Taking Credit for Reductions in GHG Emissions at Waste Composting Facilities

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Outline

- Basic conceptual and technical background to GHG emissions, offsets and carbon trading.
- Composting Protocols – uses, commonalities and differences.
- Simplified composting offset calculation example (sort of Alberta Offset System based).
- City of Edmonton composting offset calculation example.
- Review process for Alberta Aerobic Composting Protocol.
- Bigger Picture Crystal Balling.
What are Offsets?

Offsets are reductions in greenhouse gas emissions resulting from carrying out voluntary, non-regulated activities that are different from the business-as-usual scenario.
The Concept of GHG Offsets

Formalization of GHG offsets under 1997 Kyoto Protocol – 2 market mechanisms:

- Clean Development Mechanism – rich nations “offset” their emissions through investing in clean energy projects in developing world.
- Regulated domestic emitters (industries) have their free GHG emissions “capped”. Sale of surplus credits, purchase of shortfall credits (CERs and offsets) from regulated or non-regulated industries/activities through trading.
Points About Carbon Trading

- Reducing GHG emissions at lowest societal cost.
- Use of market mechanisms to determine price of carbon versus governments through setting carbon taxes.
- CDM is Communist plot for transferring wealth from first world to third world.
- CDM mechanism is cumbersome, bureaucratic, subject to abuse.
- Carbon trading during recessionary times reduces the cost of emissions.
- Transfer of emissions from first world to third world under Kyoto.
- “Capping” by industry sector reduces competition.
Kyoto Realities

- Kyoto Protocol signed in 1997, only came into effect in 2005 after a set minimum number of nations ratified it.
- Value of regulated carbon trading through EU Trading System had grown to $120 Billion/yr by 2010.
- U.S. did not ratify Kyoto, Canada, Australia have never met emission targets. Canada announced it was pulling out of Kyoto at COP 17 in Durban, SA in Dec 2011.
- Largely voluntary carbon markets in North America except for regulated Alberta market.
Offset Project/Activity Eligibility

Internationally Accepted Principles in all offset systems – IPCC Based:

- Must originate from **VOLUNTARY** actions in a non-regulated sector or operation.
- Be real, demonstrable, quantifiable.
- Have clearly established ownership.
- Be counted once for compliance purposes; and
- Be “**validated**” and “**verified**” by qualified third parties.
Side note: Validation vs. Verification

Validation/verification guidelines follow from the ISO 14064-3: 2006 standard.

**Validation** - the process of determining project eligibility and focuses on whether project/baseline conditions and methodology are appropriate – “process” check.

**Verification** - checks calculation correctness and data integrity, consistency, completeness and accuracy – “bean counting” exercise.
Protocols are SOPs for ensuring all relevant measurement, monitoring and GHG quantification elements (sources, sinks, residues) associated with a non-regulated activity are considered in a complete life cycle analysis.

Use of pre-approved protocols largely negates the need for validation except for unique projects.

Various jurisdictions have various ways to develop and approve protocols.
Various Composting Protocols

- CDM AM0025 – originally developed for composting activities at landfill in Bangladesh.
- CCX Composting Protocol – approved for voluntary CCX market Apr 2009, discarded after CCX closed.
- WCI – review of existing protocols for 2012 launch.
- CCC Composting Protocol – under development, stalled by climate change inaction at federal level.
Some Composting Protocol
Commonalities and Differences

- General IPCC principles.
- Avoidance Theory Nuances.
- System Boundary Conditions.
- Inclusions and Exclusions – N$_2$O, energy inputs, WTE, LFG capture.
- Crediting Period, early start dates.
Baseline Alternative to Composting

- Typically, the alternative fate for waste organics is landfilling.
- Landfills $\leftrightarrow$ anaerobic digesters w/ no mixing.
- Multi-step degradation of organics under anoxic and anaerobic conditions to yield $\text{CO}_2$, $\text{CH}_4$, VOCs as GHG products.
Net Emission Reduction

\[
\text{Emission Reduction (Offsets)} = \text{Emissions}_{\text{Baseline}} - \text{Emissions}_{\text{Composting}}
\]

“Business-As-Usual” scenario  “Project” scenario
Estimation of GHG Production

- Rough estimates of GHG production can be determined stoichiometrically.
- More rigorous methods through modelling.
- Estimates/calculations for GHG production: composting versus baseline case.
- GWP of various GHGs: CO$_2$, CH$_4$, NO$_x$, CO, SO$_x$
A quantity is said to be subject to exponential decay or “first order decay” if it decreases at a rate proportional to its value.

First Order Decay occurs in a wide variety of situations. Most of these fall into the domain of natural sciences and engineering.

FOD Modeling Applications:

- In pharmacology and toxicology, in the distribution, metabolism and elimination of substances from organisms.
- Radioactive decay of Carbon 14.
- Gas production from anaerobic digesters.
Scholl Canyon FOD Model is Preferred for Estimating LFG Generation

Environment Canada – National Inventory Report 1990 - 2004
(http://www.ec.gc.ca/Publications/EF6E84CA-5C7D-473B-AE0D-7C8FF1B405F3/NationalInventoryReport19902004GreenhouseGasSourcesAndSinksInCanada.pdf)


“The model accounts for the main factors responsible for LFG generation while providing a matrix approach that allows users to input site-specific information regarding climatic conditions, specifically precipitation. While a number of inputs have been described, these are all generally obtainable by landfill owners and operators.”

Waste Management Services
The methane generation potential, $L_0$, represents the total potential yield of methane.

The $L_0$ value is dependent on the composition of waste, and in particular the fraction of organic matter present.

The fraction and type of organic matter present in waste dictates the $L_0$ and potential for methane generation.

$L_0$ equals the integration of the first order decay equation from $t = 1$ to $t = \infty$.

$L_0$ is independent of the methane generation rate constant, $k$. 

**Methane General Potential $L_0$**

![Edmonton City Logo](Edmonton.png)
Scholl Canyon Time Distribution of Methane Generation Potential $L_o$ in a Landfill

Single number $L_o$ adjusted by a CH$_4$ rate generation constant $k$, and a first order time distribution function $e^{-kt}$, is the Scholl Canyon FOD equation for emissions from a landfill as illustrated below.

$$kL_o \times e^{-kt} = L_o = \text{total area under curve}$$

As per 2006 IPCC Guidelines, $L_o = M \times MCF \times DOC \times DOC_f \times F \times 16/12 \text{ kgs CH}_4/\text{tonne waste}$
Summation of FOD Curves Over Time

Time period of active landfilling

$CH_4$ Emissions ($Q$)

Time (Yrs)

0 1 2 100 $\infty$
Numerical Approximation of FOD Model Equation

\[ Q_t = \sum_{i=1}^{n} 2k L_o M_i e^{-kt_i} \]

Where
- \( Q_t \) = total LFG emission rate, volume/time
- \( n \) = total time periods of waste placement
- \( k \) = LFG emission constant, time\(^{-1}\)
- \( L_o \) = methane generation potential, volume/mass of waste
- \( t_i \) = age of the \( i \)th section of waste, time
- \( M_i \) = mass of wet waste, placed at time \( i \)
**Baseline Calculation Nuances**

- CAR protocol uses a FOD model adapted from the UNFCCC CDM methodology for quantifying CH$_4$ emissions over 10 year time frame, discounts for WTE and LFG capture.
- CCX protocol baseline calculation assumed 3 years unabated CH$_4$ emissions and then 75% LFG capture from years 4-10.
- Alberta protocol baseline uses an Environment Canada National Inventory equation that calculates $L_o$ (total CH$_4$ generation potential) and then reduces it by a baseline correction factor of 20% and a further 10% for landfill cover oxidation of CH$_4$.
- Under both baseline and composting conditions, only quantities of CH$_4$ are counted. CO$_2$ emissions in all protocols are considered biogenic and are therefore not considered.
GHG Generation from Composting

ORGANIC MATERIAL + \( 0_2 \) → MICROBIAL METABOLISM → STABILIZED ORGANIC RESIDUE (Finished compost) + \( \text{CO}_2 + \text{H}_2\text{O} + \text{HEAT} \)

Aerobic Conditions

Waste Management Services
**System Boundaries CDM Composting Protocol**

- **Waste Production** (households, commercial)
- **Waste collection, sorting, transportation**
- **Sorting**
- **Landfill**
- **Recycle**
- **Aerobic Conversion**
- **Compost**
- **End User**
  - On site use of electricity
  - Electricity from grid
  - On site use by dozers
  - Fuel (Diesel)

Boundary Limit
Quantification of emissions from:
- Project construction activities - discounted;
- Project decommissioning activities – insubstantial; and
- Ongoing facility operations:
  - Process conversion of feedstock to compost;
  - Fuel used in on-site transporting, handling and processing of feedstock and residuals;
  - Natural gas consumption; and
  - Landfilling of composting residuals.
Simplified Offset Calculation Example (Alberta Protocol Based)

Collected bagged yard waste (9,000 tonnes)

Collected brush and tree trimmings (1,500 tonnes)

Debagging

On-site waste wood chipping

Windrow composting using FEL

Screening cured compost

Compost sales to end users

On-site diesel use (screener, chipper and FEL) (26,000 L)

Landfilled residues from debagging and screening (400 tonnes (100 t organics))

On-site natural gas use for building heating (garage and office) (2,000 GJ)

Natural gas

Diesel fuel

700 tonnes (350 t organics)
**Baseline Emissions**

\[ E_{\text{baseline}} = [M_{\text{delivered}} \times \%_{\text{disposed}} (\text{MCF}) (\text{DOC}) (\text{DOC}_F) (F)(16/12) – R][1-OX][\text{GWP}_{\text{methane}}] \]

Where:
- \( E_{\text{baseline}} \) = \( \text{CH}_4 \) emissions from landfilled waste in CO\(_2\) equivalent (tonnes)
- \( M_{\text{delivered}} \) = waste delivered to composting facility (tonnes)
- \( \%_{\text{disposed}} \) = baseline adjustment factor of 0.8 in Alberta to account for total waste in Alberta already being composted in 2002 (uncertainty, conservativeness)
- \( \text{MCF} \) = methane correction factor
  = 1 for managed landfills (IPCC default)
- \( \text{DOC} \) = degradable organic fraction of waste (tonne C/tonne waste)
  = 0.19 for Alberta (calculated using Environment Canada data)
- \( \text{DOC}_F \) = fraction of degradable organic carbon dissimilated
  = 0.77 (IPCC default)
- \( F \) = fraction of LFG that is \( \text{CH}_4 \), assumed to be 0.5
- \( 16/12 \) = stoichiometric factor (molecular weight fraction of \( \text{CH}_4/C \))
- \( R \) = recovered landfill gas at baseline landfill (measured)
- \( \text{OX} \) = landfill oxidation factor
  = 0.1 for landfills with soil or compost covers (IPCC default)
- \( \text{GWP}_{\text{methane}} \) = global warming potential of methane of 21 (IPCC default)
Composting Emissions

\[ E_{\text{CH}_4\text{composting}} = M_{\text{delivered}} \times E_{\text{F CH}_4} \times G_{\text{WP methane}} \]

Where
- \( E_{\text{CH}_4\text{composting}} \) = CH4 emissions from composting in tonnes CO2 equivalent
- \( M_{\text{delivered}} \) = mass of waste composted (tonnes)
- \( E_{\text{F CH}_4} \) = emission factor for methane generation from composting
  = 0.004 tonnes CH4 per tonne (IPCC default)
- \( G_{\text{WP methane}} \) = global warming potential for CH4 of 21 (IPCC default)

\[ E_{\text{N}_2\text{Ocomposting}} = M_{\text{delivered}} \times E_{\text{F N}_2\text{O}} \times G_{\text{WP nitrous oxide}} \]

Where
- \( E_{\text{N}_2\text{Ocomposting}} \) = N2O emissions from composting in CO2 equivalent tonnes
- \( M_{\text{delivered}} \) = mass of waste composted (tonnes)
- \( E_{\text{F CH}_4} \) = emission factor for nitrous oxide generation from composting
  = 0.0003 tonnes CH4 per tonne (IPCC default)
- \( G_{\text{WP N}_2\text{O}} \) = global warming potential for N2O of 310 (IPCC default)
Natural Gas Usage Emissions

\[ E_{ng} = (F_{CO2})(V_{ng}) + (F_{CH4})(V_{ng})(GWP_{CH4}) + (F_{N2O})(V_{ng})(GWP_{N2O}) \]

Where \( E_{ng} \) = direct GHG emissions from natural gas combustion, kg CO\(_2\)-e

- \( F_{CO2} \) = emission factor for CO\(_2\) emissions from natural gas combustion
  - = 1.891 kg CO\(_2\) per m\(^3\) (CAPP value)

- \( V_{ng} \) = volume of natural gas consumed (m\(^3\))

- \( F_{CH4} \) = emission factor for CH\(_4\) emissions from natural gas combustion
  - = 0.00049 kg CH\(_4\) per m\(^3\) (CAPP value)

- \( GWP_{CH4} \) = global warming potential for CH\(_4\) of 21 (IPCC default)

- \( F_{N2O} \) = emission factor for N\(_2\)O emissions from natural gas combustion
  - = 0.000049 kg N\(_2\)O per m\(^3\) (CAPP value)

- \( GWP_{N2O} \) = global warming potential for N\(_2\)O of 310 (IPCC default)
Upstream Natural Gas Extraction and Production Emissions I

\[ E_{ng, ep} = (F_{CO2,e} + F_{CO2,p})(V_{ng}) + (F_{CH4,e} + F_{CO2,p})(V_{ng})(GWP_{CH4}) + (F_{N2O,e} + F_{N2O,p})(V_{ng})(GWP_{N2O}) \]

Where \( E_{ng, ep} \) = upstream GHG emissions from natural gas extraction and production, kg CO\(_2\)-e

\( F_{CO2,e} \) = emission factor for CO\(_2\) emissions from natural gas extraction
= 0.0043 kg CO\(_2\) per m\(^3\) (CAPP value)

\( F_{CO2,p} \) = emission factor for CO\(_2\) emissions from natural gas production
= 0.090 kg CO\(_2\) per m\(^3\) (CAPP value)

\( V_{ng} \) = volume of natural gas consumed (m\(^3\))

\( F_{CH4,e} \) = emission factor for CH\(_4\) emissions from natural gas extraction
= 0.0023 kg CH\(_4\) per m\(^3\) (CAPP value)

\( F_{CH4,p} \) = emission factor for CH\(_4\) emissions from natural gas production
= 0.0003 kg CH\(_4\) per m\(^3\) (CAPP value)

\( GWP_{CH4} \) = global warming potential for CH\(_4\) of 21 (IPCC default)
\[ E_{ng, ep} = (F_{CO2,e} + F_{CO2,p})(V_{ng}) + (F_{CH4,e} + F_{CO2,p})(V_{ng})(GWP_{CH4}) + (F_{N2O,e} + F_{N2O,p})(V_{ng})(GWP_{N2O}) \]

And,

Where \( F_{N2O} \) = emission factor for \( N_2O \) emissions from natural gas extraction

\[ = 0.000004 \text{ kg } N_2O \text{ per m}^3 \text{ (CAPP value)} \]

\( F_{N2O} \) = emission factor for \( N_2O \) emissions from natural gas production

\[ = 0.000003 \text{ kg } N_2O \text{ per m}^3 \text{ (CAPP value)} \]

\( GWP_{N2O} \) = global warming potential for \( N_2O \) of 310 (IPCC default)
Diesel Usage Emissions

\[ E_{\text{diesel}} = (F_{\text{CO}_2})(V_{\text{diesel}}) + (F_{\text{CH}_4})(V_{\text{diesel}})(\text{GWP}_{\text{CH}_4}) + (F_{\text{N}_2\text{O}})(V_{\text{diesel}})(\text{GWP}_{\text{N}_2\text{O}}) \]

Where

- \( E_{\text{diesel}} \) = direct GHG emissions from diesel combustion, kg CO\(_2\)-e
- \( F_{\text{CO}_2} \) = emission factor for CO\(_2\) emissions from diesel combustion
  
  \[ = 2.730 \text{ kg CO}_2 \text{ per m}^3 \text{ (CAPP value)} \]
- \( V_{\text{diesel}} \) = volume of diesel gas consumed (m\(^3\))
- \( F_{\text{CH}_4} \) = emission factor for CH\(_4\) emissions from diesel combustion
  
  \[ = 0.000133 \text{ kg CH}_4 \text{ per m}^3 \text{ (CAPP value)} \]
- \( \text{GWP}_{\text{CH}_4} \) = global warming potential for CH\(_4\) of 21 (IPCC default)
- \( F_{\text{N}_2\text{O}} \) = emission factor for N\(_2\)O emissions from diesel combustion
  
  \[ = 0.0004 \text{ kg N}_2\text{O per m}^3 \text{ (CAPP value)} \]
- \( \text{GWP}_{\text{N}_2\text{O}} \) = global warming potential for N\(_2\)O of 310 (IPCC default)
Diesel Production Emissions

\[ E_{\text{diesel},p} = (F_{\text{CO}_2,p})(V_{\text{diesel}}) + (F_{\text{CH}_4,p})(V_{\text{diesel}})(GWP_{\text{CH}_4}) + (F_{\text{N}_2\text{O},p})(V_{\text{diesel}})(GWP_{\text{N}_2\text{O}}) \]

Where

- \( E_{\text{diesel},p} \) = upstream GHG emissions from diesel production, kg CO\(_2\)-e
- \( F_{\text{CO}_2,p} \) = emission factor for CO\(_2\) emissions from diesel combustion
  = 0.138 kg CO\(_2\) per m\(^3\) (CAPP value)
- \( V_{\text{diesel}} \) = volume of diesel gas consumed (m\(^3\))
- \( F_{\text{CH}_4} \) = emission factor for CH\(_4\) emissions from diesel production
  = 0.0109 kg CH\(_4\) per m\(^3\) (CAPP value)
- \( GWP_{\text{CH}_4} \) = global warming potential for CH\(_4\) of 21 (IPCC default)
- \( F_{\text{N}_2\text{O}} \) = emission factor for N\(_2\)O emissions from diesel production
  = 0.000004 kg N\(_2\)O per m\(^3\) (CAPP value)
- \( GWP_{\text{N}_2\text{O}} \) = global warming potential for N\(_2\)O of 310 (IPCC default)
Calculation Results

- Baseline emissions from landfilling feedstock = 14,847 tonnes CO$_2$-e.
- Project Emissions:
  - Composting = 1,708.05 tonnes CO$_2$-e
  - On-site diesel/natural gas consumption = 175.95 tonnes CO$_2$-e
  - Upstream diesel/natural gas extraction/processing = 19.65 tonnes CO$_2$-e.
  - Landfill disposal of residuals = 831.6 tonnes CO$_2$-e
- Net calculated offsets = 12,111.75 tonnes CO$_2$-e
Edmonton Composting Facility
Complexities

- Separation of landfilled residuals in stages in composting process, different organic fractions for each type of residual.
- Composting residuals landfilled in 3 different landfills, one with LFG extraction, 2 without.
- Sophisticated site scale and data management software w/ 50+ material codes, 15 destination codes, report filtering.
- On site combustion of gasoline and propane in composting operation in addition to natural gas and diesel.
- Composting of biosolids, offset calculations only for accompanying waste woodchips used in process.
- Utility and fuel data from internal and corporate sources.
Calculation Parameters

- Mixed MSW feedstock = 100,000 tonnes
- Wood chips = 10,000 tonnes
- Discards = 8,000 tonnes, 0% organic, landfilled at site w/o LFG collection
- Primary Residuals = 14,000 tonnes, 13.4 organic, landfilled at site w/o LFG collection
- Secondary Residuals = 15,000 tonnes, 45.3% organic, landfilled at site w/o LFG collection
- Tertiary Residuals = 2,000 tonnes, 45.3% organic, landfilled at site with LFG collection
- Natural gas usage = 29,600 GJ = 785,353 m³
- Diesel usage = 483,900 L
- Propane usage = 1,740 L
- Gasoline usage = 1,280 L
ECF Offset Calculation Parameters (Alberta Protocol Based)

Collected Mixed Residential MSW

- 100,000 tonnes
- Collected waste wood
- Dewatered municipal biosolids

Pre-processing

- ECF mechanical plant
- Compost curing
- On-site waste wood chipping
- Biosolids/wood chip mixing
- Screening cured compost
- Biosolids/wood chip composting

Primary Residuals 14,000 tonnes, 13.4% organic

Secondary Residuals 15,000 tonnes, 45.3% organic

- Residues to landfill w/ no LFG Collection
- Electricity from grid
  - Natural gas 29,600 GJ
  - Diesel fuel 483,900 L
  - Gasoline 1,280 L
  - Propane 1,740 m³

Tertiary Residuals 2,000 tonnes, 45.3% organic

- Residues to landfill w/ LFG collection
- Compost sales to end users

System Boundary

- Discards 8,000 tonnes, all non-organic

- 14,640,000 kWh

- 10,000 tonnes
Calculation Results

- Baseline emissions from landfilling feedstock = 104,370 tonnes CO$_2$-e.
- Project Emissions:
  - Composting = 9,101.871 tonnes CO$_2$-e
  - On-site diesel/natural gas/propane/gasoline consumption = 2,879.564 tonnes CO$_2$-e
  - Upstream fuel extraction/processing = 328.404 tonnes CO$_2$-e
  - Landfill disposal of residuals = 17,294.087 tonnes CO$_2$-e
- Net calculated offsets = 74,752.074 tonnes CO$_2$-e
General Tips on Protocol Based Offset Calculations

- Understanding of protocol boundaries, what materials composted are eligible, what emission calculations are required as part of the protocol.

- Collection of data required for protocol calculations – **data management integrity**.

- Back up documentation for data management for verification purposes – **data management integrity**.

Waste Management Services
Alberta Offset System: 2011-12 Composting Protocol Review

Current Alberta Aerobic Composting Protocol under review – GoA uncomfortable with:

- Risk of allowing 72% of $L_o$ as baseline; and
- Level of current project monitoring and documentation.

2011 GoA proposal to use FOD model 8 year baseline similar to CAR Protocol – unworkable:

- In a temperate dry climate (southern California, $k = 0.05$), baseline = 30.4% of $L_o$.
- In a tropical wet climate (Bangkok, $k = 0.15$), baseline = 67.7% of $L_o$.
- In a continental dry climate (Edmonton, $k = 0.024$), baseline = 15.9% of $L_o$.

*Under those terms, not only could there no longer be any offsets associated with composting, but the practice itself could become a NET EMITTER of greenhouse gases.*

Waste Management Services
Alberta Composting Protocol - Stakeholder Consultation

Baseline Working Group reviewing technical baseline alternatives and ways of reducing risk:

- Proposed alternative based on:
  - Potential LFG capture under real life Alberta conditions with time lag between active cells and capping.
  - Long term efficiency of LFG capture systems.

Best Management Practices Working Group reviewing process monitoring and documentation improvements:

- Draft Acceptable Industry Practice document written for in-vessel systems, static pile systems, windrow systems.

Waste Management Services
Alternative Baseline Successive Discounting Methodology for a Landfill in the Continental Dry Zone of Alberta with a 35 Year Operating Life

Baseline for mass M1 of organic material diverted in year 1 = integrated FOD values (area under the curve) discounted by 0% to Year 10, 50% for years 11-35, then 75% from years 36-100.

*Curve area shown as a box for graphical illustration purposes only. The actual spreadsheet discounts generation values on a year by year basis.
More Recent Alberta Composting Protocol Review Developments

- Regulator ejection of alternative baseline proposal due to discomfort w/ 100 year modeling period.
- Seemingly continuing desire to tie Alberta Protocol to CAR Protocol.
- Recent compromise to model CAR baseline to 20 yrs, connect allowable Alberta baseline to same % of $L_o$.  

Waste Management Services
Offsets Crystal Balling

Waste Management Services
Offsets in Context

A number of abortive attempts/delays in first decade of 21st century to set up GHG emission regulations and offset system at Canadian federal level – Liberal ditherers and Conservative naysayers.

Current official federal stance (prevalent since Conservatives came to power in 2006) is that Canada will do nothing until the U.S. sets up federal system.

Canada will harmonize with U.S., Alberta will harmonize with Canada.

Natural organic impetus for all protocols towards harmonization.
U.S. Developments 2008-12

- Obama government took office in 2008 with desire to develop cap & trade system as an emissions reduction strategy. However, first term focus on health care reforms, Democrats lost congressional majority in Nov 2010 mid term election results.


- CCX ceased voluntary trading of CERs at end of 2010.

- Regional systems – RGGI, WCI.
**U.S. Developments – 2nd Obama Term**

- Again, desire to take action on climate change.
- Unanticipated energy diverted to gun control efforts.
- Current U.S. Secretary of State is climate change hawk.
- Potential for attaching climate change related conditions to Keystone Pipeline approval.
- Impetus for upgrading federal Canadian and Alberta actions on climate change in response.
Global Context

- Need for successor to Kyoto Protocol – CDM and carbon credit mechanisms were to disappear when Kyoto expires at end of 2012.
- Limited extension of Kyoto to 2020 at COP 18 at Qatar in Dec 2012.
- No binding climate change treaty came from major UNFCCC conference in Copenhagen in late 2009 – carbon markets fell.
- Only minor developments from UN climate conference in Mexico in late 2010 (REDD).
- COP 17 Nov-Dec 2011 Durban SA, agreement to move towards development of new climate change treaty by 2015 to include third world major emitters (China, India) for the first time.
- Continued political will in EU to continue cap and trade through ETS, but ongoing EU fiscal crisis will undermine carbon trading for some time to come.
- Continued advocacy for carbon taxes versus carbon trading, e.g. James Hansen.
Climate Change – Need for Action

- Best climate change models indicate process irreversible with an average 2°C increase in global atmospheric temperatures above pre-industrial (1900) levels.
- This equates to 450 ppm atmospheric CO$_2$ concentration. Projections are that we will reach 400 ppm CO$_2$ by 2013-14 time frame.
- At the current rate of emissions, we hit the 450 ppm CO$_2$ level around 2050…
Questions???
Next Webinar

Digging into Community Gardens

Katherine Buckley
Agriculture & AgriFood Canada

Wednesday July 3, 2013
Noon CDST