Guidance Document

Conference and Event GHG Calculator

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Guidance Document for Manitoba Green Registry: Conference GHG Calculator

Importance of this Calculator

A conference[1] or similar event can have a large carbon footprint when the greenhouse gas (GHG) emissions from attendee travel, accommodation, materials consumed and waste generated are all considered. Through the conference planning and delivery phases, conference organizers have a number of options available to them for reducing the GHG emissions from these activities. The **Manitoba Conference and Event GHG Calculator** allows conference organizers to estimate the GHG emissions resulting from a range of different conference-related activities. It does so by analysing information input by the user on the travel required for participants to attend the conference, the location of the conference facility, the length of stay, and the materials consumed and waste produced. Users provide this information using the online form at www.greenregistry.org. The calculator estimates the total GHG emission for a conference or event and links the user to information on options for reducing the GHG emissions from future events, and offsetting GHG emissions.

[1] Including business and academic conferences, workshops, management retreats, or similar events

Scope of Activity and Emissions

The **Manitoba Conference and Event GHG Calculator** includes three different sources of GHG emissions:

a) GHG emissions associated with attendee travel;
b) GHG emissions associated with accommodation at the event facility in terms of energy use (both primary from fuel burned onsite, and electricity generated offsite);
c) GHG emissions associated with disposal of waste generated at the event.

Required User Inputs

The GHG emission estimates produced by the calculator are based on the information entered by the user. In order to be as accessible and transparent as possible, the calculator has been designed to be user friendly with minimal data inputs. There are three basic categories of user inputs required in order to generate estimates of GHG emissions associated with conferences.

Data Inputs Associated with Conference Attendee Travel

Four input fields are required to generate GHG emissions estimates from attendee travel:

Input 1: The number of attendees travelling to the event;

Input 2: The origin of each attendee's trip to the event;

Input 3: The location of the event;

Input 4: The mode of each attendee's travel (e.g., airplane, bus, rail, or passenger vehicle).

Data Inputs Associated with Conference Facility and Accommodation

There are three input fields required to generate estimates of GHG emissions associated with conference facilities and accommodation:

Input 1: The duration of the conference or event;

Input 2: Total number of attendee's and their length of stay;

Input 2: The location of the event facility.

Data Inputs Associated with Waste Management Module

The data inputs required for this module relate to the disposal of waste generated at the conference. There are two input fields required to generate estimates of GHG emissions associated with waste disposal:

Input 1: Distribution of hard copy conference delegate's packages and the nature of these materials;

Input 2: Waste disposal options, including if waste is sent to the landfill, recycled, or if organics are composted.

Underlying Method and Data Sources

The **Manitoba Conference and Event GHG Calculator** includes estimates of GHG emissions from three different sources associated with a conference, namely; participant travel, building energy, conference materials and waste disposal.

Attendee Travel

The travel module includes GHG emission estimates for four different modes of travel to the event, namely: airplane, bus, rail or personal passenger vehicle. Although the overarching approach to calculating these GHG emissions is the same (i.e. multiplication of passenger kilometres traveled by the appropriate GHG emission intensity of this travel), each mode relies on different analytical steps and data sources.

Estimating Activity

For all forms of travel, the first step is determining the passenger kilometres traveled to the conference. The precise measure of distance traveled depends upon the mode of travel and the geographical location of the attendee's origin and the conference facility. To determine the distance traveled, the calculator relies on the web-based Google Maps application.[2] This allows the user to enter the address from which their trip started and the address of the conference and let the mapping application determine the total distance of the trip.

The passenger kilometres traveled (PKT) by airplane is based on the distance between the origin and destination points using the great circle formula (this is the most direct route accounting for the curvature of the earth). A similar approach is used for rail, with the assumption that rail transportation infrastructure follows closely the most direct route between major centres. To generate estimates of PKT for bus and personal vehicle transportation modes, a different functionality of the Google mapping application is used. Rather than relying on the great circle

[2] http://maps.google.com/

distance, the mapping application traces the road network from origin to destination, selecting the shortest distance along the road network.

Estimating Emissions

Central to the estimation of the GHG emissions associated with conference travel are the use of GHG emissions intensities (i.e. the amount of carbon dioxide equivalency (CO_2e) per PKT). GHG emissions intensities for PKT are especially relevant otherwise, GHG emissions associated with vehicle movements would be allocated to one passenger, whereas they should be distributed proportionally across all passengers. The process to generate PKT emission intensities differs for each mode and draws upon a range of data sources and methodologies.

The approach for estimating GHG emissions from event travel is formulized as:

Equation 1: *Estimating GHG emissions from event travel:*

$$\textbf{EventTravel}_{\text{Emissions}} = \sum_{\text{alltravel}} \left\{ \textbf{PKT}_{\text{Mode}} * \textbf{EmInt}_{\text{Mode}} \right\}$$

Where

$\textbf{EventTravel}_{\textbf{Emissions}}$ = Total GHG emissions from event travel
$\textbf{PKT}_{\textbf{Mode}}$ = Kilometres travelled by mode for each attendee
$\textbf{EmInt}_{\textbf{Mode}}$ = GHG emission intensity by mode and type of trip (Appendix A)

The mode-specific methods used to establish each term of equation 1 is provided in Appendix A.

Building Module

The general approach to estimating GHG emissions associated with occupancy of hotel guest rooms and use of conference meeting facilities is to multiply the space requirements for each attendee with a GHG emissions factor that reflects the GHG emissions generated per square metre, per day. Here, it is assumed that the average conference attendee will require 400 square metres of building space, including guest room and conference meeting facilities. The GHG emissions estimate also includes all GHG emissions attributed to space and water heating, cooling, lighting, and auxiliary equipment in the facility. This is represented by the formula:

Equation 2: *Estimating GHG emissions from facilities and accommodation:*

$$Build_{EUE} = Attendee * Time_{Occupancy} * EmInt_{SquareMetre,Time} * 400$$

Where:

- $Build_{EUE}$ = Buildings energy use GHG emissions
- **Attendee** = Number of conference attendees
- $Time_{Occupancy}$ = Length of occupancy
- $EmInt_{SquareMetre,Time}$ = Emission intensity, by square metre and time
- **400** = the 400 square metres required per attendee

The primary source for the data used to develop GHG emissions intensities by time and floor area are data tables on energy and GHG emissions associated with the accommodation and food services sub-sector in Canada available from the CUED. This source provides estimates of the GHG emissions associated with primary fuels used in these buildings for all energy end uses, as well as data on electricity demand. This information is provided at the provincial and territorial level for the time period from 1990 to 2005. Data is also provided on the square metres associated with the sub-sector (also by geography and by year). This data allows for the construction of GHG emissions intensities that reflect both regional and temporal dimensions (see table 2).

Table 2 provides an example of the emission intensities that can be used for conference building energy use

Emission intensity per area and time (kg CO2/m2/day)

	1990	**2000**	**2005**
British Columbia	0.31	0.29	0.27
Alberta	0.95	0.93	0.87
Saskatchewan	0.47	0.58	0.48
Manitoba	0.25	0.28	0.23
Ontario	0.40	0.51	0.43
Quebec	0.20	0.22	0.25
Altlantic Canada	0.39	0.40	0.53

In this case GHG emissions intensities vary both by time and by region. This reflects the underlying fuel efficiency characteristics of each province in terms of both primary energy and electricity generation. For example, Alberta has the highest GHG emissions intensity of any province for any given year. This largely reflects the GHG emissions intensity of electricity generated in the province since most of this is generated from burning coal. Meanwhile, the temporal variation in GHG emissions intensities reflects both changes in the fuel mix of electricity, and increases in the efficiency of the building stock and the auxiliary equipment included in the building stock.

Event Waste Management Module

The **Manitoba Conference and Event GHG Calculator** includes the GHG emission for waste generated by the event and sent to landfill for disposal. Below is the methodology used for this calculation.

Equation 3: *Estimating GHG emissions from event waste sent to landfill:*

$$\mathbf{EventWaste_{Emissions} = Waste * EmInt_{Waste}}$$

Where

$EventWaste_{Emissions}$ = Total GHG emissions from waste sent to landfill
Waste = Total mass of waste generated and sent to landfill in tonnes
$EmInt_{Waste}$ = GHG emission intensity (tonnes CO_2e/tonne) for waste

Table 3. Emission effects of different waste management practices, by type of material (kg CO2e/kg of waste)3

	Net Source Reduction Emissions	Net Recycling Emissions	Net Composting Emissions	Net Landfilling Emissions
Newsprint	-3.81	-2.81		-1.22
Fine Paper	-5.93	-3.33		1.18
Cardboard	-5.22	-3.34		0.29
Other Paper	-5.51	-3.36		0.71
Aluminum	-4.55	-6.49		0.01
Glass	-0.4	-0.1		0.01
HDPE	-2.74	-2.27		0.01
PET	-3.5	-3.63		0.01
Other Plastic	-3.01	-1.8		0.01
Food Scraps			-0.24	0.9

Table notes: For newsprint, it is assumed that carbon is sequestered into the landfill.

Using the Calculator

The **Manitoba Conference and Event Calculator** is an important tool for measuring this aspect of an organizations' carbon footprint. Understanding the GHG emissions arising from the delivery of conferences and similar events is a valuable step in addressing climate change in

[3] From http://www.recycle.ab.ca/Download/GHG_Impacts_Summary.pdf

Manitoba. This tool allows for organizations to start with options for reducing and offsetting GHG emissions from discrete events like conferences before addressing the carbon footprint of the entire organization.

The calculator can produce a meaningful estimate of the GHG emissions from a conference with details on delegate travel but without precise data on the venue. This baseline measurement is the starting point for planning how to reduce GHG emissions for future events or for offsetting a conference. The calculator links the user to incentive programs and recommended actions for reducing the GHG emissions. Users can select the options that are appealing to their organization and see the results reflected in a lower carbon footprint over time. Managing GHG emissions from conferences is a useful first step in Manitoba's climate change strategy and a way for organizations to reduce their carbon footprint and distinguish their event from others.

Appendix A. GHG Emission Factors for Attendee Travel

Table 1. GHG Emission Intensities for Travel by Personal Passenger Vehicle

	Fuel consumption (L/100 km)			Emission Intensity CO_2e (tonnes/km)	
Type of Vehicle	**City**	**Highway**	**Blended**	**Gas**	**Diesel**
Sub-compact (Honda Civic)	8.2	5.7	6.8	0.0001632	0.0001836
Compact (Mazda 3)	9.2	6.7	7.8	0.0001872	0.0002106
Mid-size (Chevrolet Malibu)	12.2	7.8	9.8	0.0002352	0.0002646
Full-size (Ford Crown Victoria)	13.4	8.6	10.8	0.0002592	0.0002916
Station Wagon (Volkswagen Passat Wagon)	12.7	8.3	10.3	0.0002472	0.0002781
Pickup Truck (Dodge Dakota)	14.4	9.8	11.9	0.0002856	0.0003213
Special Purpose (SUV) (Cadillac Escalade)	17.7	10.8	13.9	0.0003336	0.0003753
Minivan (Chrysler Town & Country)	12.2	7.9	9.8	0.0002352	0.0002646
Large Van (GMC Savana)	15.4	11.2	13.1	0.0003144	0.0003537

Source: Natural Resources Canada Vehicle Fuel Efficiency Guide 2009

Table 1 includes representative GHG emission intensities for common vehicle classes. These intensities may not precisely reflect the intensities of the vehicles actually used. For a precise calculation of GHG emissions from personal passenger vehicles identify the specific vehicles used in the Natural Resources Canada Vehicle Fuel Efficiency Guide 2009. The fuel consumption ratings (in L/100 km) found in the guide should be multiplied by a GHG emission factor of 2.4 kg/L for gasoline and 2.7 kg/L for diesel.

Table 2. GHG Emission Intensities for Travel by Mode and Type of Trip

Mode	Emission Intensity CO_2e (tonnes/PKT)
Bus	0.00007137
Train	0.0001902
Airplane:	
Short haul (under 500 km) small jet (e.g., Dash 8), all seating	0.00014
Medium haul (500 to 1600 km) regional jet (e.g. CRJ-2), economy seating	0.00012
Medium haul (500 to 1600 km) regional jet (e.g. CRJ-2), business class	0.00017
Medium haul (500 to 1600 km) turbo prop (e.g., NexGen Q400), all seating	0.00011
Long haul (over 1600 km) large jet (e.g., Boeing 767), economy seating	0.00011
Long haul (over 1600 km) large jet (e.g., Boeing 767),business class seating	0.00021

Source: GHG emission intensity estimates shown here are estimated using the methodology described below using fuel GHG emission estimates from Statistics Canada Energy Statistics Handbook 2008, and EMEP/CORINAIR Emission Inventory Guidebook (EIG)

Estimating Distance Traveled and GHG Emission Factors

The first step in estimating the GHG emission associated with vacation travel is establishing the passenger kilometres traveled (PKT) associated with travel by mode. The precise measure of distance traveled depends upon the mode of travel and the geographical location of the origin and destination of the trip.

To determine the distance traveled the calculator relies a mapping application such as the web-based Google Maps application[4] or similar tool using departure and destination address for all trips:

Airplane

- PKT by airplane are based on the great circle distance function calculating the distance between the origin and destination points (this is the most direct route after accounting for the curvature of the earth).

  Great Circle Distance is calculated as:
  Earth Radius = 6371;
  lat_delta = lat1 - lat2;
  long_delta = long1 - long2;
  a = Math.sin(lat_delta/2) * Math.sin(lat_delta/2) + Math.cos(lat1) * Math.cos(lat2) * Math.sin(long_delta/2) * Math.sin(long_delta/2);
  c = 2 * Math.atan2(Math.sqrt(a), Math.sqrt(1-a));
  distance = EARTH_RADIUS * c;
  Source: http://en.wikipedia.org/wiki/Great-circle_distance

- Factors that influences the distance of a flight include re-routes, head winds, refuelling stops, or other factors that can take a plane off of its optimal flight path. Therefore following the approach used by the International Civil Aviation Organization (ICAO), correction factors are applied to the estimated PKT based on the distance of each flight. These are provided below:

Table 3. Correction Factors Used to Estimate Flight Distances

Flight Distance	Correction to Flight Distance
Less than 50 km	+ 50 km
Between 550 km and 5500 km	+ 100 km
Above 5500 km	+ 125 km

- The GHG emission resulting from a trip by airplane is a function of both distance travelled and the GHG emission intensity of the specific trip. The GHG emission intensity of air travel is a function of a number of independent and interdependent factors which in some cases are known and in some cases must be assumed, including:

[4] http://maps.google.com/

1. Trip length:
   The length of a flight dictates the type and size of the aircraft used and the total amount of fuel used in the flight. In particular, since more fuel is required to lift an airplane to 3,000 feet (termed the landing and take-off cycle, or LTO) than is required during the 'cruise' phase of the flight, shorter trips will be more GHG emission intensive when measured on a flight or a passenger kilometre traveled (PKT) basis. This assumes that an aircraft flies directly between these two airports. A 10% correction factor is applied to account for things like circling, adjustments of flight routes, headwinds, etc.

2. Aircraft type and size:
   It is also important to note that there are large variations in the fuel burn rates (FBRs) and the subsequent GHG emission intensities within the different categories of aircraft. For example, for flights above 1,600 km, the aircraft used might be a Boeing 767 300 series, an Airbus 343, or a Boeing 767 299 series, all of which have different seat configurations and technical efficiencies. In order to provide a suitable metric, a representative sample of aircraft within each distance range has been taken in order to generate an average FBR and GHG emissions intensities based on a series of distance categories.

3. Airplane engine type:
   While jet engines are still dominant for most continental and intercontinental flights, turbo prop engines are now used by some airlines. Industry literature suggests that for similar size airplane, turbo prop engines can be between 30% and 40% more efficient than aircraft powered by jet engines. This type of airplane is an option available for user selection.

4. Airplane age:
   Due to technological improvements, change in materials, improvements in aerodynamics, amongst other factors, and a drive to become more cost efficient and competitive, there are continuous improvements in the efficiency of newer airplanes. The effects of aircraft age on GHG emissions are reflected by the FCR used in estimating these. This is not a required user input.

5. Proportion of passengers to freight
   The proportion of passengers to freight on any given flight will influence the emission intensity of passenger travel. If passengers are carried on a flight, then all the emissions generated by the movement of the aircraft is distributed to the passengers. However, in the freight is also moved, in order to be accurate, the emissions associated with the freight must be allocated proportionally based on the weight of this freight. In Canada as is the case in other countries, it is generally the wide bodied aircraft that carry the most freight as a proportion of total weight of the passenger/freight load. The allocation of emissions to passengers and freight is made according to statistics available from ICAO where it is assumed that wide bodied aircraft (used for long haul) may have freight contributing to upwards of 20% of their

total load, and narrow bodied aircraft having freight contribute less than 5% to total load. This is not a required user input.

6. Class of seat:
   Each class of seat on an aircraft is responsible for a certain amount of the total GHG emission based on the "foot print" of that seat – i.e., how much space is taken up. Since seats in first/executive/business class can require up to twice the space of those in economy class, these seats account for more GHG emissions on a per passenger basis. Users can select the seating option in the calculator.

7. Airplane occupancy:
   The occupancy of a flight has an inverse relationship with the emission intensity of air travel since the more seats that are occupied on an airplane, the lower the average GHG emissions intensity of that flight per passenger. The same holds true in terms of fuel consumption, and is why airline companies continuously try to increase occupancy rates by strategic flight scheduling, etc. Aircraft occupancies have been steadily rising in Canada over the last number of years, and recent estimates are that occupancies are over 80% on most domestic flights. To be conservative, a value of 75% for all flights is used in this calculator. This is not a required user input.

- The parameters that characterize these different categories, and in turn, influence the emission intensity of each are summarized in table 3.

Table 4. Aspects of Air Travel Affective Fuel Burn Rate

Flight distance (km)	Example of aircraft type	FBR (kg/km)[a]	Number of seats[b]		Footprint of seat (pitch * height) ($inches^2$)[b]	
			Economy	*Executive*	*Economy*	*Executive*
> 1,600	Boeing 767 300 series	5.26	173	30	605	1 230
<1,600 and >500	Airbus 320	3.36	120	20	544	777
<1,600 and >500	Boeing 737 300 series (only economy class)	3.01	137		544	
<1,600 and >500	Regional jet	1.67	50-70		544	
<1,600 and >500	Regional turbo prop[c]	1.02	50-70		544	
<=500	Dash 8	0.49	37		544	

Table notes:

a) Fuel burn rates are for the cruise cycle from the EMEP/CORINAIR Emission Inventory Guidebook (EIG)

b) The number and size of seats on each type of aircraft is taken from www.seatguru.com.

c) For regional turbo prop aircraft, industry data indicated that these aircraft are 30%-40% more fuel efficient than comparable regional jets (http://www.q400.com/q400/en/turbo.jsp).

Personal Passenger Vehicle

- To generate estimates of PKT for personal passenger vehicle, actual km travelled as per a mapping application that traces the road network from point of departure to point of destination, selecting the shortest distance along the road network.

- The estimation of the GHG emission for a passenger vehicle is more complex than other modes due to the wide-range of cars and trucks available and the variations in GHG emission intensities across vehicle type. Table 1 in Appendix A provides a list of typical vehicle fuel efficiencies and GHG emission intensities. To more precisely estimate the GHG emission for personal passenger vehicles, the Natural Resources Canada Vehicle Fuel Efficiency Guide 2009 may be used to identify the specific vehicle fuel consumption rating (in L/100 km) which can then be multiplied by a GHG emission factor of 2.4 kg/L for gasoline and 2.7 kg/L for diesel.

Bus

- To generate estimates of PKT for rail, a mapping application that traces the road network from point of departure to point of destination, selecting the shortest distance along the road network.

- For passenger bus transportation, the GHG emission factor is generated from data available from the transportation tables contained in the Comprehensive Energy Use Database provided by the Office of Energy Efficiency. Specifically, the OEE provide estimates of GHG emissions and passenger kilometre traveled by intercity-bus in Canada. Analysis of this data suggests an emission intensity of 71.37 grams (0.07137 kg) of CO_2e per passenger kilometre traveled on intercity-bus.

Train

- To generate estimates of PKT for rail, a mapping application using the great circle distance function calculating the distance between the origin and destination points (this is the most direct route after accounting for the curvature of the earth) is used. This is based on the assumption that rail transportation infrastructure follows closely the most direct route between major centres.

- For passenger train transportation, the GHG emission factor is generated from data available from Transport Canada's T-Facts website.5 For passenger rail transportation, this provides data on total passenger PKT, as well as the fuel consumption associated with this activity. This allowed the calculation of GHG emissions, resulting in a GHG emissions intensity of 190.2 grams (0.1902 kg) of CO_2e per PKT.

[5] http://www.tc.gc.ca/pol/en/T-Facts3/Statmenu_e.asp?type=pu&file=rail&Lang=

Appendix B. GHG Emission Factors for Landfill

Table 5. GHG Emission Intensities for Hotel Waste Directed to Landfill for Disposal

Region	Waste Disposed to landfill[a] (kilotonnes)			Total GHG Emissions[b] (kt CO_2e)	Emission intensity[c]
	Residential sources	Non-residential sources	All sources		CO_2e (tonnes/tonne of waste landfilled)
Newfoundland and Labrador	228	180	408	600	1.47
Nova Scotia	169	232	402	520	1.29
New Brunswick	216	234	450	590	1.31
Prince Edward Island					
Quebec	2,184	4,625	6,808	4600	0.68
Ontario	3,705	6,733	10,438	6600	0.63
Manitoba	455	569	1,024	960	0.94
Saskatchewan	296	538	834	990	1.19
Alberta	974	2,846	3,820	2400	0.63
British Columbia	957	1,960	2,917	3400	1.17
Yukon/NWT/Nunavut					
Canada	9,238	18,011	27,249	21000	0.77

Table notes:

a. *From Statistics Canada's Waste Management Industry Survey, "Disposal of waste — by source and by province and territory"*
b. *From Environment Canada, " National Inventory Report: 1990 to 2006"*
c. *It should be noted that the emission intensities calculated don't reflect the amount of waste exported or imported into a province, but are based on the assumption that all provincial waste reported as entering disposed in a landfill are disposed in the respective provincial landfills*

The GHG emission intensity of landfill waste is a function of the age of a landfill, the mix of waste in the landfill, climate conditions, and if landfill gas collection systems are in place. The GHG emission totals resulting from waste generation is available for the various regions across Canada from the National Inventory Report. The amount of waste sent to landfill is estimated based on data from the Waste Management Survey completed by Statistics Canada.