

# The Bullfrog Power 2010 Emissions Calculation Methodology

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## Introduction

### What is Bullfrog Power?

Bullfrog Power is Canada's 100% green electricity provider. Bullfrog Power offers a 100% clean, renewable electricity choice to everyone in British Columbia, Alberta, Ontario and the Maritimes. All of Bullfrog Power's electricity comes from renewable facilities certified as low-impact under Environment Canada's EcoLogo<sup>M</sup> certification program, and do not emit any CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>x</sub> or produce nuclear waste in their generation of electricity.

Bullfrog Power's renewable generators injects as much renewable electricity into the local or regional electricity grid as its customers use. Bullfrog purchases all the environmental attributes associated with each megawatt hour (MWh) of renewable electricity that is injected, and retires those environmental attributes on behalf of its customers.

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<sup>1</sup> Environmental Attributes represent the general environmental benefits resulting from the generation of renewable low-impact electricity including, among other things, the displacement of non-renewable fuels, the reduction of air emissions, and the reduction of impacts on aquatic, riparian and terrestrial ecosystems. These benefits are transacted in the form of Green Electricity Certificates, sometimes referred to as Renewable Energy Certificates.

### Why has Bullfrog Power developed these calculators?

Conventional electricity production in Canada is among the largest industrial sources of CO<sub>2</sub>, a primary greenhouse gas and major contributor to climate change. Electricity production is also a major source of pollutants such as NO and SO<sub>2</sub> that contribute to poor air quality and are precursors of smog conditions. In jurisdictions that rely on nuclear power, electricity generation results in radioactive waste, a highly toxic, long-lasting material that must be safeguarded for thousands of years.

Many of Bullfrog Power's customers are curious to understand how their becoming bullfrogpowered affects their environmental footprint. Companies seeking to calculate their emission footprint (also known as their emissions inventory) should follow the Greenhouse Gas Protocol (Corporate Standard)<sup>2</sup>. Individuals can apply the same methodology in order to calculate their personal emissions inventory.

The GHG Protocol identifies three categories of emissions. Direct emissions from facilities that are owned or controlled by the company are known as Scope 1 emissions. Indirect emissions resulting from a company's use of electricity, which are generally emitted at the facilities of third party generators, are known as Scope 2 emissions. All other indirect emissions (e.g. airplane and rental car emissions) related to a company's operations are known as Scope 3 emissions.

The GHG Protocol identifies how companies should calculate their emissions in each Scope. For the purposes of calculating Scope 2 (electricity) emissions, the GHG Protocol adopts an emissions factor-based methodology. This methodology estimates "GHG emissions by multiplying a level of activity (e.g., kwh of electricity consumed by a facility) by an emission factor (e.g. grams of CO<sub>2</sub> per kwh).<sup>3</sup>" For the purposes of calculating Scope 2 emissions, renewable power generating facilities are treated as having a zero emissions factor.<sup>4</sup>

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<sup>2</sup> The Greenhouse Gas (GHG) Protocol Corporate Standard provides standards and guidance for companies and other organizations preparing a GHG emissions inventory, <http://www.ghgprotocol.org/standards/corporate-standard>

<sup>3</sup> "Indirect CO<sub>2</sub> emissions from the Consumption of Purchased Electricity, Heat, and/or Steam", p. 3(registration required to access calculation tools), [http://www.ghgprotocol.org/calculation-tools/downloads/downloads-registration?referred\\_from=/downloads/calcs/ElectricityHeatSteamPurchase\\_guidance1.2.pdf/](http://www.ghgprotocol.org/calculation-tools/downloads/downloads-registration?referred_from=/downloads/calcs/ElectricityHeatSteamPurchase_guidance1.2.pdf/)

<sup>4</sup> See "National Inventory Report 1990-2006" Annex 9, p505 Environment Canada [http://www.ec.gc.ca/pdb/ghg/inventory\\_report/2006\\_report/2006\\_report\\_e.pdf](http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/2006_report_e.pdf)

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Many individuals and companies, though, do not calculate their emissions inventory, and are simply looking for an estimation of the emissions reduction imputable to their purchase from Bullfrog Power. The Bullfrog Power calculators are designed for this purpose.

Bullfrog Power maintains regional calculators to estimate emission reductions that can be imputed to each MWh of renewable electricity and the associated environmental attributes that are retired on behalf of Bullfrog Power customers.

Bullfrog Power publishes the calculators on its website to help educate consumers about the emissions produced when generating conventional electricity in their region. Bullfrog also uses the calculator when preparing customers' electricity bills to estimate avoided emissions/waste that result from the generation of renewable electricity.

### Methodology goals

Design goals for the calculators include:

- 1. Trusted Sources:** Data used in the calculator must be publicly available from trusted sources.
- 2. Up to Date:** On an annual basis, Bullfrog Power will update the calculator to use the latest data.
- 3. Transparent and Repeatable:** The calculations and formulae must be transparent and repeatable by anyone who wishes to verify the calculation.
- 4. Reasonable Assumptions:** The assumptions used must be clear and reasonable.
- 5. Understandable:** The calculator should not be overly complex or difficult to understand.

### Emission reduction methodologies

There are several ways to estimate at the emissions reductions imputable to one MWh of clean, renewable power. This section explains several of the methodologies that are most commonly used in Canada, and then discusses in more detail the two calculation methodologies Bullfrog Power uses.

#### Footprint (average) Calculation

The footprint calculation is an estimate of the emissions produced by an average MWh of electricity consumed in the region. The assumption in this calculation methodology is that, if the consumer had not purchased a MWh of renewable electricity, they would have purchased a MWh of electricity with the average pollution intensity of the electricity consumed in the region.

The calculator determines the total electricity consumption in the region. We make the assumption that exports are a representative sample of the overall electricity mix and deduct the exported volume on a pro-rata basis for each generation type (e.g. coal, gas, hydro, etc.). We then include imports from other provinces and the US in order to determine the total amount of electricity consumed in the region by generation type.

The percentage contribution by generation type (e.g. coal, gas, hydro, etc.) is then multiplied by the emissions intensity for that generation type.

#### System (Operating Margin) Calculation

System reduction is an estimate of the emissions/waste produced by a MWh of the type of generation that is “on the margin” at any point in time. Electricity generation facilities are called upon by the market operator to provide electricity at any point in time based primarily upon their marginal cost to produce an additional unit of electricity. The grid operator selects the generator with the lowest marginal cost, and that type of generator (e.g. nuclear, gas, hydro) is referred to being “on the margin”. The assumption in this calculator is that, if a MWh of renewable electricity had not been generated for the consumer, the consumer’s electricity demand would have been met by whichever type of generation was on the margin at that time.

Currently, margin data is only publicly available for the Ontario electricity market. The calculator follows a similar methodology as the Footprint Calculation but uses the “Share of Real-time MCP Set by Resource (%)”, reported by the Ontario Energy Board, to estimate how often each generation type is “on the margin”. Then the percentage “on the margin” by generation type is multiplied by the emissions/waste intensity for that generation type.

### **Build Margin Calculation**

The Build Margin reduction is an estimate of the emissions/waste that would be produced by a MWh of generation from the type of generation that would be built if the renewable electricity facility serving the consumer did not exist. In many markets, the build margin is a natural-gas fired generation facility. The assumption in this calculator is that, if the renewable generation facility supported by the consumer did not exist, a new and more polluting type of generation facility would have to be built to meet that demand.

A calculation of the build margin would use the emission intensities of recent or planned capacity additions as the basis for the calculation.

### **Hybrid Intensity Calculation**

There are also hybrid approaches that combine several different calculations to determine emission reductions. Recently, as part of its intensity-based cap and trade system, the Alberta Government published the Electricity Displacement Factor in an Offset Credit Project Guidance Document<sup>5</sup>. The Document is used by large regulated emitters in Alberta (e.g. refineries) to calculate the emissions reductions associated with purchasing, among other things, wind in order to achieve the regulatory emissions targets. The Document combines the footprint (average), system (operating margin), and build margin calculations to arrive at a reduction of 0.65 tonnes of carbon for each MWh of wind purchased. Unfortunately, the majority of the data used in this analysis is not publicly available.

### **National vs Regional Calculation**

Some provinces and emitters also consider a National emission reduction estimate. This calculation is based upon an average of the provincial footprint (average) calculations.

This emissions factor may result in a misleading estimate of your emissions footprint depending on the regional in which you are located, because your regional emission intensity may be significantly higher or lower than the National average.

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<sup>5</sup> Source: <http://environment.gov.ab.ca/info/library/7915.pdf>

### Footprint Versus System

Bullfrog Power provides regional estimates based on two leading methodologies.

Bullfrog Power calculates and reports the “Footprint Reduction”. Since individuals and companies generally calculate their emissions footprint using the average emissions intensity of electricity grid in their region, the Footprint Reduction is generally also the appropriate estimate of emissions reductions for an individual or company.

In Ontario, Bullfrog Power also reports the “System Reduction”. System Reduction is an estimate of the emissions that *would have been produced* by the overall electricity system if the MWh of clean renewable power *had not been produced*. The System Reduction is calculated by estimating the emissions produced by a MWh of generation at the margin of the local electricity system (the last unit of power produced at any given time). Unfortunately, generation at the margin data is not publicly available in most regions and so we are only able to provide a System Reduction calculation for customers located in Ontario.

### What Public Information is Available?

Ideally there would be a single trusted public source of information which clearly and transparently reported intensity of emissions per MWh of electricity consumed in each region, taking into account both electricity imports and exports. Unfortunately, to our knowledge, this information is not available today. Instead we draw data as best we can from public sources available at the time, and transparently show the calculations on this data to arrive at our calculator. Periodically these sources are updated in subsequent reports by the issuing parties, however, we do not go back and recalculate prior years' estimated reductions using any the new data, The public sources used by the calculator include:

- 1. Statistics Canada.** Statistics Canada Manufacturing and Energy Division publishes an annual report indicating the total electricity generation by source and by Province including import and export data. We use the Statistics Canada data to determine the total electricity consumption in the Province.
- 2. National Energy Board (NEB).** NEB reports monthly statistics on Electricity Exports and Imports. We use the NEB report to determine the sources of US imports into the Maritimes by State.
- 3. Provincial Utilities and Power Generators.**
  - a. **BC Hydro.** BC Hydro publishes on an annual basis the CO<sub>2</sub>e emission intensity from its fossil fuel electricity generation facilities<sup>6</sup>.
  - b. **Ontario Power Generation (OPG).** OPG's Sustainable Development Report reports the CO<sub>2</sub>, SO<sub>2</sub>, NO emissions from the Province's coal and gas plants. It also reports the radioactive waste produced by nuclear plants that OPG operates. We use the OPG report to calculate emission/waste intensity for coal and nuclear generation.
  - c. **NB Power** NB POWER publishes on an annual basis the CO<sub>2</sub>e, SO<sub>2</sub>, NO emission and Low and Intermediate Level Radioactive Waste intensity from its fossil fuel electricity generation facilities.
  - d. **Hydro Quebec.** Hydro Quebec publishes on an annual basis the CO<sub>2</sub>e, SO<sub>2</sub>, NO<sub>x</sub> emission intensity from its fossil fuel electricity generation facilities.

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<sup>6</sup> The 2009 historical GHG intensities do not match previously reported values, intensities have been recalculated due to changes in inventory scope, improvements in data collection and/or updates to emission factors. This year, recalculations reflect:

- updated CO<sub>2</sub> emission factors for stationary natural gas and diesel combustion in accordance with the National Inventory Report: 1990-2007, Greenhouse Gas Sources and Sinks in Canada (Environment Canada, 2009); and
- improved reporting of historical net generation for some generating facilities.

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- 4. Ontario Energy Board (OEB).** The OEB's twice-yearly Market Surveillance Report aggregates how much of Ontario's electricity is produced by each production type (coal, nuclear etc.) and how often each resource type of production is "on the margin".
- 5. Alberta Environment.** Alberta Environment periodically publishes reports on the levels of emissions produced in the Province and also breakdowns by facility type, including those from power plants or electricity generation.
- 6. Alberta Energy and Utilities Board (EUB).** EUB reports how much electricity is generated in the Province on an annual basis up to and including 2005. Subsequently, they have not published annual generation information.
- 7. United States Environmental Protection Agency (EPA).** We are unable to find specific NO and SO<sub>2</sub> emissions intensity data for certain fossil fuel generators, so the calculators rely on the EPA's estimate of average emissions intensity for Natural Gas and Oil generation.
- 8. EPA Emissions & Generation Resource Integrated Database (EGRID).** The EPA also publishes a comprehensive inventory of environmental attributes of all the US electric power systems by State. We use this data to determine the emissions intensity of the electricity being imported from the US.

### Why are the Calculations Only Estimates?

While electricity consumption and production is metered very accurately, many assumptions are necessary in order to develop the calculator. Assumptions include:

- Generalization about the timing of renewable power generation;
- Assumptions about how the grid operates or is managed, including which fuels are displaced when renewable electricity is generated;
- Assumptions about changes from year to year. The current year calculator is derived from historical data, some of which may be many months or even years old;
- Assumptions about how emissions intensity varies by resource type. For example, the emission intensity for the electricity produced by Industry owned facilities in the Maritimes is assumed to be identical to the utility owned facility emission intensities.

Ultimately, the exercise of calculating avoided emissions reductions is an exercise in quantifying something (pollution) that did not happen. As with any effort to quantify something that did not happen, the pollution that was avoided cannot be physically measured because it did not happen, and can only be estimated based upon educated assumptions about what would have happened if the renewable electricity had not been generated or consumed. As a result, the emissions reductions attributable to one MWh of clean renewable power should be treated as estimates.

### Overview of the Microsoft Excel Spreadsheets

The *Bullfrog 2010 Regional Emissions Calculator* files may be downloaded from the Bullfrog Power website.

The spreadsheets have four tabs across the bottom.

The “Summary” tab shows the calculated emissions intensity for the current and prior years and highlights the calculators’ conversion from MWh to quantity of pollutants avoided.

The “Electricity Generation” tab shows the total electricity consumption in the region, taking into account electricity exports and imports, and provides a detailed breakdown of US electricity imports by State.

The “Emission by Generation Type” tab shows how the emissions are calculated for each MWh of generation for each of the generation types (e.g. nuclear, coal, gas, hydro).

The “Footprint Calculator” and “System Calculator” (where available) tabs build on the emissions by generation type to develop the Footprint and System emission reduction estimates.

### Emissions Intensity by Generation Type – British Columbia:

#### B.C. Thermal Generation

BC Hydro reports CO<sub>2</sub>e emission intensity for all of its fossil fuel generating facilities. However, we were unable to find data on the NO and SO<sub>2</sub> emission intensities in the Province. Therefore, the calculator uses the EPA's estimate of emissions from gas-fired electricity production, which is reported here: <http://www.epa.gov/cleanenergy/energy-and-you/affect/natural-gas.html> and oil-fired electricity production, which is reported here: <http://www.epa.gov/cleanenergy/energy-and-you/affect/oil.html>

#### Inter-Provincial Intensity

Bullfrog Power has created a similar emissions calculator and methodology document for Alberta electricity production. We assume that the majority of inter-provincial electricity imports into BC are coming from Alberta and as a result we can use the emission intensities determined in our Bullfrog Power 2010 Alberta Emissions Calculator which can be found at: <http://www.bullfrogpower.com/business/integrity.cfm>

#### US Import Intensity

The EPA Emissions & Generation Resource Integrated Database (eGRID) reports provide emission data on a state-by-state basis. Bullfrog was unable to source any information regarding the emissions intensity of the actual electricity imported into British Columbia, and we therefore used the average emissions intensities in each state exporting into British Columbia.

### Emissions Intensity by Resource Type – Alberta:

#### Alberta Thermal Generation

Alberta Environment reports CO<sub>2</sub>e emission intensity for all of the provinces utilities generating facilities. However, we were unable to find data on the NO and SO<sub>2</sub> emission intensities in the Province. Therefore, the calculator uses the EPA's estimate of emissions from gas-fired electricity production, which is reported here: <http://www.epa.gov/cleanenergy/energy-and-you/affect/natural-gas.html> and oil electricity production, which is reported here: <http://www.epa.gov/cleanenergy/energy-and-you/affect/oil.html>

#### Inter-Provincial Intensity

Bullfrog Power has created a similar emissions calculator and methodology document for British Columbia electricity production. We assume that the majority of inter-provincial electricity imports into Alberta are coming from British Columbia. This results in a conservative estimate of the pollution avoided from green electricity, because imports from Saskatchewan would have a higher emissions intensity that imports from Alberta. As a result we can use the emission intensities determined in our Bullfrog Power 2010 British Columbia Emissions Calculator which can be found at: <http://www.bullfrogpower.com/business/integrity.cfm>

#### US Import Intensity

The EPA Emissions & Generation Resource Integrated Database (eGRID) reports provide emission data on a state-by-state basis. Bullfrog was unable to source any information regarding the emissions intensity of the actual electricity imported into Alberta, and we therefore used the average emissions intensities in each state exporting into Alberta.

### Emissions Intensity by Resource Type – Ontario:

#### Why Only Four Resource Types?

The OEB reports break out Ontario generation into four categories: “Coal”, “Nuclear”, “Oil/Gas” and “Water”. As a result, our calculator uses these same categories.

#### Coal Intensity

OPG operates all the province’s coal generation, and OPG reports CO<sub>2</sub>, NO and SO<sub>2</sub> annually in its sustainability report. The calculator takes the OPG data and averages it to develop the emissions per MWh for coal-generated electricity.

#### Oil/Gas Intensity

There are many generators using Oil/Gas in Ontario. Since we are unable to find data on the Ontario emissions from this sector, the calculator uses the EPA’s estimate of emissions from gas-fired electricity production, which is reported here: <http://www.epa.gov/cleanenergy/natgas.htm>. This will result in a conservative estimate of emissions avoided as a result of renewable power because, the EPA gas-fired figure will underestimate the emissions from oil-fired generation which is typically more polluting than gas-fired generation.

#### Nuclear Intensity

The OPG sustainability report provides data on High-Level and Low and Intermediate Level Radioactive Waste produced by OPG’s Pickering and Darlington generating stations. The calculator uses the OPG data to develop the waste intensity for nuclear power. We assume that the intensity for the nuclear generating stations operated by Bruce Power is materially the same.

#### Inter-Provincial Intensity

Quebec Hydro reports CO<sub>2</sub>e, NO, SO<sub>2</sub> emission and Low and Intermediate Level Radioactive Waste intensity for all of its fossil fuel and nuclear generating facilities.

#### US Import Intensity

The EPA Emissions & Generation Resource Integrated Database (eGRID) reports provide emission data on a state-by-state basis. Bullfrog was unable to source any information regarding the emissions intensity of the actual electricity imported into Ontario, and we therefore used the average emissions intensities in each state exporting into Ontario.

### Emissions Intensity by Resource Type – Maritimes:

#### PEI Thermal Generation

Stats Canada reports the fuel source of PEI's thermal generation plants, which is almost entirely wood. As a result we assume thermal generation intensity in PEI is nil.

#### New Brunswick Thermal and Nuclear Generation

NB Power reports CO<sub>2</sub>e, NO, SO<sub>2</sub> emission and Low and Intermediate Level Radioactive Waste intensity for all of its fossil fuel and nuclear generating facilities.

#### Inter-Provincial Intensity

Quebec Hydro reports CO<sub>2</sub>e, NO, SO<sub>2</sub> emission and Low and Intermediate Level Radioactive Waste intensity for all of its fossil fuel and nuclear generating facilities.

#### US Import Intensity

The EPA Emissions & Generation Resource Integrated Database (eGRID) reports provide emission data on a state-by-state basis. Bullfrog was unable to source any information regarding the emissions intensity of the imports into the Maritime provinces, and we therefore used the average emissions intensities in each state exporting into the Maritime Provinces.

### Conclusion and Further Information

Bullfrog Power is interested in your feedback on the methodology and the calculator. Please email your comments to [info@bullfrogpower.com](mailto:info@bullfrogpower.com).