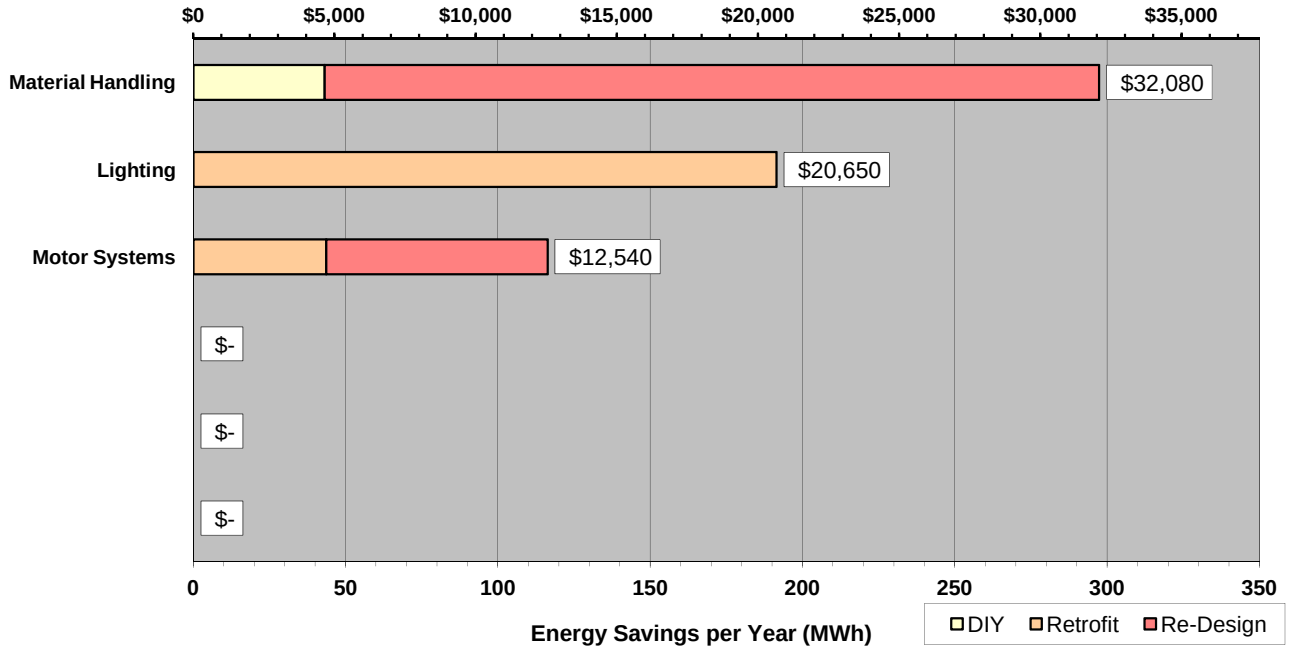


		Estimated Electricity Cost Savings		
		Percent	$/year	MWh/yr
Energy efficient do-it-yourself opportunities				
1.1	Power factor correction	n/a	$9,602	n/a
1.2	Large Conveyors - Material handling O&M	1.2%	$4,650	43
1.3				
1.4				
1.5				
1.6				
	Subtotal DIY	**1.2%**	**$14,252**	**43**
Energy efficient retrofit opportunities with more efficient equipment from your suppliers				
2.1	Lighting Retrofit Improvement	5.1%	$20,650	191
2.2	Efficient motor downsizing	2.0%	$7,840	73
2.3	Efficient motor replacement	1.2%	$4,700	44
2.4				
2.5				
2.6				
2.7				
	Subtotal Retrofit	**8.3%**	**$33,190**	**308**
Energy efficient system re-design opportunities through engineering assistance				
3.1	Material Handling Efficiency Improvement	6.8%	$27,430	254
3.2				
3.3				
3.4				
3.5				
3.6				
3.7				
3.8				
	Subtotal Re-design	**6.8%**	**$27,430**	**254**
Total Electricity Savings Estimate		**16.2%**	**$74,872**	**605**

Top 5 Electricity Cost Savings Opportunities

The top five electricity cost savings opportunities are given below. The opportunities are ranked by their preliminary cost savings estimate.

These energy savings estimates are preliminary and intended to evaluate and prioritize the savings opportunities for further investigation.



		Estimated Electricity Cost Savings		
		Percent	$/year	MWh/yr
Top 5 Electricity Conservation Measures		**12.2%**	**$58,552**	**453.64**
1	Lighting - LED Fixtures	5.1%	$20,650	191.38
2	Material Handling - Large Conveyors - Match material handling size to load	2.8%	$11,160	103.42
3	Other Systems - Power factor correction	n/a	$9,602	
4	Material Handling - Large Conveyors - Reduce overall handling system requirements	2.3%	$9,300	86.18
5	Motor Systems - Motor downsizing	2.0%	$7,840	72.66

Top 5 Energy Action Details

Bolded items indicate a recommendation to perform an energy study before proceeding

1	Typical savings for an LED lighting retrofit
2	**Typical savings for optimizing operations of material handling equipment.**
3	Power factor correction to avoid surcharges occurred over the last twelve months.
4	**Typical savings for reducing system resistance and levelling material handling loads over time.**
5	**Typical savings by motor downsizing to better match load within the motor's efficient operating range.**

Top 5 Paybacks (estimated by the Auditor)

	ECM Name	Payback Range (yrs)
1	Motor Systems - Replace failed motors with premium efficiency motors	2.0 - 6.0
2	Material Handling - Large Conveyors - Material handling operations & maintenance	5.0 - 10.0
3	Other Systems - Power factor correction	5.0 - 15.0
4	Lighting - LED Fixtures	8.0 - 18.0
5	Material Handling - Large Conveyors - Match material handling size to load	10.0 - 20.0

Recommendations of the Auditor

Due to the age of the existing system and having been designed to handle the different bulk material properties of two products, pellets and chips, the conveying system operates inefficiently. There are a number of opportunities to improve efficiency in the existing system.

• Conveyor drives were 40% loaded, of motor FLA, on average while on pellets. When handling chips, the loading would be lower due to differences in bulk density.
• Operational inefficiency of rail car dumping system would bottleneck the material flow to the product silos. Frequent black belt present on conveyor 15 during car unloading
• Operational inefficiency when using the blowers to load chips. However, as per discussions with Fibreco, the chip system will be decommissioned in 2017.

The conveyor motors are also quite old, and can be replaced with newer energy efficient models. It was noted on the site visit that the conveyor 4 motor was pulling almost double the amps on one phase. Instead of rewinding the motor, this could be replaced with a newer motor as part of the maintenance plan to replace any failed motors moving forward. The site visit was directed towards the conveying systems as it comprises of almost 50% of the total load at Fibreco, and it was apparent that there are a number of opportunities are present to optimize the conveyors to save energy. Opportunities such as:

• Reducing material handling requirements
• Installation of speed control for key conveyors
• Reduce operational inefficiencies
• Reduce motor sizes as applicable

The conveyor system warrants further study to determine which of the energy saving measures can provide the most impact to the conveying system on site. This ties in quite well with Fibreco's plan to perform some facility enhancements, and to integrate in any energy efficiency opportunities in that design.

There are two energy actions that can be accomplished without any further study, which would be to replace the existing lighting infrastructure with LED fixtures. Fibreco could also investigate the use of lighting control to reduce having all the lights on during non daylight hours, and only on when the full light levels are required for operations. Another energy action is to install power factor correction to avoid the surcharges, which can also be tied into Fibreco's facility enhancement plans.