

**Verification of Blue Source
Emission Reductions Created from
International Paper's Combined Cycle Gas Turbine Project
(January 2001 – December 2004)**

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1.0 Executive Summary

Blue Source is an active supplier of greenhouse gas (GHG) emission reductions (ERs) sourced from geologic sequestration, energy conservation, transportation, and offset and avoidance projects, and companies' entity-wide reduction programs. International Paper (IP) is a large paper and forest products company with about 200 manufacturing facilities in the United States. Its core businesses include paper, packaging, and forest products. At its Bucksport Mill in Maine, IP manufactures and purchases different types of wood pulps to produce varieties of coated and uncoated paper products.

Prior to 2001, IP operated four industrial boilers that primarily burned fossil fuels, including residual oil and coal. Other fuels included biomass and tire-derived fuel (TDF). The steam generated by the boilers, is expanded in a pair of steam turbines to generate electricity for mill use and for sale to the grid. Steam is also used to meet the mill's process heating requirements. In January 2001, IP began commercial operation of a combined-cycle gas turbine plant that generates electricity and process steam for use at the mill. A portion of the electricity generated by the turbine facility is sold to the grid. Since the operation of the turbine facility, IP has reduced its operation of the four boilers, thereby reducing the consumption of residual oil and coal. The GHG ERs resulting from the displacement of residual oil and coal with natural gas as fuel, as well as the overall plant energy efficiency improvement associated with the combined cycle gas turbine project, are the subject of this verification. The ERs cover the 2001-2004 time-period.

This verification is based on a site visit to the Bucksport mill and on data obtained from IP and Blue Source. Estimates of baseline emissions, actual (post-project) emissions, and ERs were verified based on established emissions estimation techniques, conservative assumptions and estimates, accurate/reliable data sources, and documented methodologies. Although the emissions estimates in the GHG ER report were based on annual totals of fuel and energy usage data, the verification activities documented in this report focused on the monthly data available at the mill.

Verification findings indicate that all significant emission sources that materially affect the ER volumes are included within the scope of the GHG emissions reduction project. Both direct emission sources that contribute to emissions within the reduction project's operational boundaries, and indirect emission sources that contribute to emissions generated outside the operational boundaries, were included. Applicable source characteristics (e.g., fuel flow rates and properties, electricity usage, etc.), which affect emissions were considered and accounted for appropriately.

Baseline emissions, actual emissions, and emissions reduction estimates by month are consistent over the post-project period. Normalized emission rates (tonnes CO₂e/ton of paper produced) by month are also consistent and reflect the expected decline in normalized rates over the post-project period as the mill's dependence on the gas turbine for its energy needs increased.

Data collection, management, and review procedures are applied at both site and corporate levels. Plant personnel were knowledgeable about the process data required for emissions estimation. A majority of the data was in an electronic format. The data sources are documented and records maintained. Back-up paper copies of the electronic data were verified. Samples of steam usage data were successfully trailed from daily values, to monthly and, annual totals.

This verification report documents that carbon dioxide equivalent (CO₂e) emission reductions totaling 573,000 tonnes were created during the 2001 – 2004 time-period and verified herein. This is approximately three (3) percent lower than the total claimed in the *Project Description and Emission Reduction Report* (i.e., the emissions reduction report prepared previously by Blue Source).

2.0 Project Description

The Bucksport mill located in Bucksport, Maine has a capacity to produce 483,000 tons of paper annually. Two processes are used to produce paper pulp at the mill. These include a groundwood pulping process in which logs are pulped through mechanical grinding, and a thermomechanical process (TMP) that uses wood chips to produce pulp through thermomechanical refining. In addition, IP obtains Kraft pulp and chemi-thermomechanical pulp (CTMP) from outside sources. Different mixtures of these pulps are used to produce lightweight coated and uncoated publication paper on four paper machines at the mill.

The mill produces electricity and process steam for use at the mill from a group of four industrial boilers that primarily burn fossil fuels, including residual oil and coal. In 2001, IP began commercial operation of the Bucksport Clean Energy Plant, which uses a gas-fired turbine to generate a portion of the electricity required by the mill. In addition, the energy in the exhaust gas from the turbine is used to generate steam in a heat recovery steam generator (HRSG), which is supplied to the mill's steam turbines to generate additional electricity and is also used to meet the mill's process heat requirements.

Subsequent to commercial operations of the combined cycle gas turbine power plant, the mill has reduced its operation of the four industrial boilers, which has reduced the use of residual oil and also eliminated the use of coal as a fuel. The GHG ERs resulting from the use of natural gas, which has displaced the use of residual oil and coal to meet the mill's energy requirements, as well as the overall plant energy efficiency improvement associated with the combined cycle gas turbine project, are being claimed in the emissions reduction report for the 2001-2004 time-periods.

2.1 Baseline Conditions

A schematic of the steam and power plant configuration at the mill as it existed prior to the installation of the combined cycle turbine is shown in Figure 2-1. It includes four industrial boilers (Nos. 5-8) that produce steam used to generate electricity and to meet process steam requirements. Nominal ratings for the boilers and steam generators are shown in Figure 2-1. Boilers No. 5-7 are permitted to burn fuel oil and waste oil. Boiler No. 8 is permitted to burn several fuels including, fuel oil, waste oil, biomass (wood waste, wood chips, bark, paper mill sludge, waste papers, and fiber core ends), bituminous coal, natural gas, and tire-derived fuel (TDF). Electricity is generated from two steam turbine-driven electrical generators (G2 and G3). Process steam is extracted from the outlets of both steam turbines at 150 and 40 psig for use at the mill. In addition, steam from the main inlet header is throttled to 400 psig and supplied to the paper machines. A separate steam line from the main header also directly supplies steam to operate turbine-driven feedwater pumps at the mill.

The mill consumes all of the electricity generated by G2 and part of the electricity generated by G3. The remaining electricity from G3 is sold to the grid (Central Maine Power [CMP]). The mill also imports electricity from the grid, via electricity purchases by IP from TransCanada.

Individual flow meters measure the residual oil flow rates to each of the boilers. These values are reconciled with redundant metering of the combined flow rate to all boilers. Wood waste, coal, and TDF fuel usage is based on purchase records. Paper sludge fuel is weighed.

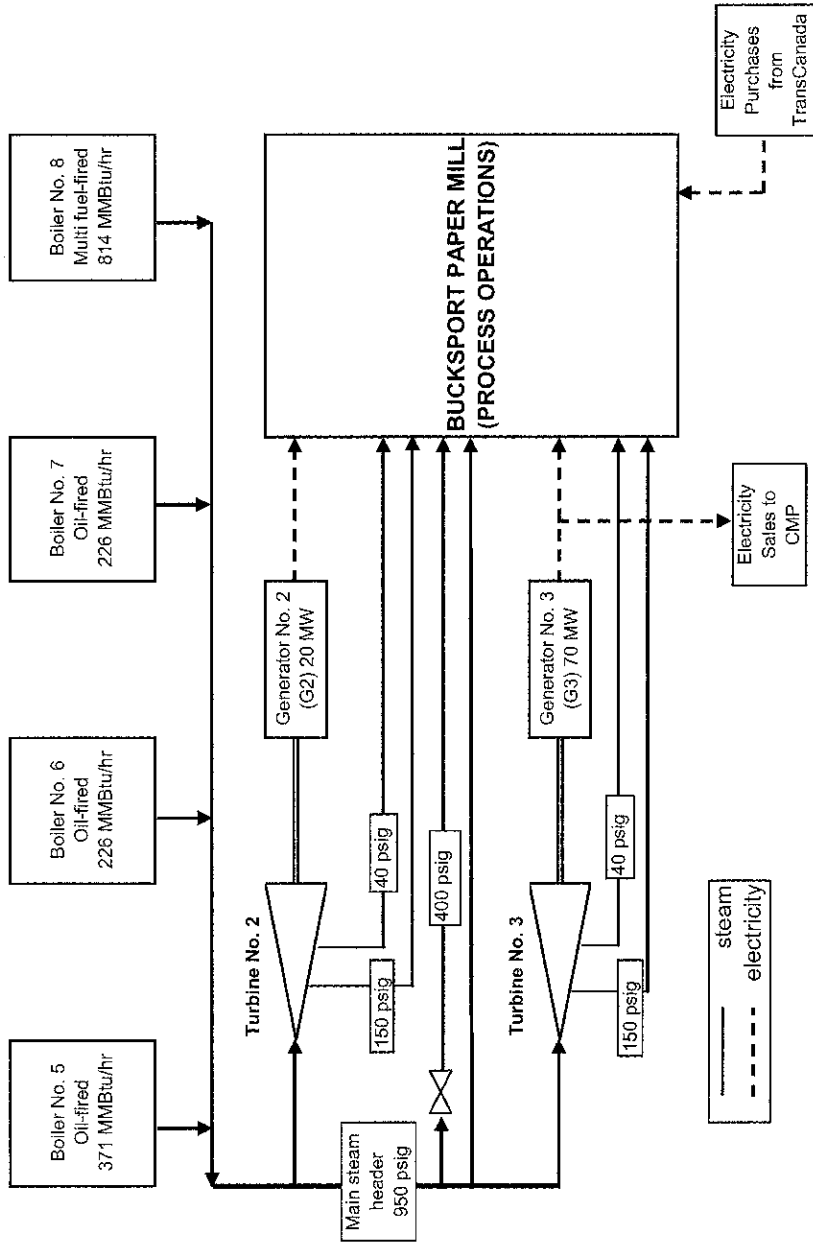


Figure 2-1. Schematic of Bucksport Steam and Power Plant (Baseline)

2.2 Post-Project Conditions

In October 2000, IP commissioned the Bucksport Clean Energy Plant. Following initial testing, it began commercial operation in January 2001. The plant includes a combined cycle gas turbine facility that provides steam and electricity to the mill. The configuration of the turbine in relation to the existing power plant is shown in Figure 2-2. The turbine facility includes a GE Frame 7 gas turbine capable of producing approximately 175 MW of electricity (generator G4), an unfired heat recovery steam generator (HRSG), and other ancillary equipment. The turbine is permitted to burn natural gas and fuel oil as fuel. A part of the electricity generated by the turbine is supplied to the mill. The remainder is sold to HQ Energy Services, Inc. (an electric power distributor). The hot exhaust gas leaving the turbine is used to generate steam in the HRSG. This steam is commingled with steam generated by the boilers in a common header and supplied to the steam turbines G2 and G3.

Under typical post-project conditions, the combustion turbine is operated at base load and boiler No. 8 is operated at about 60 percent load. To meet short-term peak energy demands, the load on Boiler No. 8 is increased. Coal is not burned in Boiler No. 8 while the turbine is operating. Boilers Nos. 5-7 operate in standby mode. In the event of a turbine shutdown, all boilers are permitted to operate as described under baseline conditions.

The Bucksport Clean Energy Plant is owned by IP (28 percent equity) and Bucksport Energy, LLC (72 percent equity). Bucksport Energy is partially owned by HQ Energy Holdings, which is the parent company of HQ Energy Services, Inc. IP is the operator of the Clean Energy Plant and is responsible for all environmental, health, and safety issues associated with its operation.

2.3 Verification Activities

A site visit of the Bucksport pulp and paper mill was conducted on February 16, 2005 as part of the verification of the GHG emission reduction project. IP corporate and plant personnel who were responsible for the collection and analysis of GHG-related process data and those involved in the calculation of GHG emissions were interviewed. These data review/checking and verification discussions focused on the configuration and operation of the steam and power plant during the baseline and emission reduction years. The measurement and handling of data associated with fuel usage and analyses; steam generation and usage; electricity generation, purchases, and sales; and key meter calibration procedures, frequency, results, and recordkeeping were discussed.

A majority of the data used for the calculation of the ERs were provided in electronic format. As part of the verification, paper copies of the following documents were obtained during and following the site visit.

- Monthly electricity sales invoices showing electricity sales from G3 to the grid (CMP) for the 1999 baseline and 2001-2004 post-project time-periods, respectively.
- Monthly electricity metering records of G2 and G3 output for 1999 and 2001-2004 time-periods and G4 output for 2001-2004.
- Monthly electricity bills showing purchases from the grid (TransCanada Power Mktg. Ltd.)
- Monthly power plant steam distribution reports showing steam flow rates for various streams and associated enthalpies.

- Sample copies of daily steam reports for a couple of months per year during the 1999 baseline year and 2001-2004 ER periods.
- Sample copies of fuel analyses showing heating values, as well as moisture contents for solid fuels.
- Sample copies of calibration records for key measurement devices.

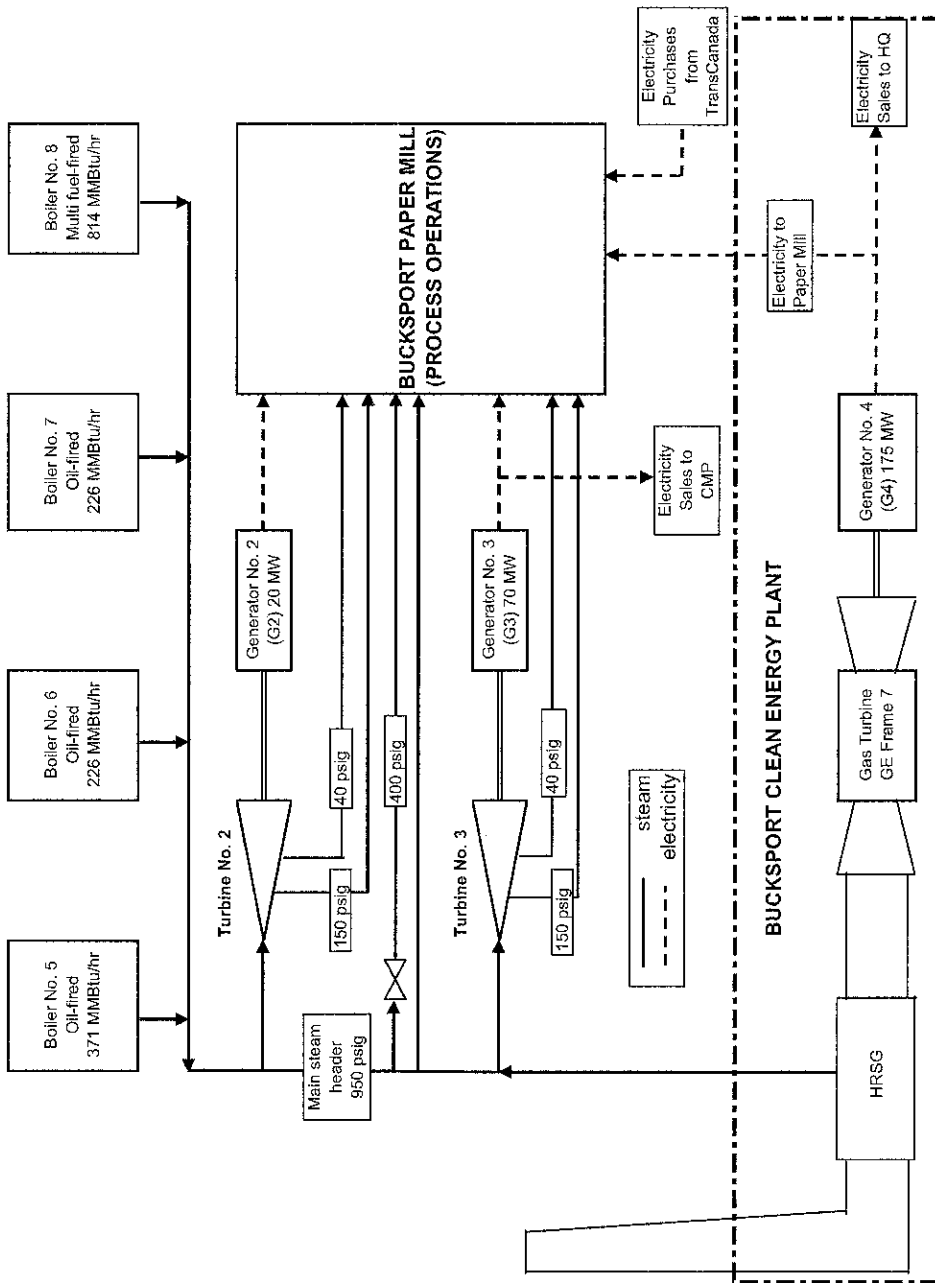


Figure 2-2. Schematic of the Bucksport Steam and Power Plant (Post-Project)

3.0 Proponent's Assumptions

The main assumptions used to calculate the ERs are listed below:

- The choice of 1999 as the baseline year for reductions claimed for the 2001-2004 time periods is reasonable. Based on discussions with IP personnel it represents a typical operating year in terms of facility production levels, boilers dispatch, mix of fuels used, and electricity imports and exports prior to the commissioning of the combined cycle turbine facility. Although the Clean Energy Plant did not begin commercial operation until January 2001, it underwent startup and initial testing in the 4th quarter of 2000. Electricity and process steam generated by the Clean Energy Plant were utilized for mill operation during that 2000 time period, which affected the fuel usage among the boilers. Therefore, the 2000 calendar year would not truly represent baseline operation.
- Baseline and project emissions were based on World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) recommended emission factors and calculation methodologies, supplemented with measured moisture content and fuel heating values. This approach is reasonable in the absence of detailed fuel composition analysis and is consistent with industry practice. Some differences in emission factors were noted but their effects are minimal. For example, these differences result in less than a 0.5 percent difference in baseline emissions.
- Carbon dioxide emissions from wood-derived fuels (i.e., biomass and sludge) were not included in the calculation of baseline and project emissions. This approach is consistent with current practices (Intergovernmental Panel on Climate Change [IPCC], WRI/WBCSD).
- The efficiency method was used to allocate emissions between steam and electricity production. Default efficiency factors of 0.80 for steam generation and 0.35 for electricity generation were used to calculate emission rates. This approach is reasonable. The efficiency method is one of the approaches recommended by WRI/WBCSD for allocating emissions between steam and electricity production in cogeneration systems. The efficiency factors used in the report are consistent with the WRI default values. Although actual efficiencies may be different, the approach is used to only allocate emissions between the two streams. Both baseline and actual emissions are calculated from fuel-specific usage and heating values for the baseline and post-project time periods.
- Emission factors for purchased electricity were based on emission factors provided by the supplier. These factors were based on the average fuel mix used to generate the supplied electricity. This is a reasonable approach to evaluating the indirect emissions resulting from purchased electricity usage. These emission factors were compared with the average emission factors for the State of Maine and found to be consistent.
- The operational boundaries for the post-project time periods include the combined cycle gas turbine plant and the boilers. This boundary determination is appropriate. The gas turbine combined cycle facility is located on IP property that is contiguous with the existing boilers and steam turbine plant. IP has operational control of the gas turbine facility and is responsible for all environmental, health, and safety issues associated with its operation. IP is required to use all steam generated by the gas turbine HRSG, which is commingled with boiler steam prior to expansion in the steam turbines and subsequent use as process steam at the mill.

- To calculate the post-project actual emissions, a single set of emission factors for steam and electricity generation from both boilers and the gas turbine was developed and used to characterize emissions from electricity and steam usage at the mill. The source (boilers or gas turbine/HRSG) of each energy stream was not considered in allocating emissions to the mill's usage. Since a large majority portion (> 70 percent) of the electricity generated by the turbine is exported to the grid, the use of an average set of emission factors affects the calculation of actual emissions and resulting ERs. As discussed in Section 5.5, the maximum difference between the verified actual emissions and those reported in the emissions reduction report is less than 2 percent for 2001.
- Residual oil flow rates are measured by individual flow meters to each boiler and compared with a redundant measurement of a calibrated flow meter that meters the total usage to all boilers. The individual boiler residual oil flow rates are then adjusted by prorating the difference in proportion to the flow to each boiler. Since the calculation of GHG emissions is dependent on the total residual oil fuel usage to all boilers, differences in actual residual oil fuel usage to individual boilers caused by the adjustment will not affect the calculated emissions.
- Waste oil usage data for 1999 were unavailable and were estimated based on IP personnel's conservative estimate of the fuel usage. Waste oil usage is a small fraction (<0.05 percent) of total fuel usage during the baseline and post-project time periods, and any error in estimating waste oil usage will not materially affect the calculated GHG emissions or ERs.

4.0 Baseline Emissions

Baseline emission factors were based on the mill's operation of its steam and power plant during 1999, the most recent full calendar year prior to the start-up of the Bucksport Clean Energy Plant. Since baseline emissions should reflect the emissions that would have occurred in the absence of the project, the emission factors developed from the 1999 data (i.e., fuel usage and analyses, generated and purchased electricity, etc.) were used during each of the post-project operating years (i.e., 2001-2004) to adjust the baseline for each year in the post-project time period.

The mix of generated electricity and purchased electricity used by the mill in 1999 was used to divide the total electricity used during each post-project operating year into generated and purchased electricity streams. Appropriate emission factors were then applied to each of these streams to calculate baseline emissions from electricity usage.

Sample Calculation

The calculation of baseline emission factors for generated steam and electricity are discussed and verified using a detailed calculation for the month of January 1999.

Emissions were based on monthly total of each fuel burned in the four industrial boilers (Nos. 5-8). Based on the mill's records, boilers No. 5, 6, and 7 used residual oil and waste oil as fuel. Boiler No. 8 used residual oil, waste oil, coal, wood waste, sludge, and TDF as fuel. The emission calculations for this verification were based on the monthly fuel usage data, and heating values data from sample fuel analyses reports obtained from IP. Waste oil usage data for 1999 were unavailable. IP personnel conservatively estimated annual usage of waste oil for 1999 as 15,000 gallons. Since waste oil usage (and hence greenhouse gas emissions) is a small fraction of the total from other fuels, any error in the estimation of this fuel usage does not materially affect the calculated GHG emissions.

Default CO₂e emission factors recommended by WRI/WCSBD were used in the calculation of GHG emissions. For fossil fuels these factors include emissions of CO₂, CH₄, and N₂O with global warming potentials of 1, 21, and 310, respectively. For the combustion of wood waste and biomass sludge, the recommended factors only include emissions of CH₄ and N₂O. Carbon dioxide emissions that result from the combustion of wood waste and biomass sludge are excluded. This is consistent with the guidance of other international organizations (e.g., IPCC) on greenhouse gas inventory reporting. Since the carbon released as CO₂ during biomass combustion was initially sequestered from the atmosphere during the growth phase of the tree, there is no net increase in the atmospheric CO₂ level as a result of wood waste and biomass sludge combustion.

Greenhouse gas emissions from fuel combustion were calculated using the following equation:

$$E = (\text{Fuel Usage}) \times (\text{Heating value}) \times (\text{Emission Factor}) / 1000 \quad (1)$$

where,

E	= GHG emissions (tonnes CO ₂ e)
Fuel Usage	= Total quantity of fuel consumed (gallons or tons)
Heating Value	= Higher heating value (HHV) based on sample fuel analyses (MMBtu/unit of measure of fuel)
Emission Factor	= CO ₂ e emission factor (kg/MMBtu)
1,000	= Conversion Factor (kg/tonne)

The calculation of total emissions for the baseline year (1999) is shown in Table 4-1.

Table 4-1. Calculation of GHG Emissions for Baseline Year

Fuel Type	Monthly Usage	Usage UOM	Fuel HHV (MMBtu/UOM)	Emission Factor – HHV basis ¹ (kg/MMBtu)	Emissions (tonnes CO ₂ e)
Residual Oil	37,406	10 ³ gal	150.439	76.933	432,928
Coal	70,778	tons	25.961	93.089	171,050
Wood Waste	205,800	tons	10.176	1.493	3,127
Sludge	41,979	tons	3.756	1.493	235
TDF	13,781	tons	27.220	85.113	31,928
Waste Oil	15,000	gal	0.140	73.695	155
TOTAL					639,423

¹ Default emission factors from WRI/WBCSD calculation tool are on a LHV basis. These factors were multiplied by 0.95 (recommended factor for solid and liquid fuels) to convert them to a HHV basis.

To calculate an emission factor for the steam and electricity generated and supplied for the mill’s operations, the total emissions generated based on fuel usage were allocated between electricity and process steam generated at the facility. Based on monthly steam reports obtained from IP, the process steam flow rates (lbm) were multiplied by their respective enthalpies (Btu/lbm) to calculate the heat content in the stream expressed in MMBtu. These values were then added to provide the total useful energy in the process steam. The calculation is represented by:

$$H_i = (w_i \times h_i) / 10^6 \tag{2}$$

where,

- H_i = useful steam energy in stream_i (MMBtu)
- w_i = total steam flow rate for stream_i (lbm)
- h_i = specific enthalpy for stream_i (Btu/lbm)
- 10⁶ = conversion factor (Btu/MMBtu)

The calculation for each of the process streams is shown in Table 4-2. The process streams for the baseline period are shown in Figure 2-1.

Table 4-2. Calculation of Process Steam Energy for Baseline Year

Stream Description	Flow Rate (w _i) (lbm)	Specific Enthalpy (h _i) (Btu/lbm)	Useful Energy (H _i) (MMBtu)
150 psig extract from G2 steam turbine	146,682,000	1,245	182,619
40 psig extract from G2 steam turbine	1,751,332,000	1,193	2,089,339
150 psig extract from G3 steam turbine	1,133,124,000	1,245	1,410,739
40 psig extract from G3 steam turbine	1,235,046,000	1,193	1,473,410
400 psig throttle to paper machines	93,880,160	1,333	125,142
950 psig to turbine pumps	102,949,285	1,450	149,276
TOTAL (H)			5,430,526

Total Electricity generated is calculated as the electricity generated by generator G2 plus the electricity generated by generator G3. Accordingly,

$$P = P2 + P3 \quad (3)$$

where,

- P = Total electricity generated (kWh)
- P2 = Electricity generated by G2 (kWh), and
- P3 = Electricity generated by G3 (kWh)

For the baseline year,

$$\begin{aligned} P &= (111,488,000) \text{ kWh} + (533,226,000) \text{ kWh} \\ &= 644,714,000 \text{ kWh} \\ &= (644,714,000) \text{ kWh} \times (3412.2) \frac{\text{Btu}}{\text{kWh}} \times \left(\frac{1}{10^6} \right) \frac{\text{MMBtu}}{\text{Btu}} \\ &= 2,199,893 \text{ MMBtu} \end{aligned}$$

Total emissions were allocated between electricity and steam generation using the efficiency method recommended by WRI/WBCSD. The following formula was used for the allocation.

$$E_H = \left(\frac{\left(\frac{H}{e_H} \right)}{\left(\frac{H}{e_H} \right) + \left(\frac{P}{e_P} \right)} \right) \times (E_T) \quad (4)$$

$$E_P = E_T - E_H \quad (5)$$

where,

- E_H = emissions allocated to steam (tonnes CO₂e)
- H = steam energy (MMBtu)
- e_H = assumed efficiency of steam production
- P = delivered electricity generation (MMBtu)
- e_P = assumed efficiency of electricity generation
- E_T = total direct emissions of the system (tonnes CO₂e)
- E_P = emissions allocated to electricity production (tonnes CO₂e)

Default efficiency factors of 0.35 for electricity generation and 0.80 for steam generation were used in accordance to WRI/WBCSD recommendations.

For 1999,

$$E_H = \left(\frac{\frac{(5,430,526) \text{ MMBtu}}{0.8}}{(5,430,526) \text{ MMBtu} + \frac{(2,199,893) \text{ MMBtu}}{0.35}} \right) \times (639,423) \text{ tonnes CO}_2\text{e}$$
$$= 331,838 \text{ tonnes CO}_2\text{e}$$

$$E_P = 639,423 - 331,838$$
$$= 307,586 \text{ tonnes CO}_2\text{e}$$

The emission factor for steam was calculated as:

$$ER_{\text{steam}} = \frac{331,838 \text{ tonnes CO}_2\text{e}}{5,430,526 \text{ MMBtu}} = 0.061 \frac{\text{tonne CO}_2\text{e}}{\text{MMBtu}}$$

and for electricity as:

$$ER_{\text{electricity}} = \frac{307,586 \text{ tonnes CO}_2\text{e}}{644,714 \text{ MWh}} = 0.477 \frac{\text{tonne CO}_2\text{e}}{\text{MWh}}$$

These baseline emission factors are consistent with those calculated in the emissions reduction report.

5.0 Actual Emissions and Emission Reductions

Actual emissions are based on the mill's usage of electricity and steam from its on-site generation, which includes the Bucksport Clean Energy Plant, and on the mill's electricity imports from TransCanada. The project boundaries and streams are shown in Figure 2-2.

Actual emissions were calculated on a monthly basis for each month in the post-project period. Since steam from the combined cycle turbine facility is commingled with steam from the boilers prior to electricity generation and process steam extraction, the energy in each stream was assigned to either the boiler or the turbine plant based on the proportion of steam energy in the main header from each source. Emission factors were developed for process steam and electricity from each source based on these allocations.

Actual emissions calculations were verified by an independent calculation of the emissions associated with each of the process streams (electricity and steam) and are discussed with an example calculation for January 2001.

5.1 Calculation of Emission Factors for Boilers and Gas Turbine

Actual emissions were calculated using Equation (1). For January 2001, emission calculations are shown in Table 5-1.

Table 5-1. Calculation of GHG Emissions for January 2001

Fuel Type	Monthly Usage (January 2001)	Usage UOM	Fuel HHV (MMBtu/UOM)	Emission Factor HHV basis ¹ (kg/MMBtu)	Emissions (tonnes CO ₂ e)
Residual Oil	2,018	10 ³ gal	149.909	76.933	23,279
Coal	2,228	tons	25.961	93.089	5,384
Wood Waste	11,311	tons	10.144	1.493	171
Sludge	2,542	tons	3.042	1.493	12
TDF	451	tons	29.614	85.113	1,137
Waste Oil	3,000	gal	0.140		31
Natural Gas (G4)	771	MMscf	1051.333	53.115	43,046
Diesel (G4)	0	10 ³ gal	140	73.695	0
Total (boilers)					30,013
Total (G4 turbine)					43,046
TOTAL					73,060

¹ Default emission factors from WRI/WBCSD calculation tool are on a LHV basis. These factors were multiplied by 0.95 for solid and liquid fuels and by 0.9 for gaseous fuels to convert them to a HHV basis.

Similar to the calculations for baseline emission factors, the Plant's monthly steam reports were used to obtain the monthly steam flow rates (lbm), which were multiplied by their respective enthalpies (Btu/lbm) to calculate the energy in the process stream in MMBtu. These values were then added to provide the total useful energy in the process steam for that month. The calculation is represented by Equation (2) and is shown for each process stream in Table 5-2.

Table 5-2. Calculation of Process Steam Energy for January 2001

Stream Description	Flow Rate (w _i) (lbm)	Specific Enthalpy (h _i) (Btu/lbm)	Useful Energy (E _i) (MMBtu)
150 psig extract from G2 steam turbine	0	1,245	0
40 psig extract from G2 steam turbine	169,392,000	1,193	202,085
150 psig extract from G3 steam turbine	75,890,000	1,245	94,483
40 psig extract from G3 steam turbine	139,353,000	1,193	166,248
400 psig throttle to paper machines	9,486,000	1,333	12,645
950 psig to turbine pumps	13,853,000	1,450	20,087
TOTAL			495,548

Based on IP energy reports, electricity generation, purchases, and exports from the mill for January 2001 are shown in Table 5-3

Table 5-3. Mill's Electricity Generation and Usage Report for January 2001

Line No.	Electricity Source	kWh
1	Electricity generated by G2	10,926,000
2	Electricity generated by G3	47,623,795
3	Electricity generated by G2 and G3 (Lines 1+2)	58,549,795
4	Electricity sales from G3	17,480,290
5	Electricity supplied to mill from G2 and G3 (Lines 3-4)	41,069,505
6	Electricity generated by G4 generator	93,042,090
7	Electricity supplied to mill from G4	17,998,300
8	Electricity purchases from TransCanada	5,219,190
9	Electricity usage at mill (Lines 5+7+8) ¹	64,286,995

¹Some differences were found between the calculated electricity usage at the mill and the values reported by IP; however these differences were within 2 percent (annual basis).

As shown in Figure 2-2, steam from the G4 HRSG is commingled with steam from the boilers in the main header leading to the G2 and G3 turbines. As a result, a portion of the electricity and all of the process steam that are generated and used at the mill originates from two sources (i.e., boilers and the G4 turbine plant) that have different GHG emission characteristics. Therefore, to calculate actual emissions, each of the energy streams (electricity and steam) was assumed to be produced from either the boilers or the G4 turbine based on the relative energy content in the steam supplied to the main header by each source.

Based on IP steam reports for January 2001,

$$\text{Steam generated by boilers} = 577,603 \text{ MMBtu}$$

$$\text{Steam supplied by G4 turbine} = 367,778 \text{ MMBtu}$$

$$\begin{aligned} \text{Fraction of total steam energy from boilers} &= \frac{(577,603) \text{ MMBtu}}{(577,603) \text{ MMBtu} + (367,778) \text{ MMBtu}} \\ &= 0.611 \end{aligned}$$

$$\begin{aligned} \text{Fraction of total steam energy from G4} &= 1 - 0.611 \\ &= 0.389 \end{aligned}$$

Assuming that the electricity generated by G2 and G3 and the useful process steam produced are in proportion to the steam from each source,

$$\begin{aligned} \text{electricity generated by steam from boilers} &= (0.611) \times (58,549,795) \text{ kWh} \\ &= 35,722,409 \text{ kWh} \end{aligned}$$

$$\begin{aligned} \text{electricity from G4 steam} &= (0.389) \times (58,549,795) \text{ kWh} \\ &= 22,777,386 \text{ kWh} \end{aligned}$$

$$\begin{aligned} \text{Similarly, process steam from boilers} &= (0.611) \times (495,548) \text{ MMBtu} \\ &= 302,767 \text{ MMBtu} \\ \text{and from G4 HRSG} &= (0.389) \times (495,548) \text{ MMBtu} \\ &= 192,781 \text{ MMBtu} \end{aligned}$$

Emission Factors for Boilers

Total GHG emissions from boilers (E_T) = 30,014 tonnes CO₂e

Total power generation associated with boiler steam (P) = 35,772,409 kWh

$$\begin{aligned} &= (35,772,409) \text{ kWh} \times (3412.2) \frac{\text{Btu}}{\text{kWh}} \times \left(\frac{1}{10^6} \right) \frac{\text{MMBtu}}{\text{Btu}} \\ &= 122,063 \text{ MMBtu} \end{aligned}$$

Total process steam from boilers (H) = 302,767 MMBtu

Using Equations (4) and (5) and recommended default efficiencies, the emissions allocated to boiler generated steam and electricity is calculated as

$$\begin{aligned} E_H &= 15,620 \text{ tonnes CO}_2\text{e} \\ \text{and, } E_P &= 14,394 \text{ tonnes CO}_2\text{e} \end{aligned}$$

Emission Factors for steam and electricity are:

$$\begin{aligned} ER_{\text{Steam}} (\text{January 2001}) &= \frac{E_H}{H} = \frac{15,620 \text{ tonnes CO}_2\text{e}}{302,767 \text{ MMBtu}} = \frac{0.0516 \text{ tonnes CO}_2\text{e}}{\text{MMBtu}} \\ ER_{\text{Electricity}} (\text{January 2001}) &= \frac{E_P}{P} = \frac{14,394 \text{ tonnes CO}_2\text{e}}{35,772.409 \text{ MWh}} = \frac{0.4024 \text{ tonnes CO}_2\text{e}}{\text{MWh}} \end{aligned}$$

To compare emission factors with the 1999 annual average used for baseline, the annual average emission factor for 2001 was calculated from the 2001 annual totals of GHG emissions, steam, and electricity production. Based on these data the emission factors were calculated as,

$$ER_{\text{Steam}}(2001 \text{ average}) = 0.049 \frac{\text{tonnes CO}_2\text{e}}{\text{MMBtu}}$$

$$ER_{\text{Electricity}}(2001 \text{ average}) = 0.379 \frac{\text{tonnes CO}_2\text{e}}{\text{MWh}}$$

These factors are about 20 percent lower than the corresponding baseline emission factors. Heat input from biomass increased from 22 percent of total in 1999 (baseline year) to 41 percent of the total in 2001. Since a greater proportion of the total heat input to the boilers was supplied by biomass in 2001, the GHG emission factors are proportionately lower. Fuel usage data are shown in Appendix A.

Emission Factors for G4 Turbine

These factors were calculated using procedures similar to those used for the boilers.

Total GHG emissions from G4 fuels' combustion (E_T) = 43,046 tonnes CO₂e

$$\begin{aligned} \text{Total power generated associated with G4 steam (P)} &= (93,042,090) \text{ kWh} + (22,777,386) \text{ kWh} \\ &= (115,819,476) \text{ kWh} \times (3412.2) \frac{\text{Btu}}{\text{kWh}} \times \left(\frac{1}{10^6} \right) \frac{\text{MMBtu}}{\text{Btu}} \\ &= 395,199 \text{ MMBtu} \end{aligned}$$

Total process steam for G4 HRSG = 192,781 MMBtu

Using Equations (4) and (5) and WRI/WBCSD recommended default efficiencies, the emissions allocated to G4 are calculated as

$$\begin{aligned} E_H &= 7,571 \text{ tonnes CO}_2\text{e} \\ E_P &= 35,475 \text{ tonnes CO}_2\text{e} \end{aligned}$$

Emission Factors for steam and electricity are:

$$ER_{\text{Steam}}(\text{January 2001}) = \frac{E_H}{H} = \frac{7,571 \text{ tonnes CO}_2\text{e}}{192,781 \text{ MMBtu}} = \frac{0.0394 \text{ tonnes CO}_2\text{e}}{\text{MMBtu}}$$

$$ER_{\text{Electricity}}(\text{January 2001}) = \frac{E_P}{P} = \frac{35,475 \text{ tonnes CO}_2\text{e}}{115,819.476 \text{ MWh}} = \frac{0.3070 \text{ tonnes CO}_2\text{e}}{\text{MWh}}$$

To compare against 1999 baseline average emission factors and the 2001 emission factors for the boilers, the 2001 annual average emission factors for the G4 turbine were calculated as

$$ER_{\text{Steam}}(2001 \text{ average}) = 0.043 \frac{\text{tonnes CO}_2\text{e}}{\text{MMBtu}}$$

$$ER_{\text{Electricity}}(2001 \text{ average}) = 0.337 \frac{\text{tonnes CO}_2\text{e}}{\text{MWh}}$$

The emission factors are about 30 percent lower than the 1999 baseline average values and about 11 percent lower than the 2001 boiler average emission factors.

5.2 Calculation of Actual Emissions from the Mill

To calculate actual emissions, the Mill's usage of generated electricity and process steam from No. 2 and 3 turbines and generators were allocated to the boilers and G4 turbine based on the fraction of steam supplied to the main steam header from each source (boilers or turbines). The calculated emission factors were then applied to each stream to determine the associated GHG emissions for January 2001.

$$\begin{aligned} \text{Mill's electricity from steam boilers} &= (G2 + G3 - G3 \text{ sales}) \times (\text{fraction of steam from boilers}) \\ &= (41,069,505) \text{ kWh} \times (0.611) \times \left(\frac{1}{1000} \right) \frac{\text{MWh}}{\text{kWh}} \\ &= 25,092 \text{ MWh} \end{aligned}$$

$$\text{Mill's process steam from boilers} = 302,767 \text{ MMBtu}$$

$$\begin{aligned} \text{Mill's electricity from G4} &= (\text{Electricity from G4 generator}) + \\ &\quad (\text{Electricity associated with G4 HRSG steam}) \\ &= [17,998,300 \text{ kWh} + (41,069,505) \text{ kWh} \times 0.389] \left(\frac{\text{MWh}}{1000 \text{ kWh}} \right) \\ &= 33,975 \text{ MWh} \end{aligned}$$

$$\text{Mill's process steam from G4 turbine} = 192,781$$

Actual emissions were calculated using Equation (1) and are shown in Table 5-4 for January 2001.

Table 5-4. Actual Emissions for January 2001

Line No.	Mill's Energy Source	Energy Usage	Energy UOM	Emission Factor (tonne CO ₂ e/UOM)	Emissions (tonnes CO ₂ e)
1	Electricity from boiler steam	25,092	MWh	0.4024	10,097
2	Process steam from boilers	302,767	MMBtu	0.0516	15,620
3	Electricity from G4	33,975	MWh	0.3070	10,406
4	Process steam from G4	192,781	MMBtu	0.0394	7,571
5	Electricity import from TransCanada	5,219	MWh	0.2957	1,543
6	Total Electricity (Lines 1 + 3 + 5)	64,287	MWh		22,046
7	Total Steam (Lines 2 + 4)	495,548	MMBtu		23,191
8	TOTAL ACTUAL EMISSIONS (lines 6 + 7)				45,237

5.3 Calculation of Baseline Emissions for the Post-Project Time Periods

To calculate the ERs generated from the project, the GHG emissions that would have occurred in the absence of the project (i.e., the baseline scenario) must be evaluated. In the absence of the project, the mill would have met its electricity and process steam requirements by burning a combination of fossil and biomass fuels in its boilers. In addition, some electricity would have been purchased from TransCanada.

The mix of generated electricity and purchased electricity used by the mill in 1999 was used to divide the total electricity used during each post-project year into generated and purchased electricity streams.

To calculate baseline emissions, the emission factors that were developed in Section 4.0 for generation of electricity and process steam can be applied to the portion of the project's current energy usage that would have been sourced from on-site generation. Emission factors for purchased electricity, which were obtained from TransCanada, reflect the mix of fuels used in the generation of electricity sold to the Bucksport mill.

Based on the 1999 data, approximately 61 percent of the mill's annual electricity usage was generated by the on-site steam turbines and electricity generators using steam generated by the boilers. The remaining 39 percent was purchased. This mix of electricity sources was assumed to apply for each month of the post-project time period.

For January 2001,

$$\begin{aligned} \text{Electricity from on-site generation} &= (0.61) \times (64,287) \text{ MWh} \\ &= 39,386 \text{ MWh} \\ \text{Purchased Electricity} &= (0.39) \times (64,287) \text{ MWh} \\ &= 24,901 \text{ MWh} \end{aligned}$$

Baseline emission factors for on-site steam and electricity generation were determined in Section 4.0 as,

$$\begin{aligned} ER_{\text{Electricity}} \text{ (baseline average)} &= 0.4771 \text{ tonne CO}_2\text{e/MWh} \\ ER_{\text{Steam}} \text{ (baseline average)} &= 0.0611 \text{ tonne CO}_2\text{e/MMBtu} \end{aligned}$$

Using these factors, baseline emissions were calculated for each of the 2001 energy streams as shown in Table 5-5.

Table 5-5. Baseline Emissions for January 2001

Mill's Energy Source	Energy Usage	Energy UOM	Emission Factor (tonne CO ₂ e/UOM)	Emissions (tonnes CO ₂ e)
Electricity from boiler steam	39,386	MWh	0.4771	18,791
Process steam from boilers	495,548	MMBtu	0.0611	30,281
Electricity import from TransCanada	24,901	MWh	0.2957	7,363
Total Electricity	64,287	MWh		26,154
Total Steam	495,548	MMBtu		30,281
TOTAL BASELINE				56,435

5.4 Calculation of Emission Reductions

The ERs resulting from the project were calculated as the difference between baseline emissions and actual emissions for each month in the post-project time period. For January 2001, the ERs were calculated as,

$$\begin{aligned} ER &= \text{Baseline Emissions} - \text{Actual Emissions} \\ &= 56,435 - 45,237 \\ &= 11,197 \text{ tonnes CO}_2\text{e} \end{aligned}$$

5.5 Summary of Findings

Baseline emissions, actual emissions, and emission reductions were calculated for each month in the post-project time period (2001-2004). The results are shown in Table 5-6. Monthly tonnage of paper produced and normalized emission rates (expressed as actual tonnes of CO₂e per ton of machine finished paper product) are also shown in Table 5-6. Annual ERs increase from about 115,000 tonnes CO₂e in 2001 to about 165,000 tonnes CO₂e in 2004. Normalized rates show a general decreasing trend from an annual average of 0.91 tonne CO₂e/ton of paper in 2001 to 0.81 in 2004. These observations are consistent with the increased use of the G4 turbine steam and electricity to meet the mill energy requirements resulting in lower emissions associated with the mill's operation. Simultaneously, the mix of fuels in the boilers has changed. Fossil fuel usage has decreased during this period resulting in lower GHG emissions from the mill. A small decrease in ERs and a corresponding increase in normalized rates for 2003 are also consistent with increases in residual oil usage in 2003 compared to 2002.

The month-to-month variations in normalized rates reflect monthly variations in fuel mix and in the mix of pulps used in the production of finished paper products.

Table 5-6. Baseline Emissions, Actual Emissions, Emission Reductions, and Normalized Emission Rates by Month

Year	Month	Baseline Emissions (tonnes CO ₂ e)	Actual Emissions (tonnes CO ₂ e)	Emission Reductions (tonnes CO ₂ e)	Paper Production (tons)	Normalized Rate (actual tonnes CO ₂ e/ton paper)
2001	January	56,435	45,237	11,197	47,212	0.96
	February	52,539	42,361	10,178	43,861	0.97
	March	52,715	43,051	9,665	42,386	1.02
	April	45,508	37,927	7,581	36,892	1.03
	May	51,038	42,030	9,008	48,628	0.86
	June	31,203	26,523	4,680	24,944	1.06
	July	46,296	37,826	8,470	42,687	0.89
	August	49,849	39,172	10,678	48,259	0.81
	September	44,953	35,299	9,654	41,286	0.85
	October	51,832	40,703	11,128	50,534	0.81
	November	53,110	39,824	13,285	47,233	0.84
	December	33,724	25,051	8,673	23,601	1.06
	TOTAL	569,202	455,005	114,197	497,523	0.91
2002	January	53,116	37,897	15,219	42,783	0.89
	February	36,355	26,822	9,533	28,807	0.93
	March	52,698	40,070	12,628	47,982	0.84
	April	52,726	37,866	14,860	47,900	0.79
	May	41,039	31,195	9,844	35,202	0.89
	June	49,657	37,397	12,260	45,209	0.83
	July	50,206	37,308	12,897	49,376	0.76
	August	49,799	37,154	12,645	48,724	0.76
	September	48,860	37,633	11,226	47,978	0.78
	October	53,179	40,343	12,836	49,281	0.82
	November	54,057	39,361	14,696	45,314	0.87
	December	42,613	33,795	8,818	31,585	1.07
	TOTAL	584,304	436,841	147,463	520,140	0.84

Year	Month	Baseline Emissions (tonnes CO ₂ e)	Actual Emissions (tonnes CO ₂ e)	Emission Reductions (tonnes CO ₂ e)	Paper Production (tons)	Normalized Rate (actual tonnes CO ₂ e/ton paper)
2003	January	53,433	42,689	10,744	38,614	1.11
	February	52,962	39,906	13,056	41,698	0.96
	March	56,693	42,091	14,602	46,706	0.90
	April	48,035	41,288	6,746	46,313	0.89
	May	52,746	38,415	14,331	48,629	0.79
	June	48,719	36,470	12,249	46,871	0.78
	July	49,992	35,914	14,079	49,224	0.73
	August	50,745	36,517	14,228	48,891	0.75
	September	47,344	34,681	12,663	45,354	0.76
	October	51,694	40,895	10,799	48,071	0.85
	November	52,619	41,211	11,408	46,122	0.89
	December	53,442	41,741	11,701	42,160	0.99
	TOTAL	618,425	471,818	146,607	548,651	0.86
2004	January	58,889	47,348	11,540	48,247	0.98
	February	50,686	33,768	16,918	43,894	0.77
	March	54,270	39,917	14,353	49,155	0.81
	April	50,118	36,826	13,291	44,662	0.82
	May	51,465	36,554	14,911	48,681	0.75
	June	48,466	36,002	12,464	46,676	0.77
	July	50,535	37,320	13,216	48,627	0.77
	August	49,994	37,134	12,860	48,536	0.77
	September	48,981	36,913	12,067	46,765	0.79
	October	52,801	39,019	13,782	48,313	0.81
	November	53,223	38,386	14,838	45,351	0.85
	December	54,875	40,368	14,508	46,829	0.86
	TOTAL	624,304	459,554	164,750	565,734	0.81

In Tables 5-7 to 5-9, the reported ERs, baseline emissions, and actual emissions are compared with the verified values. The calculated ERs are compared in Table 5-7. As shown in the table, the magnitude of the reported ERs are verified to within 8 percent for 2001 and to within 3 percent for 2002 –2004 post-project time periods. To evaluate the source of these differences, a comparison of reported and verified annual baseline and actual emissions are shown in Tables 5-8 and 5-9, respectively. As shown in Table 5-8, reported baseline emissions are verified to within 0.5 percent. Reported baseline emissions are consistently higher by about 2,500 tonnes over the verified values. These slight differences are due to small variations in emission factors and fuel heating values used.

Table 5-9 shows reported and verified annual actual emissions. Differences between verified and reported values vary from about +7,000 tonnes in 2001 to about -4,300 tonnes in 2004. In all cases the magnitude of reported emissions are within 2 percent of the verified actual emissions.

The differences in actual emissions are mainly due to the methodology used in the calculation of steam and electricity emission factors. In the emissions reduction report, the combined emissions from the boilers and turbine are allocated to the total process steam and electricity generation from both sources to generate a set of annual average emission factors for process steam and electricity generation. These

emission factors are then applied to the mill's annual usage of electricity and process steam from on-site generation with no differentiation made on the source of energy (boiler or turbine). As shown in Figure 2-2, and the Appendix A tables, a large proportion of the electricity generated by the gas turbine is exported. This energy stream has a relatively lower emission factor compared to the boilers. The net effect is an average emission factor for the mill's usage that is biased low. This effect is more pronounced in 2001, the first operating year for the gas turbine during which about 80 percent of the electricity generated by the gas turbine was exported. In 2004 about 70 percent of the gas turbine's electricity generation was exported.

Other factors affecting the reported emissions include month-to-month variations in energy usage from each source and the resulting effects on the monthly emission factors and emission allocations that are not captured in the reported emissions, and differences in emission factors and fuel heating values.

Table 5-7. Comparison Between Reported and Verified Annual ERs (2001-2004)

Post-Project Year	Reported ERs	Verified ERs	Difference	Percent Difference
2001	123,255	114,197	-9,058	-7.93
2002	149,736	147,463	-2,273	-1.54
2003	150,886	146,607	-4,279	-2.92
2004	163,067	164,750	1,683	1.02

Table 5-8. Comparison Between Reported and Verified Baseline Emissions (2001-2004)

Post-Project Year	Reported Baseline Emissions	Verified Baseline Emissions	Difference	Percent Difference
2001	571,335	569,202	-2,133	-0.37
2002	586,674	584,304	-2,370	-0.41
2003	620,883	618,425	-2,458	-0.40
2004	626,978	624,304	-2,674	-0.43

Table 5-9. Comparison Between Reported and Verified Actual Emissions (2001-2004)

Post-Project Year	Reported Actual Emissions	Verified Actual Emissions	Difference	Percent Difference
2001	448,080	455,005	6,925	1.52
2002	436,938	436,841	-98	-0.02
2003	469,997	471,818	1,821	0.39
2004	463,910	459,554	-4,356	-0.95

6.0 Surplus to Regulation

The surplus nature of these emission reductions is demonstrated by a review of applicable state and federal regulations associated with pulp and paper manufacturing operations. As summarized in Table 6-1, there are no external requirements for controlling or reducing CO₂ emissions.

The IP Bucksport paper mill and the Bucksport Clean Energy Plant are not subject to any federal or local regulations that require CO₂ emission reductions. Table 6-1 summarizes the regulations that were considered for this analysis. Although IP must comply with the regulations referenced in Table 6-1, none of these regulations apply to CO₂ or other greenhouse gas emissions.

Table 6-1. Regulations Potentially Requiring Greenhouse Gas Emission Reductions for IP Bucksport Paper Mill and Bucksport Clean Energy Plant

Agency	Rule/Citation	Applicability to Project
Maine Department of Environmental Protection (MEDEP)	Chapter 101 Visible Emissions Regulation	This regulation applies to certain sources at the project site. However, this regulation does not apply to carbon dioxide emissions.
MEDEP	Chapter 103 Fuel Burning Equipment Particulate Emission Standard	This regulation applies to certain sources at the project site. However, this regulation does not apply to carbon dioxide emissions.
MEDEP	Chapter 138 Reasonably Available Control Technology for Facilities that Emit Nitrogen Oxides (NO _x -RACT)	This regulation applies to certain sources at the project site. However, this regulation does not apply to carbon dioxide emissions.
EPA	40 CFR Part 63, Subpart JJJJ, Maximum Available Control Technology (MACT) - Paper and Other Web Coating Standards	This regulation applies to certain sources at the project site. However, this regulation does not apply to carbon dioxide emissions.
EPA	40 CFR Part 63, Subpart S, MACT - Pulp and Paper Industry	This regulation applies to certain sources at the project site. However, this regulation does not apply to carbon dioxide emissions.
EPA	40 CFR Part 63, Subpart YYYYY, MACT for Stationary Combustion Turbines	This regulation applies to certain sources at the project site. However, this regulation does not apply to carbon dioxide emissions.
EPA	40 CFR Part 63, Subpart ZZZZ, MACT for Stationary Combustion Internal Combustion Engines	This regulation applies to certain sources at the project site. However, this regulation does not apply to carbon dioxide emissions.
EPA	40 CFR Part 63, Subpart DDDDD, MACT for Industrial/ Commercial/Institutional Boilers and Process Heaters	This regulation applies to certain sources at the project site. However, this regulation does not apply to carbon dioxide emissions.
EPA	40 CFR Part 60 New Source Performance Standards (NSPS), Subparts A, D, GG, and Y	These regulations apply to certain sources at the project site. However, they do not apply to carbon dioxide emissions.
EPA	40 CFR Parts 72 and 75 Acid Rain Program	These regulations apply to certain sources at the project site. However, they do not apply to carbon dioxide emissions.

In December 2004, the Maine Department of Environmental Protection released its climate action plan pursuant to public law No. 237, which requires the reduction of total overall greenhouse gas emissions within the state to 1990 levels by 2010, and to 10 percent below those levels by 2020. However, laws mandating specific reductions in greenhouse gas emissions from different industry sectors and individual power generation and industrial facilities have not yet been enacted.

7.0 Unique

As a member of the Chicago Climate Exchange (CCX) program, IP has voluntary obligations for reducing their total, entity-wide direct CO₂ emissions by one percent in 2003 and two percent in 2004 over their baseline, which is calculated as the average over the 1998-2001 time-period.

Blue Source indicates that their GHG emission reduction offset agreement with IP confirms that IP has the right to sell the offsets created from the Bucksport mill project. IP warrants to Blue Source that it has the right to sell these GHG offsets while being a member of voluntary programs like the CCX and EPA Climate Leaders program, and that the ERs claimed in the emissions reduction report and verified herein have not been previously claimed and/or sold by IP or any other Party.

8.0 Conclusions

A summary of the verifiable ERs is shown in Table 8-1. CO₂e ERs totaling 573,017 tonnes (an approximately 24 percent reduction) were generated from the project during the 2001 – 2004 post-project time periods. This estimate is about 3 percent lower than the reported ERs of 586,944 tonnes CO₂e claimed in the emissions reduction report. The reasons for the differences were discussed in Section 5.5.

The overall approach used in the calculation of the project ERs is reasonable. Data on fuels usage, electricity production, sales, and purchases, and steam production and usage, were complete. The overall methodology used in the calculation of ERs, including the determination of the project operational boundaries and the scope of the GHG emissions reduction project, is reasonable. Annual ERs were calculated based on an aggregation of monthly data obtained from the site. The data were verified to be consistent and reasonable. Both baseline emissions and actual emissions were appropriately calculated based on the activity data for that year. Emission factors used for the combustion of various fuels are appropriate. The operations of the boilers and gas turbine were consistent with their specifications.

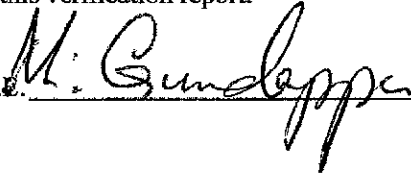
Table 8-1. Verified Baseline Emissions, Actual Emissions, and Emission Reductions (tonnes CO₂e)

Post-Project Year	Verified Baseline Emissions	Verified Actual Emissions	Verified Emission Reductions
2001	569,202	455,005	114,197
2002	584,304	436,841	147,463
2003	618,425	471,818	146,607
2004	624,304	459,554	164,750
TOTAL (2001 - 2004)	2,396,235	1,823,218	573,017

9.0 Signed Attestation

I hereby warrant that this report was prepared by me based on my site visit and an examination of information and records provided by International Paper and Blue Source. Project reductions were calculated independent of the claims in the *Project Description and Emission Reduction Report*. The findings indicate that the verified ERs generated from the project meet the criteria as discussed in Sections 4.0 to 7.0 of this verification report.

Mahesh Gundappa, P.E.

A handwritten signature in black ink, appearing to read "M. Gundappa", is written over a horizontal line.

Appendix A



Table A-1. Monthly Fuel Usage and Electricity Records for 1999 Baseline Year

Month	Residual Oil (10 ³ gal)	Coal (tons)	Wood Waste (tons)	Sludge (tons)	TDF (tons)	Waste Oil (gal) ¹	Electricity (kWh)			Purchases from TransCanada
							G2 Generation	G3 Generation	G3 Sales	
January	3,679	3,417	13,450	2,544	622	1,250	7,792,000	45,376,000	17,678,158	14,585,794
February	3,709	4,192	16,458	3,401	1,174	1,250	10,230,000	45,440,000	15,729,229	18,152,406
March	4,120	2,604	17,631	3,554	999	1,250	10,102,000	46,608,000	18,103,949	21,799,914
April	3,789	3,739	17,443	3,577	1,193	1,250	10,510,000	46,172,000	16,282,084	20,659,349
May	3,723	2,503	9,828	2,324	673	1,250	8,332,000	38,338,000	15,468,508	26,123,236
June	3,232	3,814	17,224	4,111	1,257	1,250	10,756,000	42,880,000	17,003,266	25,551,527
July	2,540	7,083	17,996	3,636	1,113	1,250	10,636,000	39,840,000	16,236,386	28,718,042
August	2,247	10,021	19,905	4,096	1,356	1,250	6,766,000	47,726,000	17,009,266	27,504,039
September	2,579	6,152	19,506	3,523	1,374	1,250	6,546,000	46,580,000	16,231,084	26,891,004
October	2,683	8,724	18,063	3,358	1,717	1,250	8,344,000	49,054,000	15,475,436	24,603,042
November	2,513	9,416	18,310	4,141	1,293	1,250	10,230,000	41,738,000	16,681,349	23,587,301
December	2,593	9,113	19,986	3,714	1,010	1,250	11,244,000	43,474,000	18,074,697	23,005,943
TOTAL	37,406	70,778	205,800	41,979	13,781	15,000	111,488,000	533,226,000	199,973,412	281,181,597

¹ Waste Oil usage records were unavailable for 1999. IP estimated the annual usage as 15,000 gallons, which was prorated as 1,250 gallons per month.

Table A-2. Monthly Process Steam Totals for 1999 Baseline Year (lbm)

Month	150 psig steam extract from G2	40 psig steam extract from G2	150 psig steam extract from G3	40 psig steam extract from G3	400 psig steam to paper machines	950 psig steam to turbine-driven feedwater pumps
January	11,112,000	153,825,000	94,061,000	112,196,000	7,697,050	14,922,577
February	11,773,000	156,358,000	102,265,000	122,601,000	8,858,930	14,982,898
March	11,814,000	161,553,000	98,679,000	90,319,000	8,625,870	15,978,664
April	12,801,000	134,847,000	93,293,000	101,527,000	8,478,470	5,417,503
May	13,141,000	162,081,000	90,506,000	60,217,000	7,794,250	151,241
June	15,193,000	161,027,000	86,832,000	51,742,000	8,102,200	0
July	10,776,000	118,242,000	94,793,000	100,870,000	8,029,440	44,622
August	10,025,000	114,143,000	90,864,000	103,065,000	7,615,210	0
September	11,106,000	139,187,000	99,293,000	116,743,000	7,630,940	6,404,730
October	11,858,000	160,038,000	92,119,000	103,655,000	7,390,630	15,805,517
November	16,218,000	169,905,000	94,004,000	124,364,000	7,904,590	16,702,593
December	11,112,000	153,825,000	94,061,000	112,196,000	7,697,050	14,922,577
TOTAL	146,682,000	1,751,332,000	1,133,124,000	1,235,046,000	93,880,160	102,949,285

Table A-3. Monthly Fuel Usage for 2001-2004 Post-Project Time Periods

Month/Year	Residual Oil (10 ³ gal)	Coal (tons)	Wood Waste (tons)	Sludge (tons)	TDF (tons)	Waste Oil (gal)	Natural Gas (MMscf)	Diesel (10 ³ gal)
January-01	2,018	2,228	11,311	2,542	451	3,000	771	0
February-01	1,446	578	16,020	3,275	935	1,500	1,061	0
March-01	1,308	391	17,183	3,229	1,429	2,500	1,246	0
April-01	1,322	0	13,569	2,998	1,334	1,400	1,048	0
May-01	1,058	0	13,691	2,500	1,317	500	1,197	0
June-01	1,282	0	9,691	1,250	421	2,000	638	0
July-01	1,329	0	14,405	2,695	538	1,000	949	2
August-01	816	0	13,296	3,223	1,286	500	1,171	0
September-01	985	0	14,920	2,664	973	1,000	919	0
October-01	1,103	0	14,475	3,022	1,120	500	1,079	58
November-01	802	0	15,884	3,457	1,314	1,000	1,171	0
December-01	359	0	8,101	1,250	493	5,000	1,213	0
TOTAL	13,829	3,197	162,546	32,105	11,611	19,900	12,463	60
January-02	535	0	17,731	1,000	1,053	500	1,214	0
February-02	377	0	6,268	1,774	617	1,000	1,110	0
March-02	814	0	15,133	2,464	951	250	1,146	0
April-02	473	0	15,900	2,308	1,291	400	1,148	0
May-02	472	0	10,726	1,600	676	2,500	1,189	0
June-02	732	0	14,342	2,640	1,107	2,000	1,023	17
July-02	532	0	15,048	2,731	1,042	1,900	1,149	0
August-02	577	0	15,081	2,958	1,065	450	1,119	5
September-02	785	0	10,728	2,013	777	500	1,070	0
October-02	893	0	12,255	2,179	803	1,500	1,113	26
November-02	609	0	13,739	2,244	1,148	3,200	1,179	0
December-02	526	0	10,684	1,460	730	500	1,016	1,490
TOTAL	7,325	0	157,635	25,371	11,260	14,700	13,477	1,538

Month/Year	Residual Oil (10 ³ gal)	Coal (tons)	Wood Waste (tons)	Sludge (tons)	TDF (tons)	Waste Oil (gal)	Natural Gas (MMscf)	Diesel (10 ³ gal)
January-03	939	0	12,790	3,400	800	500	1,044	1,555
February-03	906	0	14,522	2,340	1,135	2,950	1,084	0
March-03	720	0	15,828	2,547	1,127	5,000	1,184	0
April-03	1,321	0	11,197	1,890	834	4,000	614	49
May-03	415	0	17,573	3,500	1,534	5,000	1,200	0
June-03	382	0	15,290	3,003	1,124	3,050	1,127	0
July-03	352	0	14,380	3,738	955	3,100	1,133	0
August-03	267	0	15,118	3,862	1,255	3,500	1,162	0
September-03	327	0	11,194	2,739	1,026	3,000	1,141	0
October-03	974	0	9,405	2,325	739	2,800	1,047	0
November-03	1,075	0	11,522	3,162	1,166	2,750	987	0
December-03	1,498	0	12,218	2,466	926	5,000	910	0
TOTAL	9,177	0	161,037	34,972	12,621	40,650	12,633	1,604
January-04	1,390	0	15,895	2,480	1,199	3,500	868	1,052
February-04	464	0	13,630	3,342	1,000	4,100	1,053	0
March-04	463	0	15,712	1,240	1,141	3,500	1,211	0
April-04	471	0	13,017	2,315	963	4,050	1,092	0
May-04	376	0	13,730	2,475	817	4,000	1,170	0
June-04	780	0	15,201	2,887	932	3,000	896	1
July-04	529	0	12,071	2,742	790	3,050	1,108	39
August-04	357	0	14,551	3,350	1,132	2,400	1,159	0
September-04	362	0	12,069	2,950	946	2,000	1,124	0
October-04	625	0	12,844	3,560	1,210	3,000	1,056	0
November-04	443	0	12,971	3,340	1,051	1,000	1,177	0
December-04	544	0	14,649	3,017	650	2,500	1,250	0
TOTAL	6,805	0	166,340	33,698	11,831	36,100	13,164	1,092

Table A-4. Monthly Electricity Records for 2001-2004 Post-Project Time Periods (kWh)

Month/Year	G2 Generation	G3 Generation	G3 Sales	Purchases from TransCanada	G4 Generation	G4 Supply to IP	G4 Sales to HQ
January-01	10,926,000	47,623,795	17,480,290	5,219,290	93,042,090	17,998,300	75,043,790
February-01	10,016,000	45,979,474	15,889,080	1,217,775	114,692,370	19,074,035	95,618,335
March-01	11,206,000	50,604,379	17,783,865	0	134,263,860	16,449,810	117,814,050
April-01	10,704,000	44,603,870	16,797,226	970,411	110,992,980	13,572,930	97,420,050
May-01	11,156,000	45,913,939	18,120,299	49,920	126,749,100	27,210,980	99,538,120
June-01	5,672,000	33,225,869	18,549,294	368,200	67,201,290	14,759,465	52,441,825
July-01	9,566,000	42,498,446	16,062,031	2,509,665	100,104,480	21,322,885	78,781,595
August-01	11,212,000	44,876,462	17,980,280	0	123,465,540	27,912,550	95,552,990
September-01	9,172,000	38,316,485	12,597,288	1,743,049	97,631,220	20,327,790	77,303,430
October-01	10,828,000	45,076,363	17,009,534	1,810,875	118,400,940	26,852,540	91,548,400
November-01	10,576,000	43,122,269	17,261,395	0	127,877,280	29,306,610	98,570,670
December-01	5,388,000	42,707,448	16,480,800	0	133,456,830	6,722,070	126,734,760
TOTAL (2001)	116,422,000	524,548,799	202,011,382	13,889,185	1,347,877,980	241,509,965	1,106,368,015
January-02	10,318,000	39,000,226	18,395,925	0	132,959,880	31,175,620	101,784,260
February-02	7,144,000	35,112,960	19,705,845	0	121,444,650	17,412,960	104,031,690
March-02	10,800,000	39,960,662	16,480,800	3,227,190	125,660,310	30,152,340	95,507,970
April-02	10,880,000	38,414,851	17,265,600	0	124,352,850	33,686,770	90,666,080
May-02	7,958,000	40,180,234	21,675,356	0	127,816,920	23,061,970	104,754,950
June-02	10,054,000	38,790,835	15,456,593	3,174,021	109,799,070	27,976,800	81,822,270
July-02	11,066,000	40,815,850	18,051,630	0	122,869,800	33,443,070	89,426,730
August-02	10,882,000	41,244,451	17,015,361	305,916	119,242,950	31,112,520	88,130,430
September-02	10,702,000	38,366,035	15,463,036	266,641	114,678,390	30,374,580	84,303,810
October-02	11,004,000	38,529,187	17,027,444	999,120	121,183,440	33,364,110	87,819,330
November-02	10,594,000	37,801,080	16,481,251	0	129,269,040	32,587,440	96,681,600
December-02	8,424,000	38,066,314	19,661,469	584,230	131,045,400	20,360,820	110,684,580
TOTAL (2002)	119,826,000	466,282,685	212,680,310	8,557,118	1,480,322,700	344,709,000	1,135,613,700

Month/Year	G2 Generation	G3 Generation	G3 Sales	Purchases from TransCanada	G4 Generation	G4 Supply to IP	G4 Sales to HQ
January-03	9,552,000	40,829,458	18,208,544	95,088	135,352,530	27,724,930	107,627,600
February-03	10,030,000	37,456,229	15,697,487	1,075,862	117,754,770	28,574,040	89,180,730
March-03	11,294,000	36,657,302	15,558,676	1,056,886	127,694,160	33,888,110	93,806,050
April-03	12,246,000	13,559,342	5,417,200	21,313,900	67,236,870	21,181,970	46,054,900
May-03	11,266,000	41,240,995	17,265,691	0	126,845,677	30,559,537	96,286,140
June-03	10,192,000	37,217,045	16,480,799	0	117,848,990	33,200,280	84,648,710
July-03	10,934,000	39,041,712	17,257,934	0	117,715,798	34,121,298	83,594,500
August-03	9,478,000	41,020,906	16,487,879	0	120,618,000	33,318,170	87,299,830
September-03	8,368,000	39,000,125	17,333,024	0	119,182,673	30,765,613	88,417,060
October-03	8,378,000	36,835,445	17,007,899	4,051,095	110,129,536	32,503,156	77,626,380
November-03	7,016,000	36,785,952	14,891,812	5,617,910	104,931,960	26,920,940	78,011,020
December-03	6,956,000	39,592,930	18,121,537	11,100,211	99,952,350	19,397,440	80,554,910
TOTAL (2003)	115,710,000	439,237,441	189,728,482	44,310,952	1,365,263,314	352,155,484	1,013,107,830
January-04	8,658,000	38,494,642	16,677,604	8,459,104	107,132,220	27,984,012	79,148,208
February-04	9,792,000	34,139,146	15,521,374	600,615	121,073,070	26,943,870	94,129,200
March-04	178,000	47,188,843	18,045,501	163,881	129,138,180	36,960,500	92,177,680
April-04	3,880,000	41,078,938	15,637,347	79,800	115,511,580	33,107,818	82,403,762
May-04	7,424,000	43,037,582	16,480,800	0	122,960,190	31,376,230	91,583,960
June-04	5,686,000	39,391,848	17,003,234	7,951,830	93,439,320	25,793,480	67,645,840
July-04	7,186,000	42,578,150	16,230,360	353,521	116,496,150	32,618,922	83,877,228
August-04	7,380,000	42,432,523	17,361,329	0	120,463,260	33,729,713	86,733,547
September-04	7,260,000	37,673,539	17,265,599	0	116,325,600	36,484,031	79,841,569
October-04	6,744,000	39,551,904	15,457,486	3,887,221	111,477,390	31,455,956	80,021,434
November-04	7,104,000	39,158,323	17,303,100	0	126,345,000	34,567,260	91,777,740
December-04	8,252,000	37,059,422	18,049,722	0	131,620,320	36,083,324	95,536,996
TOTAL (2004)	79,544,000	481,784,860	201,033,456	21,495,972	1,411,982,280	387,105,116	1,024,877,164

Table A-5. Monthly Process Steam Totals for 2001-2004 Post-Project Time Periods (lbm)

Month/Year	150 psig steam extract from G2	40 psig steam extract from G2	150 psig steam extract from G3	40 psig steam extract from G3	40 psig steam extract from G3	400 psig steam to paper machines	950 psig steam to turbine-driven feedwater pumps
January-01	0	169,392,000	75,890,000	139,353,000	9,486,000	13,853,000	
February-01	2,598,000	155,272,000	64,191,000	133,001,000	8,682,000	13,143,000	
March-01	176,000	173,113,000	58,345,000	123,766,000	8,840,000	14,646,000	
April-01	1,503,000	165,009,000	45,263,000	89,099,000	8,443,000	13,029,000	
May-01	989,000	172,493,000	32,570,000	96,096,000	9,636,000	13,360,000	
June-01	17,160,000	97,294,000	35,082,000	62,288,000	7,604,000	6,130,000	
July-01	2,058,000	149,165,000	52,892,000	69,952,000	9,516,000	11,559,000	
August-01	1,399,000	171,782,000	47,121,000	65,151,000	10,456,000	13,265,000	
September-01	1,641,000	144,472,000	46,599,000	78,558,499	9,645,000	12,019,500	
October-01	1,032,000	153,695,504	50,499,000	99,930,000	9,892,000	12,777,000	
November-01	5,292,000	166,363,000	57,082,000	103,279,000	10,176,000	12,785,000	
December-01	5,859,000	82,535,000	57,605,000	85,200,000	6,440,000	6,175,000	
TOTAL (2001)	39,707,000	1,800,585,504	623,139,000	1,145,673,499	108,816,000	142,741,500	
January-02	1,323,000	155,049,000	65,398,000	117,720,000	10,069,000	10,735,000	
February-02	1,000	109,595,000	38,675,000	98,973,000	7,270,000	7,182,000	
March-02	135,000	145,628,000	55,162,000	101,092,000	9,387,000	11,215,000	
April-02	3,325,000	163,400,000	52,993,000	91,593,000	10,527,000	12,127,000	
May-02	167,000	122,523,000	48,024,000	82,163,000	8,072,000	8,483,000	
June-02	884,000	156,161,000	49,511,000	70,468,000	9,485,000	12,509,000	
July-02	0	168,574,000	50,445,000	49,807,000	9,468,000	12,351,000	
August-02	0	165,287,000	46,475,000	55,410,000	9,844,000	12,479,000	
September-02	22,000	165,162,000	50,464,000	55,654,000	9,475,000	9,627,000	
October-02	0	171,599,000	66,016,000	76,408,000	9,782,000	9,816,000	
November-02	0	165,878,000	64,515,000	107,623,000	9,607,000	11,553,000	
December-02	0	136,844,000	49,373,000	99,068,000	7,397,000	8,556,000	
TOTAL (2002)	5,857,000	1,825,700,000	637,051,000	1,005,979,000	110,383,000	126,633,000	

Month/Year	150 psig steam extract from G2	40 psig steam extract from G2	150 psig steam extract from G3	40 psig steam extract from G3	400 psig steam to paper machines	950 psig steam to turbine-driven feedwater pumps
January-03	1,001,000	148,273,000	68,179,000	142,551,000	9,990,000	10,412,000
February-03	118,000	152,163,000	62,273,000	129,216,000	9,608,000	12,187,000
March-03	7,511,000	168,972,000	63,743,000	116,736,000	10,690,000	14,126,000
April-03	37,006,000	163,928,000	24,303,000	38,983,000	10,260,000	14,602,000
May-03	190,000	170,612,000	51,772,000	92,065,000	10,270,000	12,773,000
June-03	2,637,000	156,617,000	40,009,000	74,040,000	9,755,000	10,080,000
July-03	540,000	167,369,000	47,615,000	56,650,000	10,290,000	11,822,000
August-03	0	153,149,000	54,807,000	72,116,000	9,822,000	11,683,000
September-03	0	139,300,000	53,583,000	80,674,500	9,979,000	9,545,000
October-03	0	131,438,000	59,204,000	120,829,000	9,409,000	8,984,000
November-03	331,000	123,484,000	71,980,000	145,712,000	8,041,000	11,212,000
December-03	0	123,229,000	77,037,000	167,045,000	7,001,000	12,031,000
TOTAL (2003)	49,334,000	1,798,534,000	674,505,000	1,236,617,500	115,115,000	139,457,000
January-04	557,000	146,337,000	82,166,000	177,397,000	7,776,000	11,663,000
February-04	706,000	158,196,000	63,464,000	135,943,000	7,336,000	10,305,000
March-04	0	9,687,000	127,375,000	209,214,000	8,188,000	9,249,000
April-04	0	71,741,000	84,769,000	156,995,000	7,457,000	9,690,000
May-04	0	128,983,000	69,673,000	114,426,000	8,186,000	11,987,000
June-04	0	97,161,000	65,271,000	129,745,000	7,767,000	12,188,000
July-04	0	123,087,000	60,494,000	111,017,000	7,954,000	11,949,000
August-04	0	125,947,000	62,108,000	100,855,000	8,204,000	11,733,000
September-04	2,604,000	121,609,000	59,790,000	105,187,000	7,969,000	9,621,000
October-04	0	120,060,000	67,188,000	139,991,000	7,726,000	12,134,000
November-04	0	125,187,000	66,307,000	156,197,000	7,955,655	12,129,576
December-04	2,001,000	138,828,000	71,451,000	159,822,000	7,750,000	11,459,000
TOTAL (2004)	5,868,000	1,366,823,000	880,056,000	1,696,789,000	94,268,655	134,107,576

Table A-6. Higher Heating Values of Fuels Used During Baseline and Post-Project Time Periods

Fuel	1999	2001	2002	2003	2004
Residual Oil (Btu/gal)	150,439	149,909	149,909	149,909	149,909
Coal (Btu/lb) ¹	12,981	12,981			
Wood Waste (Btu/lb)	5,088	5,072	5,072	5,072	5,072
Sludge (Btu/lb)	1,878	1,521	1,521	1,521	1,521
TDF (Btu/lb)	13,610	14,807	14,807	14,807	14,807
Waste Oil (Btu/gal)	140,000	140,000	140,000	140,000	140,000
Natural Gas (Btu/scf) ¹		1,051	1,051	1,051	1,051
Diesel (Btu/gal) ¹		140,000	140,000	140,000	140,000

¹ Coal was not fired during the 2002-2004 time periods; natural gas and diesel were not fired in 1999.