

THE BULLFROG POWER 2009 ONTARIO EMISSIONS CALCULATION METHODOLOGY

PUBLISHED JANUARY 2009

CONTENTS

| | |
|--|---|
| Introduction..... | 3 |
| What is Bullfrog Power? | 3 |
| Why Has Bullfrog Power developed this calculator?..... | 3 |
| Methodology Goals | 3 |
| Footprint versus System..... | 4 |
| What public information is available? | 4 |
| Why are The calculations only estimates? | 5 |
| Overview of the Microsoft Excel Spreadsheet | 5 |
| Emissions and Waste Intensity by Resource Type:..... | 6 |
| Why Only Four Resource Types? | 6 |
| Coal Intensity..... | 6 |
| Oil/Gas Intensity..... | 6 |
| Nuclear Intensity | 6 |
| Footprint Calculation | 7 |
| System Calculation | 8 |
| Conclusion and Further Information | 9 |

INTRODUCTION

WHAT IS BULLFROG POWER?

Bullfrog Power supplies Ontario-based customers with clean power from Ontario-based renewable energy producers. All of Bullfrog Power's producers are EcoLogo certified by the federal government, and do not emit any CO₂, NO, SO₂ or produce nuclear waste in their generation of electricity.

Bullfrog Power purchases all the environmental attributes¹ for each MWh it purchases from its suppliers. Bullfrog Power retires the environmental attributes, on behalf of its customers, of each MWh it sells. Bullfrog Power is audited on an annual basis to ensure that it purchases and retires at least as much as it sells. The audits are available to the public on Bullfrog Power's website.

WHY HAS BULLFROG POWER DEVELOPED THIS CALCULATOR?

The negative environmental consequences of conventional electricity generation are well known: CO₂ is a greenhouse gas and the major contributor to global warming; NO and SO₂ are major precursors of smog; and radioactive waste is 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 purchase of green electricity affects their environmental footprint. Bullfrog Power maintains this calculator to illustrate emission/waste reductions that can be imputed to the environmental attributes being retired (per MWh) on behalf of Bullfrog Power customers.

Bullfrog Power publishes the calculator on its website to help educate about the emissions and radioactive waste produced when generating electricity in the province. Bullfrog also uses the calculator when preparing customers' electricity bills to illustrate avoided emissions/waste.

METHODOLOGY GOALS

Design goals for this calculator include:

1. **TRUSTED SOURCES:** Data used in the calculator must be publicly available from trusted sources.

¹ 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, the reduction of solid and nuclear wastes, and the reduction of impacts on aquatic, riparian and terrestrial ecosystems.

2. **UP TO DATE:** At the beginning of each calendar year, 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.

FOOTPRINT VERSUS SYSTEM

There are several ways to look at the emissions reductions imputable to the retiring of a MWh of environmental attributes from clean, renewable power. Historically, Bullfrog Power has reported what we call the “System Reduction”. System reduction is an estimate of the emissions/waste that *would have been produced* by the overall electricity system, if the MWh of clean renewable power *had not been produced*. We calculate the System Reduction by estimating the emissions/waste produced by a MWh of generation at the margin of the Ontario electricity system.

Beginning in 2008, Bullfrog Power is also calculating and reporting what we call the “Footprint Reduction”. Footprint reduction is an estimate of the emission/waste produced by an average MWh of production in Ontario.

WHAT PUBLIC INFORMATION IS AVAILABLE?

Ideally there would be a trusted public source of information which clearly and transparently reported both average and margin intensity of emission/waste per MWh of production in Ontario. Unfortunately, to our knowledge, this information is not available directly today. Instead we draw data as best we can from public sources, and transparently show the calculations on this data to arrive at our calculator. The public sources used by the calculator include:

1. **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”.
2. **ONTARIO POWER GENERATION (OPG).** OPG’s Sustainable Development Report reports the air emissions from the Province’s coal 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.
3. **United States Environmental Protection Agency (EPA).** We are unable to find specific emissions intensity data for Ontario generators in the “Oil/Gas” category, so the calculator relies on the EPA’s estimate of emissions intensity for gas-fired generation.

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. As a result, the emission/waste reductions attributable to retiring Environmental Attributes from a MWh of clean renewable power should be treated as estimates. Inaccuracies with the calculator include:

- Generalization about the timing of renewable power generation. We don't know exactly what the system mix is composed of, or exactly what form of generation was on the margin at the same moment the renewable power was generated.
- Assumptions about how the grid operates or is managed. We don't know exactly how the rest of the grid reacts to the production of renewable power.
- Assumptions about changes from year to year. The current year calculator is derived from historical data, some of which may be many months old.
- Assumptions about how emissions/waste intensity varies by resource type. For example, the waste intensity for the Bruce Nuclear operation is assumed to be identical to the OPG-operated nuclear generation. And because emissions for much of the oil/gas generation is not available, we conservatively assume all oil/gas generation is as clean as a combined-cycle natural gas plant.

OVERVIEW OF THE MICROSOFT EXCEL SPREADSHEET

The *Bullfrog Ontario Emissions Calculator 2009.xls* file may be downloaded from the Bullfrog Power website.

The spreadsheet has four tabs across the bottom.

The "Summary" tab shows the calculated emission/waste intensity for the current and previous years.

The "Emission,Waste By Resource Type" tab shows how the emissions/waste is calculated for each MWh of generation for each of the four resource types.

The "Footprint Calculator", and "System Calculator" tabs build on the emissions/waste by resource type to develop the Footprint and System emission reduction estimates.

EMISSIONS AND WASTE INTENSITY BY RESOURCE TYPE:

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 CO₂, NO and SO₂ annually in its sustainability report. The calculator takes the OPG data and simply averages it to develop the emissions per MWh or 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>.

NUCLEAR INTENSITY

The OPG sustainability report provides data on high-level and intermediate/low-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.

FOOTPRINT CALCULATION

The footprint calculation is simply an estimate of the emission/waste produced by an average MWh of production in Ontario.

The calculator sums the total number of TWh of generation by each of the four resource types, for the most recent full year (as reported by the OEB), and then determines the percentage contribution of each resource type.

Then the percentage contribution by resource type is multiplied by the emissions/waste intensity for that resource type developed in the previous step.

SYSTEM CALCULATION

System reduction is an estimate of the emissions/waste produced by a MWh of generation at the margin of the Ontario electricity system.

The calculator averages the “Share of Real-time MCP Set by Resource (%)”, reported by the OEB, to estimate how often each resource type is “on the margin”.

Then the percentage “on the margin” by resource type is multiplied by the emissions/waste intensity for that resource type developed in the previous step.

CONCLUSION AND FURTHER INFORMATION

The Summary tab of the spreadsheet summarizes the System and Footprint calculations for the current and previous years.

Bullfrog Power is interested in your feedback on the methodology and the calculator. Please email your comments to info@bullfrogpower.com