Background Notes
EcoLogo™ Program Standard Review (Round 1)

May 14, 2009

CCD-003 Electricity-Renewable Low-Impact
(A) GENERAL CONSIDERATIONS

Table of Contents

1 Introduction

During a preliminary research period, the EcoLogo™ Program engaged with stakeholders to help identify critical aspects of the renewable low-impact electricity standard (CCD-003) in need of revision, as well as to narrow the scope of the standard (i.e. which categories/technologies should be included or removed). Additionally, a discussion with stakeholders was initiated to help propose environmental leadership criteria statements for renewable low-impact electricity within each identified category/technology. This was accomplished by circulating a suite of documents called *Certification Discussion Document (Sections A-J),* for which stakeholder comments were solicited and collected during a 45 day period. Based on the feedback received, the EcoLogo™ Program was able to narrow down the scope of the standard, and propose potential criteria statements for each identified category/technology. Moreover, the EcoLogo™ Program has prepared of a series of background notes that contain both the science and rationale behind each proposed criteria statement for every category/technology included in the draft standard. It should be noted that a specific background note has been established for each technology included in the standard, while a separate more generic background note was written for the broad-reaching categories of the standard (which includes alternative-use electricity).

In the following, the EcoLogo™ Program will discuss the broad-reaching categories of the standard and propose environmental leadership criteria statements for the next stakeholder consultation, as well as present unresolved questions to be addressed by stakeholders. This document is one of nine background notes circulated for the review of CCD-003.

2 New Criteria Statements to the Current Active Standard

Following preliminary research and a discussion with stakeholders, the EcoLogo™ Program will address the following environmental impact categories and related stressors by proposing to add new criteria statements to the current active standard. Each proposed criteria statement is followed by a rationale explaining why we are proposing the addition to the standard. Only those topics that were discussed with stakeholder will be presented below.

2.1 Cumulative Effects

[Addition]:

4. To meet the requirements of this standard, the renewable low-impact electricity must:

   (h) demonstrate that cumulative effects have been assessed and potentially mitigated, or avoided following a Cumulative Effects Assessment in Canada or a Cumulative Effects Analysis in the United States.

Interpretation

"Cumulative Effects Assessment" means a cumulative assessment performed following the Cumulative Effects Assessment Practitioners Guide (The Cumulative Effects Assessment Working Group, 1999)

"Cumulative Effects Analysis" means an analysis performed following the Council on Environmental Quality (1997) recommendations

Rationale:

Currently, cumulative effects are only somewhat addressed in the standard statements pertaining to water-powered electricity. However, following preliminary research and a discussion with stakeholders, cumulative effects were raised as potential concerns related potentially to all renewable technologies. To address this issue, the EcoLogo™ Program is proposing that all new EcoLogo™ certified electricity products be assessed for potential cumulative effects. This is why we are therefore proposing this new criteria statement.

3 Revised Criteria Statement to the Current Active Standard

Following preliminary research and a discussion with stakeholders, the EcoLogo™ Program will address the following environmental impact categories and related stressors by proposing to revise certain criteria statements to the current active standard. Each proposed criteria statement is followed by a rationale explaining why we are proposing the revision to the standard. Only those topics that were discussed with stakeholder will be presented below.

3.1 Renewable Energy Certificates

[Revision]:

See *Tradeable Renewable Energy Certificates* Background Notes presented elsewhere for the review of CCD-003.

4 Unchanged Criteria Statements in the Current Active Standard

Following preliminary research and a discussion with stakeholders, the EcoLogo™ Program proposes to keep certain criteria statements intact. Only those criteria statements that were discussed with stakeholder will be presented below. A rationale explaining why we are proposing to keep statements unchanged is provided for those.

4.1 Greenhouse Gas Emissions

[Current]:

2. This category comprises electricity from renewable energy sources which are apt to impose relatively low impacts on the environment, and produce potential benefits including, inter alia, low net greenhouse gas emissions, limited or no depletion of non-renewable resources, reduced emissions of other pollutants, and reduced impacts on aquatic, riparian, and terrestrial ecosystems and species.

Rationale:

The table below illustrates the CO_2 emissions and/or CO_2 equivalent emissions from different sources of electricity. It is clear that compared to the U.S grid which is mostly composed of fossil fuels, that all forms of renewables in the table below have lower greenhouse gas emissions than fossil fuels. Therefore, the EcoLogo™ Program proposes to leave the statement 2 of the current active standard as is.

Table A: Greenhouse Gas Emissions of Different Electricity Sources and Power Mixes

Electricity Source	Grid Power Mix	Greenhouse Gas Emissions	
		CO_2 Emissions Rate (kg/MWh)	CO_2 Equivalents Emissions Rate (kg/MWh)
Biomass	N/A	Woodwaste= 404.68 (Corinair, 1994)	Comparatively negligible for CH_4 and N_2O (Corinair, 1994)
Biogas	N/A	Sludge gas= 196.4 (IPCC, 2006), Landfill gas= 196.4 (IPCC, 2006)	Comparatively negligible for CH_4 and N_2O (IPCC, 2006)
Tidal and Wave	N/A	Wave=15 (Wavenet, 2003)	N/A
Solar	N/A	N/A	Between 0 and 300 (Rybach, 2003)
Hydro	N/A	N/A	Between 0 and 420 (Rybach, 2003) 3-4 (Bratrich et al., 2004) 15 from flooded reservoirs and 2 from run-of-river hydroelectric (OPA et al., 2005)

Geothermal	N/A	Average CO_2 emissions of 0.48 (Brophy,1997)	New facilities emit 0.1 (NRCan, 2006) Between 0 and 400 (Rybach, 2003)
Wind	N/A	N/A	Between 0 and 100 (Rybach, 2003) 0.034-0.125 kg (Dey & Lenzen, 2006)
All Electricity Canada	Petroleum=3% Natural Gas=8% Coal=15% Nuclear=12% Hydro=60% Wind=02% Biomass=1.3% (Centre for Energy, 2007)	N/A	211 (Retscreen, 2005)
All Electricity USA	Petroleum=3.03% Natural Gas=18.8% Coal=49.6% Nuclear=19.3% Hydro=6.50% Wind=0.44% Biomass=1.3% Solar=0.01% Geothermal=0.36% (EPA, 2005)	602.98 (eGrid, 2005)	579 (Retscreen, 2005) 606.19 (eGrid, 2005)

5 Considerations Withdrawn from Review

Following preliminary research and a discussion with stakeholders, the EcoLogo™ Program has withdrawn the following environmental considerations from this review. Below, we provide a rationale explaining why we have decided not to address these considerations further during this review. Only those topics that were discussed with stakeholder will be presented below.

5.1 White Tags for Negawatts

Rationale:

Following preliminary research and a discussion with stakeholders, the EcoLogo™ Program is in agreement with stakeholders that white tags should be treated separately from renewable low-impact electricity. Therefore, it has decided to remove white tags from consideration at this time. Some of the reasons for this include: the immaturity of White Tags market, potential risks of double counting, and most importantly, the fact that white tags and potential issues related to them are sufficiently different from renewable low-impact electricity products to warrant a separate treatment.

5.2 Visual Impacts

Rationale:

The EcoLogo™ Program believes that visual impacts are sufficiently addressed in the current standard in points 4 a), b) and c). Therefore, we do not think it necessary to further consider this issue during this review of CCD-003.

5.3 Local Employment

Rationale:

Although the EcoLogo™ Program recognizes that local employment could lead to lower greenhouse gas emissions while providing benefits to the local community, no data was found to substantiate that this could be required of renewable low-impact electricity producers in North America when the whole life cycle of the electricity products are considered in the current economic climate. Therefore, the EcoLogo™ Program cannot consider local employment in the draft standard at this time.

5.4 Land Use

Rationale:

Following preliminary research and a discussion with stakeholders, the EcoLogo™ Program did not receive sufficient information to be able to propose an addition to the standard on this issue. Furthermore, the following incomplete table does not suggest that the EcoLogo™ Program should be concerned about the land use question when renewables are compared to coal.

Power Source	Land Occupied (square meters per gigawatt-hour over 30 years)
Biomass	N/A
Biogas	N/A
Tidal and Wave	N/A
Solar	3561 (thermal)/3237 (PV) (Brophy, 1997)

Hydro	N/A
Geothermal	404 (Brophy, 1997)
Wind	1335 (Brophy, 1997)
Coal	3642 (Brophy, 1997)

6 Unresolved Issues

Following preliminary research and a discussion with stakeholders, the EcoLogo™ Program has not been capable of resolving certain issues. Indeed, no clear direction could be found indicating how EcoLogo™ should address these issues, although, in certain cases, several proposals were brought forward. The goal of the EcoLogo™ Program is to determine whether these issues can be resolved, and what criteria statement could be included in the standard.

6.1 Age of Facilities

[Proposal A]:

One proposal is to remove:

To meet the requirements of this standard, marketers of electricity must be able to demonstrate to the satisfaction of the EcoLogo™ Program, that the portion of their multi-sourced power product conforming to this standard incorporates a minimum of 50% Type II Electricity and/or Type III Electricity and a maximum of 50% Type I Electricity.

And to replace it with:

To meet the requirements of this standard, marketers of electricity must indicate the age of the facility in its product disclosure information.

Pros:

This would ensure that the vintage choice is made by consumers.

Cons:

The current program is designed to favor newer renewables over older ones. When the renewable low-impact electricity definition is used by financial incentive programs, this can ensure that the development of newer renewables is favored over older one. This can therefore lead to helping the market for renewables to grow, leading to more renewables on the market. This in turn leads to overall greater environmental benefits for society. Removing the preference for new renewables in CCD-003 might not lead to newer renewables being incented if consumers decide not to purchase newer renewables. This could therefore lead to an overall decreased environmental benefit from renewables overall.

[Proposal B]:

A stakeholder has proposed that the EcoLogo™ Program should remove type I and only keep type II and type III electricity products.

Pros:

A stakeholder has mentioned that "given that most new renewable projects require 20 years of funding to be economic, the current Type II classification should be retained." Also these age types would represent a post-Kyoto date.

Cons:

This would cause discordance among North American renewable low-impact certification programs since other certification programs use other age type delineations.

[Proposal C]:

Stakeholders have proposed that the EcoLogo™ Program harmonize their age type with that of U.S. Green-e Energy standard. As a stakeholder proposed, EcoLogo™ could eliminate type I, type II, and type III designations and replace them with these two types:

- older facilities that have most likely amortized their capital costs, specifically those facilities online before January 1, 1997, and;

- newer facilities that are still amortizing investment costs, specifically those facilities that came online on or after January 1, 1997

Pros:

This harmonization of age types would provide more clarity to the North American market for renewable power.

Cons:

Some stakeholders think that it should be consumers who decide the vintage of the renewables they want to purchase. This would not let consumers decide completely. Also, some think that facilities should be judged by equal performance standards regardless of age. This would not address this concern.

[Proposal D]:

A stakeholder has proposed that:

#1 – Add a type of REC that enables owners of EcoLogo™ certified, pre-1991 generation, to unbundle, and possibly sell separately, the attributes associated with the generation of this environmentally-preferred electricity.

#2 – Introduce the constraint that this type of REC cannot be used for any greenhouse gas offset purpose.

Pros:

Some stakeholders believe that allowing for pre-1991 RECs would help promote pre-1991 renewable low-impact electricity which has environmental benefits (e.g. comparatively low carbon emissions) that conventional electricity does not produce. Currently, this is not possible in the *Green Leaf TRCs Program*. According to them, this would enable consumers to differentiate between pre-1991 renewable low-impact electricity and pre-1991 conventional sources of power.

Cons:

Distinguishing between pre and post 1991 electricity instead of pre and post 1997, would cause discordance among North American renewable low-impact certification programs. Also, the REC Program is not an offset program. Offset programs like Green-e Climate generally require separate performance additionality tests.

[Current]:

The current Verification section of CCD-003 includes a section that states that:

To meet the requirements of this standard, marketers of electricity must be able to demonstrate to the satisfaction of the Environmental Choice Program [now known as the EcoLogo™ Program] that the portion of their multi-sourced power product conforming to this standard incorporates a minimum of 50% Type II Electricity and/or Type III Electricity and a maximum of 50% Type I Electricity.

The age types of electricity found in CCD-003 are defined as such:

- "Type I Electricity" means ECP-certified electricity from a generation facility that began operations (e.g. generating electricity) prior to January 01, 1991"

- "Type II Electricity" means ECP-certified electricity from a generation facility that began generating electricity from January 01, 1991 to March 31, 2001 inclusive.

- "Type III Electricity" means ECP-certified electricity from a generation facility that began generating electricity on or after April 01, 2001.

Alternatively, the current *Green Leaf™ TRCs Program Standard*, it is stated that Green Leaf™ TRCs must be designated as either:

- "Level A tradeable renewable electricity certificate" means a TRC that is from a facility that began generating electricity on or after April 1, 2001.

- "Level B tradeable renewable electricity certificate" means a TRC that is from a facility that began generating electricity from January 1, 1991 to March 31, 2001 inclusive.

Furthermore, the *GL TRCs Program Standard* includes:

17. EcoLogo™ RECs must be accompanied by product disclosure information that includes, as a minimum, the following information:

(b) the Level of the EcoLogo™ RECs (i.e. Level A or Level B) and a description of what that level means;

6.2 Impacts of Transmission Lines

[Proposal A]:

The EcoLogo™ Program proposes to certify renewable low-impact electricity that is both tied and not tied to the grid.

Pros:

This would help avoid the environmental impacts associated with grid-tied electricity caused by transmission lines which can be significant according to the Ontario Power Authority & SENES Consultants Limited (2005).

Cons:

This proposal would cause some discordance in the North American certification world, since Green-e in the U.S only certifies RECs from grid-tied renewable energy facilities. Not allowing grid tied electricity to be certified ensures that certified renewable low-impact electricity replaces the same amount of other higher impact forms of electricity on the grid.

[Proposal B]:

The EcoLogo™ Program proposes to only certify renewable low-impact electricity that is tied to the grid.

Pros:

This proposal would ensure greater harmony among certified North American renewable electricity products.

Cons:

The environmental benefits potentially brought on by off-grid facilities not using the grid would not be considered within CCD-003.

6.3 Waste Heat

[Proposal A]:

A stakeholder proposed that waste heat recovery be included within CCD-003 as such:

"Electricity from heat rejected to atmosphere" means electricity generated from a supplemental process, and/or equipment to alter, and/or add to the processes of an existing operation in order to generate electricity from thermal energy that would otherwise be vented, or rejected into the atmosphere. The existing operation must not have been originally designed or intended for electricity generation, nor had any processes in place at the time of commissioning that would have facilitated electricity generation. Examples of electricity generation from recovered waste heat sources include,

inter alia, geothermal operations, stack heat, radiator heat or condenser heat, and other waste heat captured from an industrial or commercial process that is fuelled by a thermal energy source where that thermal energy would otherwise be vented to atmosphere.

Pros:

According to the WorldWatch Institute (2007), out of 500,000 smokestacks in the United States, 47,500 stacks that produce waste heat above 260 degrees Celsius could produce at least 50,000 MW of power. The United States could also conceivably continue producing the same amount of energy it does now, with half the fossil fuels, by recycling the waste heat from its factories and electric generating stations. In Canada, the electricity potential of waste heat has been estimated to be 3000 MW. Some stakeholders are advocating that waste heat is equally environmentally beneficial to the other renewable low-impact electricity sources already covered within CCD-003.

Other benefits of waste heat recovery touted by stakeholders include:

- Utilizes existing energy that would otherwise be wasted or vented to the atmosphere;
- Minimizes land use impacts/results in minimal incremental land use;
- Could minimize transportation and transmission impacts;
- Waste heat recovery systems consume no incremental non-renewable sources of energy;
- The conversion of waste heat to electricity avoids the consumption of additional non-renewable fuel, by displacing electricity generated from coal or gas;
- Operates with ultra-low air emissions, including criteria air contaminants, particulate matter, VOCs, and greenhouse gases;
- Requires no water for cooling and releases no water to the environment;
- Results in no loss of heritage, cultural or recreational value; and
- Results in no cumulative environmental impacts.

Furthermore, the economics of waste heat recovery projects are significantly benefited and incented by the receipt of production subsidies or revenues accessed through the sale of power that qualifies for a Renewable Energy Portfolio standard or a low-impact certification.

Cons:

A stakeholder argues that "While capturing and using waste heat generated from non-renewable fuels does have a benefit, this represents an efficient use of non-eligible fuels and not a renewable fuel." Also, adopting this proposal would also create discordance among the North American market since Green-e does not accept waste heat within its standard.

[Current]:

At present, CCD-003 addresses waste heat from renewable energy sources as such:

"alternative-use electricity" means electricity generated from the installation of a supplemental process, and/or equipment to alter, and/or add to the processes of an existing operation in order to generate electricity from a renewable energy source. The existing operation must not have been originally designed or intended for electricity generation, nor had any processes in place at the time of commissioning that would have facilitated electricity generation. Examples of alternative-use electricity generation sources include, inter alia, irrigation control dams, waterways with locks, and **waste heat captured from an industrial or commercial process that is fuelled by renewable energy sources**.

6.4 Energy Use

The current standard only requires the use of renewable electricity for waste heat when it states that:

> *Examples of alternative-use electricity generation sources include, inter alia, irrigation control dams, waterways with locks, and* ***waste heat captured from an industrial or commercial process that is fuelled by renewable energy sources***.

Overall, it is generally accurate that renewables demonstrate a much higher efficiency of electricity usage. For instance, the Energy Payback Time, which indicates the number of years a technology must produce electricity to offset the total energy required over its lifetime, of photovoltaics may vary between 0.6 to 5 years depending on installation and manufacturing locations (Reich-Weiser, Fletcher, Dornfeld & Horne, 2008). Alternatively, the energy payback time for a wind turbine typically takes only a few months, 3-8, depending on the average wind speed at its site (AWEA,2002). However, according to Nalukowe, Liu, Damien, & Lukawski (2006), the environmental impacts related to fossil fuel usage, such as those due to resource mining, the release of greenhouse gases, respiratory inorganics emissions, and the production of carcinogens, is one of the four most significant impact categories for wind power production when the whole life cycle of the product is considered. According to their Life Cycle Assessment, wind turbines produced from oil had the biggest negative impact on the environment. Coal-based wind power led to slightly smaller impacts comparatively. Wind from wind and wind from hydro had less of these environmental impacts compared to wind from the two conventional sources of power above. Also, according to Schleisner (2000), "Nearly all of the damages from an offshore wind farm are related to the production of the materials for the wind farm". Also, for biomass, one of the main impacts for biomass is sometimes due to energy-intensive fertilizer use and transportation (Zah et al., 2007).

[Proposal]:

The EcoLogo™ Program would therefore like to identify leadership for this impact category amongst renewable low-impact electricity facilities. In other words, we would like stakeholders to provide us with plant data regarding the typical amount of MWh and type (eg. hydro, wind, coal, natural gas etc) of generation in North America required to produce a MWh of renewable low-impact electricity (eg. solar, wind, hydro etc).

<u>Rationale:</u>

The EcoLogo™ Program recognizes that currently, not all renewable low-impact electricity systems are manufactured using renewable sources of electricity. However, to ensure an energy transition that encourages renewables, and that has the lowest impact possible, we recognize that choosing renewable low-impact electricity VS higher impact non renewables to manufacture renewable low-impact electricity systems would be preferable. However, we do not know, at current, what the leadership potential in this area currently is in North America.

6.5 Criteria Air Emissions (CO, NOx, SOx and PM)

[Proposal]:

The EcoLogo™ Program proposes to do further research on the CO and PM emissions rates of biomass-fueled electricity during this review. We call on all stakeholders, who can, to please provide us with data on the CO and PM emissions of fossil fuel-powered plants and biomass-fueled electricity. We also ask that those who can present us with potential methods for mitigating CO and PM emissions from these types of plants.

Rationale:

Following preliminary research and a discussion with stakeholders, questions pertaining to CO, NOx, SOx and PM emissions were asked in several technology-specific certification discussion documents (CDDs). Views were divided as to whether or not the load points for biomass and biogas in the current standard still represented leadership. In hindsight, and following preliminary research and a discussion with stakeholders, the EcoLogo™ Program recognizes that these emissions could be addressed all together. Therefore, we have decided to provide you with the table below to facilitate the comparison of the emissions rates performance of the different technologies for which these emissions had been raised as potential areas of concern in the CDDs and during consultations.

The values for CO and PM emissions might no longer represent environmental leadership as is demonstrated in the table below. Please note that some of the data below represent gross estimates, only to provide us with a cursory idea of whether or not we should be concerned with researching this issue further. The data could be further refined to assess further whether this concern is valid. This is why we are requesting further help from stakeholders in this area.

Table B: Criteria Air Emissions from Different Electricity Sources and Power Mixes

Electricity Source	Grid Power Mix	Criteria Air Emissions			
		CO Emissions Rate (kg/MWh)	NOx Emissions Rate (kg/MWh)	SOx Emissions Rate (kg/MWh)	PM Emissions Rate (kg/MWh)

Biomass	N/A	Average emissions= 3.221 - 4.30 (EcoLogo™, 2003)	Average emissions= 1.151 - 1.52 (EcoLogo™, 2003)	Average emissions= 0.2121 - 0.282 (EcoLogo™, 2003)	Average emissions= 0.3871 - 0.516 (EcoLogo™, 2003)
Biogas	N/A	N/A	N/A	N/A	N/A
Tidal and Wave	N/A	Comparatively low (Wavenet, 2003)	Comparatively low (Wavenet, 2003)	0.05 (Wavenet, 2003)	Comparatively low (Wavenet, 2003)
Solar	N/A	0.001 (TerraChoice, 1999)	0.082-1.33 (WEC, 2004) 0.016-0.34(CanSIA, 2006)	0.1-0.3 (WEC, 2004) 0.25 (CanSIA, 2006)	0.006-0.055 (WEC,2004) 0.001 (TerraChoice, 1999)
Hydro	N/A	N/A	0.01 (Bratrich et.al, 2004)	0.01 (Bratrich et.al, 2004)	N/A
Geothermal	N/A	N/A	Comparatively less (Western GeoPower Corp, 2003) zero NOx (Brophy,1997)	Comparatively less (Western GeoPower Corp, 2003)	N/A
Wind	N/A	N/A	0.015-0.076 (WEC, 2004)	0.015-0.087 (WEC, 2004)	0.005-0.014 (WEC, 2004)
Coal (International)	N/A	N/A	N/A	N/A	Avg=0.704 (coal) Avg=0.52 (lignite)

All Electricity USA	Petroleum=3.03% Natural Gas=18.8% Coal=49.6% Nuclear=19.3% Hydro=6.50% Wind=0.44% Biomass=1.3% Solar=0.01% Geothermal=0.36% (eGRID, 2005)	N/A	0.88 (eGrid, 2005)	2.39 (eGrid, 2005)	N/A
Canadian Fossil Fuel Electricity Highest Emissions Rate/Plant	N/A	0.5 (EcoLogo™, 2009)	14.42 (EcoLogo™, 2009)	4.92 (EcoLogo™, 2009)	0.62 (PM10) 0.62 (PM 2.5) (EcoLogo™, 2009)
Canadian Fossil Fuel Electricity Lowest Emissions Rate/Plant	N/A	0.04 (EcoLogo™, 2009)	0.16 (EcoLogo™, 2009)	3.96 (EcoLogo™, 2009)	0 (PM 10) 0 (PM 2.5)
Canadian Fossil Fuel Electricity Average Emissions Rate/Plant	N/A	0.22 (EcoLogo™, 2009)	3.95 (EcoLogo™, 2009)	4.44 (EcoLogo™, 2009)	0.18 (PM10) and 0.14 (PM 2.5) (EcoLogo™, 2009)
US Collective Fossil Fuel	N/A	N/A	1.66 (CEC, 2004)	3.79 (CEC, 2004)	N/A
US Electricity Lowest State	N/A	N/A	0.064 (eGrid, 2005)	0.008 (eGrid, 2005)	N/A

US Electricity Highest State	N/A	N/A	2.19 (eGrid, 2005)	6.45 (eGrid, 2005)	N/A

7 References

American Wind Energy Association. (2002). *The most frequently asked questions about wind energy*. Retrieved April 22, 2009, from http://www.awea.org/pubs/documents/faq2002%20-%20web.pdf

Batrich et al. (2004). Green Hydropower: a new assessment procedure for river management. *River Research and Applications*, *20*, 865-882.

Brophy, P. (1997). Environmental Advantages to the Utilization of Geothermal Energy. *Renewable Energy*, *10* (issue 2/3), 367-377.

Corinair. (1994). *Find EF - Start Page*. Retrieved Mar, 2009, from http://www.ipcc-nggip.iges.or.jp/EFDB/find_ef_main.php

Council on Environmental Quality. (1997). *Considering Cumulative Effects Under the National Environmental Policy Act*. Retrieved April 21, 2009, from http://ceq.hss.doe.gov/NEPA/ccenepa/ccenepa.htm

Dey, C., & Lenzen, M. (2006). Greenhouse Gas Analysis of Electricity Generation Systems. Proceedings from the ANZSES Solar 2000 Conference. Australia.

International Panel on Climate Change. (2006). *Find EF - Start Page*. Retrieved Mar, 2009, from http://www.ipcc-nggip.iges.or.jp/EFDB/find_ef_main.php

Nalukowe, B., Liu, J., Damien, W., & Lukawski, T. (2006). *Life Cycle Assessment of a Wind Turbine*. Retrieved October 11, 2008, from: http://www.infra.kth.se/fms/utbildning/lca/projects%202006/Group%2007%20(Wind%20turbine).pdf

Natural Resources Canada. (2006). *About Earth and Geothermal Energy*. Retrieved April 8, 2008, from http://www.canren.gc.ca/tech_appl/index.asp?CaID=3

Ontario Power Authority & SENES Consultants Limited. (2005). *METHODS TO ASSESS THE IMPACTS ON THE NATURAL ENVIRONMENT OF GENERATION OPTIONS*. Retrieved September 3, 2008, from http://www.energy.gov.on.ca/opareport/Part%204%20-%20Consulting%20Reports/Part%204.4%20SENES%20Final%20Report%20to%20OPA.pdf

Reich-Weiser, C., Fletcher, T., Dornfeld, D., & Horne, S. (2008). *Development of the Supply Chain Optimization and Planning for the Environment (SCOPE) Tool-Applied to Solar Energy*. Retrieved September, 2008, from http://repositories.cdlib.org/lma/gmg/reich-weiser 08 5

Rybach, L. (2003). Geothermal Energy: Sustainability and the Environment. *Geothermics, 32*, 463–470.

Schleisner, L. (2000). Life cycle assessment of a wind farm and related externalities. *Renewable Energy, volume 20,* 279-288.

The Cumulative Effects Assessment Working Group. (1999). *Cumulative Effects Assessment Practitioners Guide*. Retrieved April 21, 2009, from http://www.ceaa-acee.gc.ca/013/0001/0004/Cumulative-Effects_e.pdf

U.S. Environmental Protection Agengy. (2005). *eGRID2007 Version 1.1*. Retrieved Mar, 2009, from http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html

Wavenet. (2003). Results from the work of European Thematic Network on Wave Energy. Retrieved June 18, 2008, from www.wave-energy.net/Library/WaveNet%20Section%20A%20-%20Exec%20Sum%20&%20Introduction(11.1).pdf

Worldwatch Institute. (2007). *Clean Energy's Best-Kept Secret: Waste Heat Recovery*. Retrieved November 5, 2008, from http://www.worldwatch.org/node/5499.

Zah et al. (2007). *A Life Cycle Assessment of Energy Products: Environmental Impact Assessment of Biofuels*. Retrieved May 20, 2008, from http://www.theoildrum.com/node/2976