Edmundston Energy

Energy and Greenhouse Gas Emission Reduction Quantification Plan

Prepared by CSA Climate Change Services in Conjunction with Edmundston Energy and the Department of Energy

1 General

1.1 Background

The New Brunswick Climate Change Action Plan 2007-2012 provides a greenhouse gas (GHG) emissions reduction target of 2.2 million tonnes (Mt) CO_2e from energy efficiency and renewable energy related activities (equalling 40% of the province's emission reduction targets). The NB Climate Change Action Plan 2007-2012 also states that the Climate Chang Secretariat aims to track and report on greenhouse gas emissions trends and progress regarding the implementation of all climate change initiatives in this action plan. Furthermore the provincial authorities have decided to quantify the emission reductions according to the ISO 14064 framework.

This document quantifies the impact of the *Edmunston Energy* project on GHG emission reductions. Since it is expected that the project involved will result in annual emission reductions below the threshold of 25,000 tonnes of CO_2e, this specific quantification follows a track 2 quantification process that is consistent with ISO 14064-2 principles. This is a simplified approach to estimating emissions that is meant to be transparent, with a level of rigour that is balanced by the availability of data and level of effort required.

1.2 The Importance of Reporting Emission Reductions

Efforts have been undertaken to report on the emission reductions accrued from this project so that the emission reduction assertion is viewed as credible. There are a number of reasons that underlie the need to adequately document and report efforts to reduce emissions.

- The basic premise of climate change policy is to take actions that lead to *real* reductions in GHG emissions to the atmosphere. In this respect, it is critical to understand what would have occurred in absence of the project, and to adequately describe what the project is and how it will reduce emissions relative to this "baseline". This in turn increases the rigour and transparency of an emission reduction assertion.
- It is important that there is accountability to how funds are invested and the environmental and economic benefits resulting from this investment. In this regards, it is important that estimates or measurements are provided of both the environmental and economic impacts of a project
- The emission reductions resulting from a project can ultimately be "retired" (i.e. used to reduce a company's or government's emissions), or sold in the carbon market. In terms of this latter option, how rigorous the emission reduction assertion is will help dictate the market price of the emission reduction – i.e. offsets created from a high quality project will be deemed more valuable than for a project seen of lower quality.

1.3 ISO Principles Followed in Emission Reduction Estimation

The following principles from the ISO-14064 standards were followed in the estimation of emission reductions resulting from the implementation of this project:

Transparency: We have tried to make the estimation of emission reductions as transparent as possible by explaining all data sources used and providing all equations used in the estimation

Accuracy and rigour: We have followed or adapted best practices in order to help ensure accuracy and rigour in the emission estimations

Conservativeness: In order to not overestimate emission reductions, we have been conservative in our assumptions

Completeness and consistency: We have tried to consider all controlled (owned), affected or related emissions. We have tried to remain consistent in emission reductions.

1.4 Best practice guidance

Other than the requirements identified in ISO 14064-2 the following documents were used as a best practice guidance documents:

- *The energy efficiency quantification protocol* developed for the Alberta carbon offset system

1.5 Program and intended user

This quantification is intended to be used to:

- Report to the Climate Change Secretariat on the greenhouse gas emissions reductions that have occurred due to this program as part of the Climate Change Action Plan 2007-2012 reporting requirements.
- Report back to the people of New Brunswick on the impact of the actions taken to reduce GHG emissions

This quantification does not take into account any other program requirements.

1.6 Project proponent

Name: Edmundston Energy
Address: 5, 31e avenue, Edmundston, NB
Contact Person: Michael Couturier
Phone Number: 506-737-6896
E-mail: Mike.Couturier@edmundston.ca

2 The Edmunston Energy Project

2.1 Current situation in New Brunswick

The single largest provide of electricity in New Brunswick is NB Power, a crowned owned company. There are also three local utilities in the province, of which Edmunston Energy is one. The generation plants owned and operated by NB Power are summarized in table 1, including details on plant name, type, capacity, and year brought into operation.

Table 1 Details on NB Power's Generation Assets

Plant	Type	Capacity (MW)	Since
Coleson Cove	Heavy fuel oil and petcoke	978	1976
Mactaquac	Hydro	672	1968
Point Lepreau	Nuclear	635	1983
Belledune	Coal	458	1993
Millbank	Combustion turbine	399	1991
Dalhousie	Heavy fuel oil	300	1969
Beechwood	Hydro	113	1957
Courtenay Bay	Heavy fuel oil	109	1961
Sainte-Rose	Combustion turbine	100	1991
Grand Falls	Hydro	66	1928
Grand Lake	Coal	57	1952
Grand Manan	Combustion turbine	28	1989
Tobique	Hydro	20	1953
Nepisiguit Falls	Hydro	11	1921
Sisson	Hydro	9	1965
Milltown	Hydro	4	1911

The largest generation unit in New Brunswick is the Coleson Cove Plant which has a capacity of nearly 980 MW. The plant recently underwent a refurbishment and burns a mix of heavy fuel oil and petroleum coke. Three of generation plants that have a capacity over 100 MW burn heavy fuel oil as their main source of fuel, while one burns coal.

2.2 Description of project

The Department of Environment is providing Edmundston Energy with $1,740,000 to build a second powerhouse on the Madawaska River in Edmundston.[1] The new powerhouse would have a single 3.8 MW hydro generating unit. In addition, Edmundston Energy plans to refurbish a 1917 vintage 1.4 MW plant to better utilize river flows in excess of the capacity of the new powerhouse. In its entirety, this is a $20 million project.

It is expected that the new generation unit will generate about 20.05 GWh (million kWh) of electricity, while the refurbishment of the existing unit could result in an additional 2.95 GWh of electricity generated. Thus, in its entirety, implementing the project will mean that Edmunston Energy would have to purchase approximately 23 GWh less electricity per year from NB Power.

1 Edmundston is one of three municipalities in New Brunswick (the two others including Perth-Andover and Saint John) with municipal utilities. Edmundston Energy is the only one of the three that generates electricity.

2.2.1 Project background

Edmundston Energy bought the Madawaska hydro plant from Fraser Papers Inc. in October 2005. The rationale was fourfold, including to increase the generating capacity of Edmundston Energy, generate more revenue, and to pursue a new strategic plan for the utility.

In January 2006, Hatch Energy completed an assessment examining the possibility of refurbishing and increasing the generating capacity of the plant.

The analysis was the second phase of a prior work conducted by Fraser Papers Inc in 2000 and involved reviewing three various alternatives: (1) refurbishing existing units, (2) replacing existing units, and (3) building a powerhouse with a single turbine.

In July 2006, a detailed analysis of the three alternatives was conducted. This report consisted of a detailed power and energy analysis, conceptual designs, and detailed construction costs. Upon recommendations from Hatch Energy, Edmundston council granted a mandate to further investigate the installation of a powerhouse on the east side of the Madawaska River.

Geotechnical investigations were conducted in December 2006, and Hatch Energy conducted an updated cost analysis in February 2008 for the construction of a 3.8-MW powerhouse. The project is targeted for completion by March 2011.

The total project cost is estimated to be $21 million, of which $1.74 million is in the form of a grant from the climate action fund. The project supports New Brunswick's goal of increasing small scale renewable energy generation, and it will provide significant stimulus to the local economy.

2.2.2 Edmundston Energy and NB Power

Edmundston Energy owns and operates 2 hydro generating stations and a hydro reservoir that, on average, generate about 18 GWh (million kilowatt hours) of electricity per year. In order to meet the energy requirements of the approximate 5,800 residents in Edmunston whom Edmunston Energy services, the utility also purchases an additional 175 GWh from NB Power annually.

The first hydro station owned and operated by Edmunston Energy is located at Second Falls on the Green River. The generation station has a capacity of 3MW (consisting of 3 units with a capacity of 1MW each) and is supported by an upstream watershed dam. The second hydro plant is located on the Madawaska River and has a capacity of 1.5MW (consisting of two 750KW units). For comparison, the new single unit that is going to be installed has a capacity of 3.8MW and is forecasted to produce 20 GWh annually. Thus, by building this new generation unit, Edmunston Energy will reduce the amount of electricity that it would have to purchase from NB Power by about 20 GWh per year.

It should be noted that the majority of emission reductions associated with the project will be those resulting from electricity generation. As discussed in later sections of this report, these sources of emissions are in fact related to the project, and not directly owned or controlled by the project proponent. This reflects the situation that in the case of projects that involve changing sources for electricity or projects that result in lowered requirements for electricity generation due to energy efficiency improvements, the emission reductions will ultimately happen upstream of the project. This creates a situation where emission reductions are double counted if both the project proponent and the electricity generator claim ownership of these emission reductions.

As an example, if both the project proponent who implements an energy efficiency project and the electricity generator claim the emission reductions associated with such a project, this would in effect be double counting the emission reduction. In terms of this specific project, NB Power could ultimately claim that they are reducing emissions since the project implemented would ultimately reduce their requirements for electricity generation by upwards of 20 GWh per year. Thus, if the project proponent or the province wishes to move forward with bringing the emission reductions accrued through the project to market, then there would have to be a written agreement, likely a clause to the power purchase agreement between Edmunston Energy and NB Power, stipulating the terms and conditions of this.

2.3 Project timeline

Project construction began on Jan 4th 2010 and completion is scheduled for 15 March 2011, after which point the project will be put into operation. A detailed project timeline will be included with next years report.

2.4 Description of technology

The technical attributes of the second powerhouse being built includes:

- 3.8-MW powerhouse
- Double regulation Kaplan turbine
- Configuration: Vertical
- Speed: 138.5rpm

The guaranteed total output of the generated unit, measured at generator terminals, with 8.2 m net head acting on turbine, and turbine passing a total flow of 55.0 m^3/s, and generator operating at a 90% lagging PF equals 4,248 kVA (Power Output X Generator Efficiency/Generator PF) or 3,823 kW (Power Output X Generator Efficiency).

2.5 GHG reductions strategy

The project will result in emission reductions since the hydroelectricity generated will offset electricity that otherwise would have been purchased from the grid. It has been estimated that the 3.5 MW hydroelectric generator will produce 20.05 GWh annually, with an average peak shaving capacity of 2.05 MW per month. Additionally, the refurbishment project will result in an additional 2.95 GWh of generation per year.

2.6 Co-benefits of project

Other than the reduction of GHG emissions, the co-benefits of this project can be summarized as follows[2]:

- Contribute to provincial auto sufficiency objectives
- Contribute to provincial objectives to reduce GHG's
- Contribute to municipal objectives to reduce GHG's
- Reduce air pollution in the province
- Opportunity to promote green economic development
- Tourism (hydro electric interpretation center)

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[2] Based on the results of the initial feasibility study completed for project

- Job creation during construction

It is estimated that during construction, a peak of 57 jobs will be created. The majority will be laborers and carpenters.

3 Selection and justification of the baseline scenario

A baseline scenario is used to establish what the quantified emissions are in terms of what will occur under “business as usual” (BAU) conditions. It is therefore important to establish what the baseline scenario is. The common practice is to identify multiple possibilities for the baseline scenario, and then to identify the one most likely to occur through the process of barrier analysis (see below).

The following scenarios were identified for the purposes of this project:

Scenario 1: Edmundston Energy purchases the forecasted 20 GWh’s from NB Power to supply their 5,800 customers.

Scenario 2: Edmundston Energy refurbishes its existing units

Scenario 3: Edmundston Energy replaces its existing units,

Scenario 4: Edmundston Energy builds a powerhouse with a single turbine (i.e. the project)

A barrier test is used to help identify barriers to any of these scenarios occurring. A barrier test is a common technique used to help justify a baseline scenario and to substantiate the claim that a project is in fact additional to the business as usual.

Figure 1 Barrier analysis of baseline scenarios

Possible baselines / Barriers	Scenario 1: Edmunston Energy purchases from NB Power	Scenario 2: Edmunston Energy refurbishes generation assets	Scenario 3: Edmunston Energy replaces generation assets	Scenario 4: Edmunston Energy builds new generation assets
Regulatory barriers	No barrier	No barrier	No barrier	No barrier
Common practice barriers	No barrier	Refurbishment of a generation unit is only common practice when this reaches its operational lifetime or this can be justified financial in terms of increased capacity.	Replacement of a generation unit is only common practice when this reaches its operational lifetime or this can be justified financial in terms of increased capacity.	Edmunston Energy would only build a new generation unit if it were economically viable
Financial barriers	No barrier	There are financial barriers since refurbishment would have to be justified by return on investment, available cash, or justification for debt	There are financial barriers since replacement would have to be justified by return on investment, available cash, or justification for	There are financial barriers since building new would have to be justified by return on investment, available cash, or justification for debt

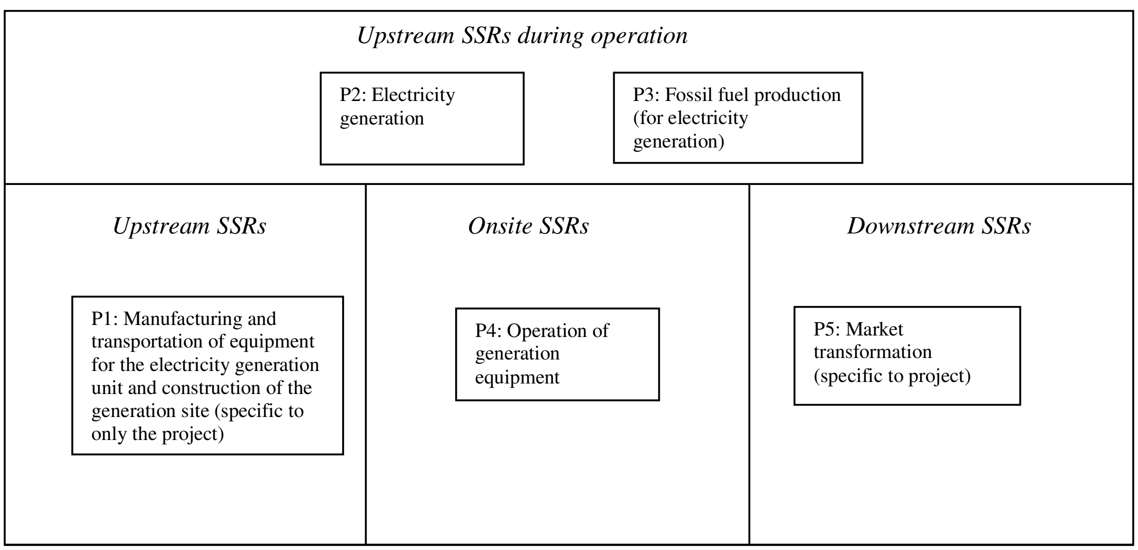
Possible baselines / Barriers	Scenario 1: Edmunston Energy purchases from NB Power	Scenario 2: Edmunston Energy refurbishes generation assets	Scenario 3: Edmunston Energy replaces generation assets	Scenario 4: Edmunston Energy builds new generation assets
		financing	debt financing	financing
Barriers due to the geographical location	No barrier	No barrier	No barrier	No barrier
Barriers due to public perception	No barrier	No barrier	No barrier	No barrier
Market barriers	No barrier	No barrier	No barrier	No barrier
Technological barriers	No barrier	No barrier	No barrier	No barrier

Based on this assessment, it is concluded that the baseline is most likely the scenario where Edmunston Energy purchases electricity from NB Power rather than refurbishing, replacing, or build new generation units. This assessment also helps to establish the additionality of the project, namely that without carbon funding this project would not have occurred.

4 Identification of SSRs attributable to the project and baseline

Sources, sinks, and reservoirs (SSRs) are defined in order to determine the full breathe of emissions attributable to the project being implemented.[3] The SSRs associated with both the project and the baseline was identified and are shown in figure 2.

Figure 2 Sources, Sinks, Reservoirs Associated with Project and Baseline



[3] A source means any process or activity that releases a greenhouse gas into the atmosphere, whereas a sink means any process, activity or mechanism that removes a greenhouse gas from the atmosphere and a reservoir means a physical unit or component of the biosphere, geosphere or hydrosphere with the capability to store or accumulate GHGs (from http://www.ec.gc.ca/creditscompensatoires-offsets/default.asp?lang=En&n=7CAD67C6-1&offset=12&toc=show).

[4] Emission reductions that are "owned" by the project proponent can be claimed for the purposes of emission reduction and be retired or sold. Emission reductions which are "related", alternatively, refer to those emissions that are affected by the project indirectly (e.g. emissions associated with manufacturing the equipment). Emission reductions that are "affected" generally refer to the wider impacts of fuller implementation of a policy

The SSRs attributable to the baseline and project are defined in table 2 in terms of what is controlled/owned, related, or affected.

Table 2 Defining Attributable SSRs

SSR	Owned, related or affected
P1: Manufacturing and transportation of equipment for the electricity generation unit and construction of the generation site (specific to only the project)	Related
P2: Electricity generation	Related
P3: Fossil fuel production (for electricity generation)	Related
P4 : Fuel production	Related
P5 : Operation of generation equipment	Owned
P6: Market transformation (specific to project)	Affected

Since this is a track 2 project, attention is only given to emissions that are "controlled/owned" by the project – namely, emission reductions directly attributable to the project.

5 Quantification of GHG emissions and/or removals

An estimation is provided of the baseline emissions, the project emissions, and the emission reductions accrued from the project.

5.1 Baseline emissions

Baseline emissions are estimated based on the expectation that Edmunston Energy would be purchasing 20.5 GWh annually from the grid if the project did not occur. Baseline emissions are estimated using the following equation:

$$Emissions_{Baseline} = Electricity * EF_{Grid} \quad (1)$$

$Emissions_{Baseline}$ = Baseline emissions, in kilograms of carbon dioxide equivalent (kg CO_2e)

$Electricity$ = Amount of electricity purchased from the grid annually, in KWh

EF_{Grid} = The emission factor of purchased electricity (grid average), in kg CO_2e / KWh

Since the amount of electricity to be purchased in future years is known (20.05 GWh annually), the next step is to determine the emission factor of the electricity purchased.

5.1.1 Determining the emission factor to use for the baseline

As identified in earlier parts of the project, the emission factor of electricity generated in New Brunswick in any given year is a function of the source mix of electricity generation (e.g. hydro, nuclear, and other primary sources relative to fossil fuels), the fossil fuel mix of fossil fuel generated electricity, the efficiency of generation, and factors such as the auxiliary use of power (i.e. electricity used by the generators themselves) and transmission and distribution losses. The emissions factor used for electricity is also representative of what is being measured in terms of whether this is base-load or peak-load electricity (i.e. electricity

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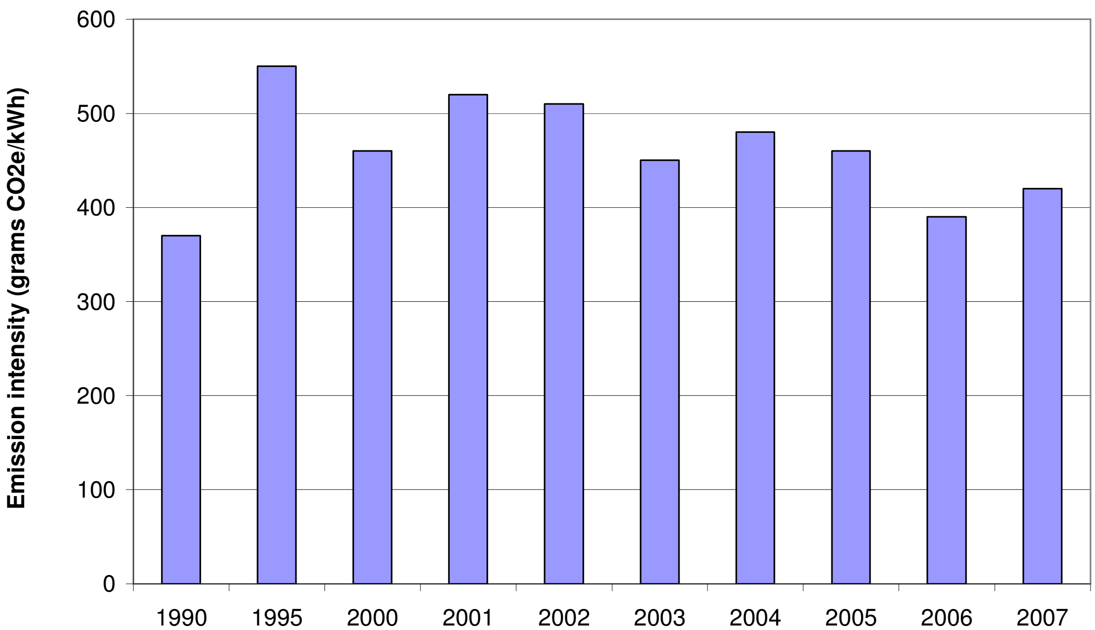
or a program (i.e. the emission reduction benefits accrued with fuller adoption of the renewable energy or technology) generation units used to meet the highest load on the load curve). Base-load in New Brunswick typically will be provided by the "always-run" large hydro generation stations and the Point Lepreau nuclear generation station (when it is in operation), while peak-load is the higher cost fossil fueled generators.

Since the electricity generated by the hydroelectric facility is expected to meet base-load requirements, the emission baseline is calculated using the grid-average emission factor.

Figure 3 shows the variation in the grid average emission intensity of the electricity generated in New Brunswick between 1990 and 2007 as computed from Environment Canada data.

Figure 3 Grid average emission factor of electricity generated in New Brunswick, 1990 to 2007



In 2007, the grid average emission factor in New Brunswick equaled 420 grams CO_2e/kWh, while the average annual variation between 1990 and 2007 was approximately 57 grams/kWh.[5]

The normal practice when determining the emission factor of electricity is to calculate a three-year average, rather than using only one year of data. This reduces the risk of having one year of abnormal data (i.e. the statistical outlier). These calculations are summarized in table 3:

[5] Although the 2007 Environment Canada National GHG Inventory does not provide data that can be used to estimate the emission factor for peak-load electricity in 2007 (in 2007 they changed which information is presented in the national inventory), generally in years past this about 800 grams CO_2e/kWh.

Table 3 Estimated three-year average grid emission factor for New Brunswick

	2005	2006	2007	Three-year average
Emissions (kt CO_2e)[a]	9,200	6,800	6,900	7,633
Electricity generated (GWh)[a]	20,300	17,500	16,300	18,900
Emission intensity (g CO_2e / kWh electricity generated)	453	389	423	422

a) from Environment Canada, 1990-2007 National Inventory Report.

5.1.2 Estimating baseline emissions

Baseline emissions are estimated as a product of electricity purchased and the emission intensity of this electricity, with the baseline emission factor used being the grid average for New Brunswick for the three-year period spanning from 2005 to 2007. In order to be conservative, we assume that in 2012, both the Grand Lake and Dalhousie Generation Stations are decommissioned near to the end of their operating lifetime and that this electricity is sourced from zero emission sources. This reduces the emission intensity of electricity by 30 percent. We show baseline emissions separately for the new generation unit and the refurbishment.

These calculations are summarized in table 4 for the entire eight-year expanse of the project.

Table 4 Estimates of baseline emissions, Edmunston Energy Project

	2011	2012	2013	2014	2015	2016	2017	2018	Total
Electricity purchased (million kWh) - only new generation unit	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	160.4
Electricity purchased (million kWh) - new generation unit + refurbishment	23	23	23	23	23	23	23	23	184
Emission intensity (g CO_2e / kWh electricity generated)	422	295	295	295	295	295	295	295	
Baseline emissions (tonnes CO_2e) - new generation unit + refurbishment	8,455	5,918	5,918	5,918	5,918	5,918	5,918	5,918	49,884
Baseline emissions (tonnes CO_2e) - new generation unit + refurbishment	9,699	6,789	6,789	6,789	6,789	6,789	6,789	6,789	57,224

5.2 Project emissions

Project emissions are estimated using equation 2.

$$Emissions_{Project} = Electricity \ * EF_{Project} \qquad (2)$$

$Emissions_{Project}$ = Baseline emissions, in kilograms of carbon dioxide equivalent (kg CO_2e)
$Electricity$ = Amount of electricity purchased from the grid annually, in KWh
$EF_{Project}$ = The emission factor of the project, in kg CO_2e / KWh

As explained earlier, the project activity is equal to the generation resulting from both the new generation unit and the refurbishment of the existing generation unit, or 23 GWh of electricity annually. This is the subsequent amount of electricity that is not needed in terms of the amount of electricity purchased from the electricity grid by Edmunston Energy (i.e. the baseline).

Seeing the electricity generated from this project will be done using a run-of-the-river generation unit, the emission intensity of this electricity equals 0. Thus, no emissions are attributable to the project.[6]

5.3 Quantification of GHG emission reductions and removal enhancements

Emission reductions are estimated using equation 3.

$$Emission\,\mathrm{Re}\,duction = Emissions_{Baselines} - Emissions_{\mathrm{Pr}\,ojectt} \quad (3)$$

Since project emissions are equal to zero, the emission reductions attributable to the project are directly equal to the emissions in the baseline. This is summarized in table 5:

Table 5 Summary of emission reductions attributable to Edmunston Energy Project

	2011	2012	2013	2014	2015	2016	2017	2018	Total
Emission reductions (tonnes CO_2e) - new generation unit + refurbishment	8,455	5,918	5,918	5,918	5,918	5,918	5,918	5,918	49,884
Emission reductions (tonnes CO_2e) - new generation unit + refurbishment	9,699	6,789	6,789	6,789	6,789	6,789	6,789	6,789	57,224

5.4 Data and method to improve accuracy and rigour of emission estimates

In future years, Edmunston Energy will have to report exactly how much electricity is generated from the new generation unit installed as part of this project, as well as establishing how much electricity was generated as attributable to the refurbishment of the existing generation unit. The project proponent will then have to update the grid average electricity intensity factor in order to establish the emission reductions attributable to the project.

6 Verification Statement

For track 2 projects, verification of emission reductions is not required since emission reductions are below a threshold which makes the verification of emission reductions economically viable.

[6] Alternatively, hydroelectric generation which relies on a man-made reservoir will result in methane emissions, a powerful GHG, from the decomposition of biologic matter resulting from inundation of a land area behind a dam.