

**Greenhouse Gas Emission Reduction Trading Pilot
Project Documentation
Green Power Sale by Enmax,
and Purchase by Her Majesty in Right of Canada (as represented by
Environment Canada and Natural Resources Canada),
with Assignment and Transfer of CO₂ Emission Reductions**

2.2 EXECUTIVE SUMMARY

- I) Vision Quest Windelectric Inc. (VQ) installed two 600-kW capacity Vestas wind turbines in Alberta, one at Belly River (near Hill Spring) and one at Castle River (near Pincher Creek), in the autumn of 1997. The turbines are connected to the Alberta Interconnected Electric System by separate interconnection facilities with separate metering. VQ began selling the electricity in November 1997 to the Power Pool of Alberta on a non-dispatchable basis at established prices. The electricity so generated displaces electricity which would otherwise have been generated by dispatchable sources, often including fossil-fuel generated electricity which emits greenhouse gases.

- II) Enmax entered into a contract on November 7, 1997 with VQ for the purchase of "Green Power". Green Power was defined in the contract as:
 - i) "... a form of non-fossil fuel source electricity generation having the following characteristics:
 - ii) originating from Renewable Energy Sources coming into production, or yielding incremental production, subsequent to June 1, 1997;
 - iii) originating from a facility maintaining EcoLogo™ "alternative source electricity generation" certification under the Environmental Choice Program of Environment Canada;
 - iv) which incrementally displaces, from time to time, fossil-fuel electricity generation on the Interconnected Electric System which would otherwise have supplied Alberta electricity purchasers, including Government Canada with electrical energy; and
 - v) which results in air pollution Emission Reduction Credits, through its displacement of fossil-fuel electricity generation for which ownership accrues to the Green Power purchaser."

- III) The Green Power delivery under the Enmax/VQ contract began at 12:01 AM November 8, 1997, and was contracted to continue for 10 years.

- IV) Also on November 7, 1997, Environment Canada entered into an agreement with Enmax for a purchase of Green Power (similarly defined

as above), commencing at 12:01 AM November 8, 1997 for a 10-year period. The Green Power was to originate from VQ's Belly River and Castle River facilities, be deemed to be delivered for the use of all Environment Canada facilities in Alberta, and include the ownership of air emission reductions, including greenhouse gases. Enmax and Environment Canada recognized in the contract that both electricity generators and consumers share responsibility for the emissions arising from the production of electricity used by the consumer. Through the Green Power purchase, Environment Canada is effectively replacing the electricity arranged under the auspices of the Power Pool of Alberta, which is on average associated with greenhouse gas emissions, with zero-emission wind power, on average over each calendar year during which the agreement remains in effect. The quantity of Green Power to be purchased and imputed as used by Environment Canada facilities in each calendar year was to be calculated under the agreement through estimation of the facilities' electricity consumption for the previous fiscal year. This is necessary since most Environment Canada facilities are not separately metered, and the precise electricity consumption is therefore unknown, but is approximately 2,000 MWh annually.

- V) On January 8, 1998, Natural Resources Canada entered into an agreement with Enmax for Green Power, defined somewhat similarly as above, for a period of 10 years commencing on January 8, 1998. Under the agreement, the ownership of the emission reductions is not assigned or transferred to Natural Resources Canada. However, Natural Resources Canada obtained interest in the emission reductions by obtaining entitlement under the agreement to any monetary proceeds which Enmax may accrue through any disposition of the emission reductions associated with the Natural Resources Canada Green Power purchase. Under the agreement, Natural Resources Canada obtains 1,400 MWh of Green Power annually.
- VI) Through this project documentation, Canada seeks award under the GERT Pilot of 427.107 tonnes of Registered Emission Reductions for its purchases of Green Power generated in 1997. Approval of the method of calculation for future years is also requested.

3.0 ELIGIBILITY REQUIREMENTS

3.1 LOCATION AND REPORTING OF EMISSION REDUCTIONS:

3.1.1 Describe the physical location of the project.

- I) Belly River wind turbine site of Vision Quest Windelectric Inc., near Hill Spring, Alberta. Located within LSD 2, SE1/4 Sec. 12, Twp. 3, Rge. 28, W4M. See attached topographic map (**Annex A**).
- II) Castle River wind turbine site of Vision Quest Windelectric Inc., near Pincher Creek, Alberta. Located within LSD 3, SW1/4 Sec. 35, Twp. 6, Rge. 1, W5M. See attached topographic map (**Annex B**).
- III) All facilities of Environment Canada and Natural Resources Canada in Alberta which receive power from Alberta's Interconnected Electric System. See the list in Annex 'A' of the attached Abridged copy of the Agreement Between Her Majesty the Queen in Right of Canada, as represented by the Minister of the Environment, and The City of Calgary (**Annex C**). (Please note that no abridged, public version of the similar agreement between Enmax and Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, is available.)
- IV) All Alberta-based fossil-fuel generating units which are directly connected to the Interconnected Electric System. The "Interconnected Electric System" means all transmission facilities and all electric distribution systems in Alberta that are interconnected. See the list of generating units attached (**Annex D**).

3.1.2 Provide the names of the participant(s) and a brief description of the nature of the organization(s) involved (private company, NGO, local government, etc).

- I) The vendor of the Green Power and associated emission reductions was initially The City of Calgary Electric System (CCES), a division of The City of Calgary. The City of Calgary is an incorporated municipality under the laws of the Province of Alberta. The contract for the sale of the Green Power was later assigned to Enmax Power Corporation, a subsidiary of Enmax Corporation, the City of Calgary's reorganized subsidiary municipal electrical utility, in early January 1998. Enmax and Enmax Power Corporation are municipal corporations incorporated under the laws of the Province of Alberta, and wholly owned by The City of Calgary. The vendor will be referred to as "**Enmax**" in this project documentation, meaning either Enmax Power Corporation, or collectively Enmax Power Corporation, Enmax Corporation, and The City of Calgary, depending on the context.
- II) The buyer of the Green Power and associated emission reductions (or rights to benefit from emission reductions) is Her Majesty the Queen in Right of Canada, as represented by the Ministers of the Environment and Natural Resources. The Ministers of the Environment and Natural Resources are responsible for Environment Canada and Natural Resources Canada, which are departments of the Government of

Canada. Separate contracts were established between Enmax Power Corporation and each department. The buyer will be referred to as “**Canada**”, or separately as necessary as “**EC**” and “**NRCan**”, in this project documentation.

III) Vision Quest Windelectric Inc. is a vital entity in this transaction as it is owner of the two wind turbines which generate the Green Power and cause the associated emission reductions. Vision Quest Windelectric Inc. is a private corporation incorporated under the laws of the Province of Alberta, and will be referred to as “**VQ**” in this project documentation.

3.1.3 In the case of Canadian buyers, document the buying organization’s commitment to report the emission reduction in Canada (i.e., to the VCR).

Canada reports annually to the Voluntary Challenge and Registry (VCR) in a combined report entitled “Emissions Reductions from Federal Operations” (ERFO). This transaction and any updates needed will be reported within the ERFO report.

3.1.4 Document the selling organization’s adjustment of its greenhouse gas emissions reports to reflect the transfer of ownership of the emission reductions.

Enmax and VQ are members of the VCR and report periodically. While descriptive and approximately quantitative greenhouse gas reductions, and transfers thereof, have already been reported for 1997, upon establishment of any Registered Emission Reductions by the GERT Pilot, the actual RER figures will be reported and adjusted appropriately by these organizations.

3.1.5 Document the evidence for Canadian participants of their VCR registration.

Attached are the letter to the VCR registering Enmax, and Canada’s 1997 ERFO report (**Annex E**).

3.2 START DATE OF EMISSION REDUCTIONS:

I) Green Power for EC, with associated emission reductions to be owned by Canada, commenced at 12:01 AM November 8, 1997 for a contracted 10-year period (see **Annex C**).

- II) Green Power for NRCan, with associated emission reductions to be held by Enmax with Canada obtaining a pecuniary interest in any disposition of these reductions by Enmax, commenced at 12:01 AM January 8, 1998 for a contracted 10-year period.

4.0 MANDATORY REVIEW CRITERIA-DOCUMENTING EMISSION REDUCTIONS

4.1 DOCUMENTING EMISSION REDUCTIONS

4.1.1. Document the estimated annual emissions with the project (the Emission Reductions case), by individual greenhouse gas over the project's life (1).

- I) Annual CO₂ emissions for Alberta utility-owned fossil-fuel generation directly connected to the Interconnected Electric System are projected for the purposes of this project documentation at a constant 41,284,921.870 tonnes.
- II) For 1997, total CO₂ emissions from Alberta utility-owned fossil-fuel generation directly connected to the Interconnected Electric System were 41,284,921.870 tonnes.

4.1.2. Document the estimated annual emissions without the project (the Reference Case), by individual GHG over the projections life (2).

- I) Annual estimated CO₂ emissions for Alberta utility-owned fossil-fuel generation directly connected to the Interconnected Electric System are projected for the purposes of this project documentation at a constant 41,285,379.124 tonnes, if the project had not been established.
- II) For 1997, total CO₂ emissions from Alberta utility-owned fossil-fuel generation directly connected to the Interconnected Electric System would have been 41,285,379.124 tonnes had the project not been in place, with respect to that portion of the project's Green Power purchased for EC's facilities.

4.1.3. Document the estimated annual emission reductions resulting from the project, by individual GHG, over the project's life (3 = 1 - 2).

- I) The annual CO₂ emission reduction associated with the project is expected to be 2,777 tonnes.

- II) For 1997, the total CO₂ emission reduction associated with the portion of the project's Green Power purchased for EC's facilities was 427.107 tonnes, which is the first claim for Registered Emission Reductions (RERs) under this project documentation.

4.2: MANDATORY REVIEW CRITERIA

4.2.1 REAL EMISSION REDUCTIONS

4.2.1-1 Document the precise nature of the emission reduction (e.g., energy efficiency improvement, fuel-switching measure, renewable energy technology, carbon sequestration).

- I) The emission reductions arise from the “imputed use” of zero-emission Green Power (renewable energy from the project’s two wind turbines) by Canada’s facilities in Alberta, as an alternative to grid-electricity which is generated in large part from Alberta-based utility-owned fossil-fuel generation directly connected to the Interconnected Electric System.
- II) The “imputed use” involves payment by Canada to Enmax according to the quantity of Green Power purchased over a calendar year, with a consequent arrangement between Enmax and VQ for the purchase and sale of Green Power arising from VQ’s two wind turbines at Belly and Castle Rivers. The VQ turbines began operation in November 1997 in anticipation of the arrangement, and were commissioned as a direct result of the announcement by Canada in April 1997 of the contract award to Enmax, and Enmax’s negotiations with VQ.
- III) Grid-electricity potentially used by federal facilities has an associated calculable average emissions factor. Since this electricity is imputed to be replaced by zero-emission electricity, the Green Power arising from Vision Quest Windelectric Inc.’s wind turbines, the federal facilities have completely eliminated the CO₂ emissions associated with their use of electricity.
- IV) The non-dispatchable wind power is incremental to the needs of all consumers on the Interconnected Electric System, and thus displaces an equal amount of generation which would otherwise have been dispatched, and would otherwise have emitted CO₂.

4.2.1.2 Document any potential sources of leakage, and associated impacts on annual emission reductions.

- I) Life-cycle CO₂ emissions associated with the manufacture, installation and operation of VQ’s wind turbines have occurred and continue to occur. These involve the use of:
 - fossil-fuel based electricity and coal for metal production;

- the use of fossil-fuel generated electricity and energy for space-heating in the facilities which were used to manufacture the wind turbines, their supporting structures, and various parts and supplies for maintenance;
- the use of fossil-fuels for transporting the turbines and parts to the site of installation;
- the use of fossil-fuels in the production of the concrete for the foundations for the towers;
- the use of fossil-fuels for the equipment (e.g. cranes, excavating equipment, vehicles to transport personnel to the site, etc.) used to install the turbines and perform environmental mitigation at the sites;
- ongoing use of fossil-fuels for vehicles to transport maintenance personnel to the sites; and
- ongoing use of fossil-fuel based electricity for offices administering the Green Power sales at VQ and Enmax.

In general, such emissions as those detailed above are small in comparison with the displaced emissions from fossil-fuel plants which would otherwise have been used to generate electricity had the turbines not been generating (See Beals *et al.* 1993).

II) Transmission line losses occur in any electricity transmission system. If the losses associated with the transmission and distribution of the Green Power for imputed use by a customer were greater than losses that would have been associated with supply otherwise used, then this would amount to leakage since the electricity production amounts from the Green Power sources would be being lost at a greater rate than the alternative supply. This would imply that the Green Power produced would not in fact displace an equivalent amount of grid-electricity, but something less than that.

4.2.1.3 Document proposed actions to mitigate any leakage, parties responsible for carrying them out, and a quantification of the mitigative effect.

I) VQ has eliminated the emissions associated with its use of electricity by imputed use of only zero-emission Green Power exclusively for its office facilities. VQ also performs maintenance on the wind turbines by remote control over a cellular telephone connection as much as possible, thus reducing emissions from transportation.

In general, such emissions attributable to VQ's business operations in support of their contract with Enmax are very small in comparison with the displaced emissions from fossil-fuel plants which would otherwise have been used to generate electricity had the turbines not been generating. Quantification of the mitigative effect is therefore unwarranted.

- II) VQ has sited the two wind turbines in locations which are on portions of the Interconnected Electric System which are well-removed from most alternative sources on the grid. Consequently, the total transmission and distribution line losses in the Interconnected Electric System have been (slightly) reduced by the addition of the two wind turbines. This has been recognized by the Alberta transmission authority through the payment or crediting of a preferential transmission rate for VQ's two wind turbines.

Quantification of the mitigative effect is unwarranted because it is small.

4.2.2 MEASURABLE EMISSION REDUCTIONS

Two Cases are detailed in the Reference Case and Emission Reduction Case sections:

Case A: An amount of electricity equal to the wind energy production and assumed to have the calendar-year average emissions factor for all utility-based generation on the Alberta Interconnected Grid, is replaced by the zero-emission wind energy, resulting in a total reduction in emissions due to the wind energy which is then apportioned to the Buyer in proportion to its Green Power purchase as a fraction of the wind energy production in that year.

Case B: An amount of electricity in each hour equal to the wind energy production during that hour and assumed to have the hourly average emissions factor for all utility-based generation on the Alberta Interconnected Grid, is replaced by the zero-emission wind energy produced for the Buyer in that hour. A summation of these emission reductions is then done over all the hours for which the Buyer was purchasing the Green Power (which in the case of 1997, was the eight week period November 8-December 31).

CALCULATING THE REFERENCE CASE

4.2.2.1 Document a minimum of one Reference Case and, unless agreed otherwise by the Technical Committee, no more than four Reference Cases in total, based on either of the methodologies defined above.

I) Reference Case A

Based on an average 1997 CO₂ emissions factor for electricity on the Interconnected Electric System of 0.816772439 tonnes/MWh, and total generation and imports of 50,546,984.35 MWh, total CO₂ emissions of **41,285,379.124 tonnes** would have been produced in the absence of the Green Power purchased for EC's facilities.

II) Reference Case B

Based on November 8-December 31, 1997, hourly-average CO₂ emission factors, hourly estimates of emissions which would have occurred had the combined electricity production of the Belly River and Castle River East wind turbines during that hour been replaced by generation with the concurrent hourly-average emission factors, were made, and summed over that eight-week period. These CO₂ emissions total **6,636,178.684 tonnes**.

4.2.2.2 Document a description of the methodologies used for each Reference Case, and underlying models, data, and key assumptions.

I) Reference Case A

The 1997 emissions from electricity units connected to the Interconnected Electric System were calculated as follows:

$$E_{\text{Ref A CO}_2(1997)} = \sum_{\text{all units } i} F_{i(1997)} \sum_{j=1}^{8,760} G_{i,j}$$

where:

$E_{\text{Ref A CO}_2}$ = Reference Case A CO₂ emissions during 1997, in tonnes

$F_{i(1997)}$ = the CO₂ emission factor for the i^{th} generating unit, applicable to that year, as per Annex D, except for the VQ Belly River and Castle River East wind turbines electricity production, which is assumed to be replaced in this reference case A by

production having average emissions for the other units for 1997 (not including the VQ wind turbine production itself):

$$F_{i(\text{VQ } 1997)} = \frac{\sum_{\text{all } i \text{ units except VQ}} F_{i(1997)} \sum_{j=1}^{8,760} G_{i,j}}{\sum_{\text{all } i \text{ units except VQ}} \sum_{j=1}^{8,760} G_{i,j}}$$

$$F_{i(\text{VQ } 1997)} = 0.816772439 \text{ tonnes of CO}_2 / \text{MWh}$$

$G_{i,j}$ = the electricity generated by generating unit “i” during the j^{th} hour of the year, as recorded

8,760 = the number of hours in 1997.

j^{th} hour = a particular hour of 1997

i^{th} generating unit = a member of the list of units in Annex D

II) Reference Case B

The November 8 to December 31, 1997, emissions from generating units directly connected to the Interconnected Electric System were calculated as:

$$E_{\text{Ref B CO}_2(\text{Nov/Dec, 1997})} = \sum_{\text{all } i \text{ units}} \sum_{k=1}^{1,296} F_{i(1997),k} G_{i,k}$$

where the symbols are defined as above except that:

1,296 = the number of hours in the period November 8 to December 31, 1997

k^{th} hour = a particular hour during the period November 8 to December 31, 1997; and

$F_{i(1997),k}$ = the CO₂ emission factor for the i^{th} generating unit for the k^{th} hour in 1997, which is assumed identical to $F_{i(1997)}$, the emission factor for the i^{th} generating unit applicable to the whole of 1997 as per Annex D; *except* for the VQ Belly River and Castle River East wind turbine production, which in this Reference Case B are assumed to have been replaced by units having the k^{th} hour’s average emissions (not including the VQ wind turbine production):

$$F_{i(\text{VQ ND1997}),k} = \frac{\sum_{\text{all } i \text{ units except VQ}} F_{i(1997)} G_{i,k}}{\sum_{\text{all } i \text{ units except VQ}} G_{i,k}}$$

4.2.2.3 Document a discussion of the key sources of risk and uncertainty for each Reference Case and, where feasible, a quantification of the uncertainty (e.g., probability estimates on the different cases).

The following paragraphs apply to both Reference Cases.

I) Imports and exports to Alberta's Interconnected Electric System

Imports of electricity to the Interconnected Electric System are assigned zero emission factors because representative values of emission factors for imports are impossible to compute. The precise source of the imported electricity is generally unknown, as this is determined within the electric system of the adjoining jurisdiction. Even grid-average average emission factors for these imports are difficult to estimate. Consequently, an assumption of a zero-emission factor for imports results in a conservatively-low reference case.

Exports from Alberta are assumed to not "carry" the emissions associated with the generating unit used to supply the export, since the precise unit used is not known publicly. Instead, exports are included in the emission calculation as if the emissions remained associated entirely with the generated electricity consumed in Alberta.

An extensive discussion of imports and exports, and implications and practical means of quantifying emissions, is presented in Emission Quantification Working Group (1999.)

II) B.C. based generation in Alberta's Interconnected Electric System

A generating unit located in British Columbia at Fort Nelson is treated as an import and assigned a zero-emission factor even though it is a fossil-fuel plant and is operated as part of the Interconnected Electric System. This will lower the quantity of emissions in the reference cases slightly.

III) Dispatch uncertainty in Alberta's Interconnected Electric System

The reliable operation of the Interconnected Electric System requires that units be dispatched for a variety of reasons on a moment-by-moment basis. This is usually done by "merit order", a ranking based on least-cost bids for blocks of electricity, as tendered from suppliers or importers. It may also be to dispatch "spinning-reserve" to account for sudden demand fluctuations in the System, or sudden failures of dispatched generation.

It could be argued that the last unit partially dispatched at a given moment (or the next unit on the merit order if the last unit could have been fully dispatched), is the marginal unit of operation on the System, and is in fact the unit "displaced" by the VQ wind turbines. To calculate the emissions from these marginal units is a very difficult task and requires confidential information only in the possession of the Power Pool of Alberta. The magnitude of the difference this would make for the reference cases is unknown, but assumed to be small on the average.

Please see Emission Quantification Working Group (1999) for a more comprehensive discussion of marginality on the Interconnected Electric System.

IV) Emission factors for generating units operated as part of the Alberta Interconnected Electric System

These factors are calculated as follows:

$$F_{i(1997)} = \frac{\text{heat rate for unit } i}{\text{higher heating value for fuel used in unit } i} \times \text{unit } i \text{ fuel carbon content}$$

The values of $F_{i(1997)}$ are presented in Annex D.

The higher heating value (HHV) refers to the heating value of fuel containing hydrogen, where the latent heat of vapourization of the water vapour produced as a result of the oxidization of the hydrogen is assumed to be recovered by the generating unit. The HHV is commonly used in North America.

The heat rates and HHVs for utility-owned generation were abstracted from several sources, including: General Rate Applications (1998), Independent Assessment Team (1999), and Shaw (1997). The most timely values that could best be attributed to 1997 were used.

The fuel carbon content was taken from Jaques *et al.* (1997).

A slight reduction of the emission factor for Edmonton Power's Clover Bar natural gas generating units was made due to the use of landfill gas by this plant. The adjustment accounts for the report by Epcor (1997) that 5.67 MW of electricity generation (1,632.96 MWh for all of 1997) arose from the use of the landfill gas instead of Alberta natural gas. This landfill gas originates from organic matter placed in a landfill which is presumably part of a zero-emission carbon cycle as the organic matter is regrown as food and fibre, taking up the carbon dioxide emitted by its decomposition and combustion in Clover Bar as methane.

V) Full Loading of Available Generation on the Interconnected Electric System

On occasion, the Interconnected Electric System may experience demand peaks and supply limitations such that all available generating units are operated to the maximum and brown-outs or load-shedding must never-the-less be implemented to assure the reliability of the entire System. In such a circumstance, no fossil-fuel generation is displaced by VQ wind turbines. No such events occurred in 1997.

VI) Non-CO₂ Greenhouse Gases

In addition to CO₂, CH₄ (methane) and N₂O (nitrous oxide) are known to be released by generating units in Alberta. These emissions have not been quantified at this time, and therefore this project documentation presents a conservatively-low estimate of the Reference Cases.

The applicants wish to reserve the right to quantitatively establish these emissions in future years' RER applications, should the ability to estimate these be developed.

VII) Upstream emissions of CH₄ (methane) and CO₂

The full fossil-fuel cycles for fuel used by generators contributing to the Interconnected Electric System include emissions of CH₄ and CO₂ “upstream” of the burner tip of the generating units. These notably include CO₂ and CH₄ releases from coal mining operations, and stray CH₄ releases from natural gas pipelines.

These emissions are substantial (see Beals *et al.*, 1993), but are neglected in the project documentation. This results in conservatively-low estimates for the Reference Cases.

CALCULATING THE EMISSION REDUCTION CASE

4.2.2.4 Document a description of the methodology used for the ER Case, and underlying models, data, and key assumptions.

I) Emission Reduction Case A

The 1997 emissions from electricity generation units connected to the Interconnected Electric System, including those from VQ’s turbines, were calculated as follows:

$$E_{\text{CO}_2(1997)} = \sum_{\text{all units } i} F_{i(1997)} \sum_{j=1}^{8,760} G_{i,j}$$

where:

E_{CO_2} = CO₂ emissions during the period referenced, in tonnes

$F_{i(1997)}$ = the CO₂ emission factor for the i^{th} generating unit, applicable to that year, as per Annex D, including for the VQ Belly River and Castle River East wind turbines, which are assigned in this ER Case zero-emission factors.:

G_{ij} = the electricity generated by generating unit “ i ” during the j^{th} hour of the year, as recorded

8,760 = the number of hours in 1997.

j^{th} hour = a particular hour of 1997

i^{th} generating unit = a member of the list of units in Annex D

II) Emissions Reduction Case B

The November 8 to December 31, 1997, emissions from generating units directly connected to the Interconnected Electric System were calculated as:

$$E_{\text{CO}_2(\text{Nov/Dec},1997)} = \sum_{\text{all units } i} F_{i(1997)} \sum_{k=1}^{1,296} G_{i,k}$$

where the symbols are defined as above except that:

1,296 = the number of hours in the period November 8 to December 31, 1997

k^{th} hour = a particular hour during the period November 8 to December 31, 1997

and

$F_{i(1997)}$ = the CO₂ emission factor for the i^{th} generating unit, applicable to that year, as per Annex D, including for the VQ Belly River and Castle River East wind turbines, which are assigned in this ER Case a zero-emission factor.

4.2.2.5 Document a discussion of the key sources of risk and uncertainty for the ER Case and, where feasible, a quantification of the uncertainty.

The key sources of risk and uncertainty for the ER Cases are similar to those of the Reference Cases. Please see section 4.2.2.3.

4.2.2.6 Document the expected life of the project and corresponding emission reductions, including a description of any significant factors which could alter the project life.

l) The agreements between Enmax, and EC and NRCan are for periods of 10 years commencing November 8, 1997 (expiring

November 7, 2006) and January 8, 1998 (expiring January 7, 2007), respectively, with provision for a five-year extension of either or both agreements. (See **Annex C.**)

- II) The wind turbines have projected lifetimes of 25-30 years if proper maintenance is performed.
- III) Disasters such as wind storms or other Acts of God which could destroy the wind turbines are possible, although extremely unlikely. In such an event, it is anticipated that insurance coverage would enable the owners to replace the turbines with equivalent or better facilities.
- IV) Violation of contract terms (e.g. non-payment for the Green Power by Canada; or failure by Enmax to maintain custodial ownership of the emission reductions as contracted) could end the Green Power Procurement pilot projects. (See **Annex C.**)
- V) Mechanical or electrical failures could result in reduced production in any year of the agreements, at a level lower than envisaged. Provision for an approval of substitution of Green Power sources is made in the agreements. (See **Annex C.**)

4.2.2.7 Document potential leakage factors and magnitude.

Leakage factors for the ER Cases are similar to those in the Reference Cases. Please see Sections 4.2.1.2 and 4.2.1.3.

4.2.2.8 Calculate the annual emission reduction from the project as the difference between the Reference Case(s) and the Emission Reduction Case for each year of the project's life.

In both ER Cases, the portion of the emission reductions attributable to the Green Power purchases by Canada, as opposed to the emission reductions arising from the entire VQ wind turbine production from Belly River and Castle River East, are a fraction of the total VQ electricity production purchased by Canada as Green Power. For example, in 1997 VQ's turbines produced 559.83 MWh; Canada purchased 522.921 MWh, and therefore $522.921/559.83 = 0.934071$ of the total emission reductions by VQ's turbines is the quantity of 1997 RERs for which application is being made in this project documentation in Case A. In Case B, the calculation of reductions is hour-specific to the hours and amounts that VQ's turbines produced during November 8-December 31, 1997, and would therefore be a somewhat different fraction of the total VQ turbine's reductions. This Case B fraction

has not been calculated since the hourly calculations have not been done for hours prior to November 8.

I) Emission Reductions Case A

The emission reduction for 1997 is:

$$\begin{aligned}
 & 0.934071 \times (E_{\text{Ref A CO}_2(1997)} - E_{\text{CO}_2(1997)}) \\
 & = 0.934071 \times (41,285,379.124 \text{ tonnes} - 41,284,921.870 \text{ tonnes}) \\
 & = 427.107 \text{ tonnes}
 \end{aligned}$$

Formulaically,

$$\begin{aligned}
 & 0.934071 \times (E_{\text{Ref A CO}_2(1997)} - E_{\text{CO}_2(1997)}) \\
 & = 0.934071 \times \left\{ \sum_{\substack{\text{all } i \text{ units} \\ \text{except VQ}}} F_{i(1997)} \sum_{j=1}^{8,760} G_{i,j} + F_{i(\text{VQ } 1997)} G_{i(\text{VQ } 1997)} - \sum_{\text{all } i \text{ units}} F_{i(1997)} \sum_{j=1}^{8,760} G_{i,j} \right\}
 \end{aligned}$$

which, since the two double summations are equal (because in the emission reduction case the VQ turbines have an $F_{i(1997)} = 0$), yields:

$$\begin{aligned}
 & = 0.934071 \times \{ F_{i(\text{VQ } 1997)} G_{i(\text{VQ } 1997)} \} \\
 & = 0.934071 \times \frac{\sum_{\substack{\text{all } i \text{ units except VQ}}} F_{i(1997)} \sum_{j=1}^{8,760} G_{i,j}}{8,760} G_{i(\text{VQ } 1997)} \\
 & = 0.934071 \times \frac{\sum_{\substack{\text{all } i \text{ units except VQ}}} F_{i(1997)} \sum_{j=1}^{8,760} G_{i,j}}{8,760} G_{i(\text{VQ } 1997)}
 \end{aligned}$$

$$\begin{aligned}
 & = 0.934071 \times 0.816772349 \text{ tonnes of CO}_2 / \text{MWh} \times 559.83 \text{ MWh} \\
 & = 427.107 \text{ tonnes of CO}_2 \text{ reduced}
 \end{aligned}$$

and 427.107 Registered Emission Reductions claimed in this Project Document.

The stream of emission reductions into the future are calculated using the same $F_{i(1997)}$ and an estimated annual Green Power purchase amount for both NRCan and EC.

YEAR	Green Power (MWh)		Interconnected Grid Annual Average Emission Factor (tonnes/MWh)	CO ₂ Reduction (tonnes)
	Natural Resources Canada	Environment Canada		
Registered Emission Reductions applied for in this project document:				
1997	0	522.921	0.816772349	427.107
Projected Emission Reductions under the Green Power Procurement agreements:				
1998	1,373.151	2,022.549	0.816772349	2,774
1999-2006	1,400.000 per annum (fixed as per agreement)	2,000.000 per annum (estimated)	0.816772349	22,216 (2,777 per annum)
2007	1,400.000	1,704.110	0.816772349	2,535
2008	26.849	0		22
1997-2008 Total:				27,974

II) Emission Reductions Case B

The emission reduction for November 8-December 31, 1997, is:

$$\begin{aligned}
 & E_{\text{Ref B CO}_2(\text{Nov/Dec, 1997})} - E_{\text{CO}_2(\text{Nov/Dec, 1997})} \\
 &= 6,636,178.684 \text{ tonnes} - 6,635,731.163 \text{ tonnes} \\
 &= 447.421 \text{ tonnes.}
 \end{aligned}$$

or, formulaically:

$$= \sum_{\substack{\text{all } i \text{ units} \\ \text{except VQ}}} \sum_{k=1}^{1,296} F_{i(1997),k} G_{i,k} + \sum_{k=1}^{1,296} F_{i(\text{VQ ND}1997),k} G_{i(\text{VQND}1997),k} - \sum_{\text{all } i \text{ units}} F_{i(1997)} \sum_{k=1}^{1,296} G_{i,k}$$

which, because the two double summations are identical (since for the VQ wind turbines the $F_{i(1997)} = 0$, and for the non-VQ production $F_{i(1997)} = F_{i(1997),k}$ for all i and k), yielding:

$$= \sum_{k=1}^{1,296} F_{i(\text{VQ ND}1997),k} G_{i(\text{VQ ND}1997),k}$$

$$= \sum_{k=1}^{1,296} \frac{\sum_{\substack{\text{all } i \text{ units except VQ} \\ F_{i(1997)}}} G_{i,k}}{\sum_{\substack{\text{all } i \text{ units except VQ} \\ G_{i,k}}} G_{i(1997),k}} G_{i(VQ \text{ ND}1997),k}$$

Which could be rewritten as:

$$= \text{weighted average hourly emission factor Nov. 8-Dec. 31, 1997} \times G_{i(VQ \text{ ND}1997)}$$

where the weighting is by the VQ wind turbine production on an hourly basis. A data base and spreadsheet were used to calculate these as:

$$= 0.855809959 \text{ tonnes/MWh} \times 522.921 \text{ MWh}$$

$$= 447.521 \text{ tonnes}$$

Precise projections into the future using the Case B calculation approach are not possible. Instead, for the period subsequent to 1997 the weighted average hourly emission factor from November 8-December 31, 1997, is used for illustrative purposes. It may be randomly or systematically inaccurate to a greater extent than the average presented in Case A.

YEAR	Green Power (MWh)		Interconnected Grid Annual Weighted Average Hourly Emission Factor (tonnes/MWh)	CO ₂ (tonnes)
	Natural Resources Canada	Environment Canada		
Registered Emission Reductions which, in the alternative to ER Case A), could be applied for in this Project Document:				
1997	0	522.921	0.855809959	447.521
Projected Emission Reductions under the Green Power Procurement contracts:				
1998	1,373.151	2,187.000	0.855809959	3,047
1999-2006	1,400.000 per annum (fixed as per agreement)	2,000.000 per annum (estimated)	0.855809959	23,278 (2,910 per annum)
2007	1,400.000	1,704.110	0.855809959	2,657
2008	26.849	0	0.855809959	23
1997-2008 Total:				26,796

MONITORING AND MEASUREMENT

4.2.2.9 Document the party(ies) responsible for monitoring and measuring GHG emissions during the project's life, which may include non-participants (i.e., third parties).

The utility owners of fossil-fuel generating units in Alberta track their greenhouse gas emissions through a mass balance procedure. These owners are: TransAlta Utilities, Edmonton Power, and ATCO Power (formerly Alberta Power Ltd.).

4.2.2.10 Document the specific measures that will be used to track emissions.

Emission factors based on information provided by Alberta utilities for their generating units will be combined with electricity generation records to estimate the emissions reduced.

4.2.2.11 Document the data collection procedures for these measures, including a description of sampling techniques, monitoring equipment, calibration, and methods for estimating emission reductions.

- I) Measurement of the electricity production by the Green Power generation and by other generation on the Interconnected Electric System is performed using highly accurate, certified, electrical meters on an hourly or more frequent basis. The Power Pool of Alberta maintains hourly records on production of all such facilities, and on exports and imports into the Interconnected Electric System. The records are maintained to an accumulated hourly precision of 10 kWh for each generating unit.
- II) Emission factors are calculated based on information on heat rate, heating value of the fuel, and carbon content of the fuel. Such information is monitored frequently and in detail by the operators of generating units using standardized laboratory and operational weighing or volume-measurement equipment. However, only partial information is released from time to time by the utilities, often pursuant to somewhat unrelated government regulatory requirements, or for summary submissions to the Voluntary Challenge and Registry. The emission factors calculated from such information provide stable estimates of actual CO₂ emissions from generating units,

and such emission factor estimates are used in Canada's National Greenhouse Gas inventory maintained by Environment Canada. Data used to establish Registered Emission Reductions under this project documentation will comprise the most relevant unit-specific data publicly available for each year for which RERs are requested.

4.2.2.12 Document a proposed schedule for monitoring and measurement activities.

Monitoring activities are performed on a continuous basis for electricity production, and with better than annual frequency for plant heat rates and the heating value of fuels. The carbon content of fuels used in Alberta is stable and available from Jaques *et al.*, 1995.

4.2.2.13 Document a proposed process for periodically updating emission reduction estimates.

Actual figures for each year of the project will be calculated *post facto* on an annual basis using reported utility emission information and Power Pool of Alberta electricity production, import and export information for the Interconnected Electric System.

4.2.3 VERIFIABLE EMISSION REDUCTIONS

4.2.3.1 Document how raw or source data will be tracked, and how it could be audited.

Except for the quantity of Green Power purchased for Canada's facilities, publicly available information on the electricity production and emission factors or the component factors thereof, will be used.

4.2.3.2 Document all calculations and models in sufficient detail to allow replication.

Please see previous sections where this was presented.

4.2.3.3 Document the names, addresses, telephone and fax numbers, and e-mail of the party(ies) responsible for conducting third party verification of project activities and/or records.

Terrachoice Environmental Services Inc.
Suite 400
2781 Lancaster Road
Ottawa, Ontario
K1B 1A7
telephone: (613) 247-1900
facsimile: (613) 247-2228
e-mail: jpolak@terrachoice.ca

4.2.3.4 Document the frequency/schedule for third party verification; and

Terrachoice Environmental Services Inc. administers the Environmental Choice Program (ECP) on behalf of Environment Canada. The Green Power facilities described by this project documentation are licensed and labelled with an EcoLogo under the ECP. Periodic, approximately annual, auditing of production is performed.

4.2.3.5 Document a description of what aspects of the project will be subject to third party verification.

The production and sales of Green Power from the two turbines will be audited under the ECP.

4.2.4 SURPLUS EMISSION REDUCTIONS

4.2.4.1 Document evidence that the project is not being implemented to comply with any existing regulations (e.g., local air quality standards, energy efficiency codes or standards), which would make it part of Reference Case activities.

There are no requirements in law under which Canada is required to reduce any of its emissions associated with its use of electricity. Neither are there any legal requirements placed on fossil-fuel generators in Alberta which would have required the commissioning of Green Power facilities or the taking of any action which would have produced equivalent emissions reductions. No documentation is available to establish the non-existence of such requirements.

4.2.4.2 Document a process for adjusting emission reduction estimates over time to account for any new GHG emission or other regulations that may come into effect.

The Registered Emission Reductions proposed under this project documentation depend on the average emissions of fossil-fuel generation in Alberta. If these emissions are reduced as a result of compliance with any new GHG or other emission regulations that may come into effect, the average emission rate will decline and the emission reductions caused by the Green Power displacement of the remaining fossil-fuel electricity generation will be proportionately reduced.

5.0 OTHER REVIEW CRITERIA/INFORMATION

5.1 SOLE OWNERSHIP

5.1.1 Document information on the project's ownership

- I) Please review the Abridged copy of the Agreement Between Her Majesty the Queen in Right of Canada, as represented by the Minister of the Environment, and The City of Calgary (**Annex C**).
- II) Please also note the 1997 Green Power Reconciliation Statement from Enmax Power Corporation (**Annex F**).

5.1.2 Document other potential claims to ownership and any actions undertaken to resolve such claims.

- I) Owners of fossil-fuel generators may attempt to report their actual emissions to the VCR, including the effect of the reductions claimed by this project documentation. If supplementary information on the reasons for the emissions being at the reported level rather than a higher level are omitted, such reporting may result in double-counting within the VCR of any Registered Emission Reductions established by the GERT Pilot or its successors.
- II) The Emission Quantification Working Group was cooperatively established in August 1998 with several participants from Alberta electricity industry stakeholders and the federal and provincial governments. The EQWG has recommended procedures to quantify emissions and emission reductions in its final report (see Emission

Quantification Working Group, 1999, which is being submitted by the EQWG to the GERT Pilot Steering and Technical Committees). The adoption of widely-accepted procedures which could be used for reporting to the VCR and other purposes, should reduce the likelihood of inadvertent double-counting.

5.2 PROJECT ADDITIONALITY

The Green Power Procurement by Canada was performed specifically to reduce air emissions, including greenhouse gas emissions, associated with the electricity consumption by facilities in Alberta owned or used by the departments (please see news release, **Annex G**). Therefore, the Green Power Procurement is entirely additional to what would have otherwise occurred. Furthermore, the two wind turbines were commissioned and are in operation solely because of the federal Green Power Procurement pilot projects and the resulting contractual arrangements.

5.3 OTHER ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS

5.3.1 Document any significant non-GHG impacts of the project on the natural environment.

Please refer to the Environmental Assessment screening statement attached as **Annex H**.

5.3.2 Document significant socio-economic impacts

Please refer to the Environmental Assessment screening statement filed by Environment Canada and attached as **Annex H**.

6.0 OTHER REQUIREMENTS & ISSUES

6.1 PROJECT CONTACT

Document the name, address, telephone and fax numbers, and e-mail of the official participant contact person for the project.

l) Mr. Leslie Welsh
Head, Sustainable Energy Section
Environment Canada
Environmental Protection Service

Oil, Gas and Energy Branch
Place Vincent Massey, 10th Floor
351 St. Joseph Boulevard
Hull, Quebec
K1A 0H3
Phone: 819-953-1127
Fax: 819-953-8903
e-mail: Leslie.Welsh@ec.gc.ca

II) Deirdre Hetherington
Renewable Energy Policy Analyst
Natural Resources Canada
Energy Sector Renewable and Electrical Energy Division
580 Booth Street
Ottawa, Ontario
K1A 0E4
Phone: 613-996-2596
Fax: 613-995-0087
e-mail: Dhetheri@NRCan.gc.ca

III) Leon Burn
Manager Business Development
Enmax Power Corporation
2808 Spiller Road SE
Calgary, Alberta
T2G 4H3
phone: 403-268-1227
fax: 403-262-5928
e-mail: Lburn@Enmax.com

References:

Beals and Associates. 1993. "Environmental Impacts of Alternative Electricity Generation Technologies—Final Report". Ontario Hydro. Toronto, Ontario. 65 pp.

Emissions Quantification Working Group. 1999. "Report of the Emission Quantification Working Group". Calgary, Alberta. 24 pp. + appendices.

Epcor. 1997. 1997 Annual Report. Edmonton, Alberta. 55 pp.

General Rate Application. 1998. Submitted to the Alberta Energy and Utilities Board. Edmonton, Alberta.

Independent Assessment Team. July 9, 1999. Reports to the Alberta Energy and Utilities Board. Edmonton, Alberta. Available on web site: <http://www.pwcstt.com/>

Jaques, A., F. Neitzert and P. Boileau. 1997. "Trends in Canada's Greenhouse Gas Emissions 1990-1995". Environment Canada. Hull, Quebec. Appendix C, Tables 1 and 4, pp. I-2 and I-4.

Shaw, Roderick W. (editor). 1997. Electric Power Generation (Fossil Fuel) Sector Issue Table Technical Background Document Volume 3: Appendices containing the report of Task Group 3 and associated consultants' reports. Prepared for the Electric Power Generation (Fossil Fuel) Sector Issue Table. Published by Environment Canada and The Canadian Electricity Association. Hull, Quebec. Approx. 400 pp.