Biomass and Biocarbon

BRIL - KTT Workshop

Ontario’s Agricultural Biomass Based Activate Biocarbon

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GHG Offsets 101

Presenter

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Jason has spent more than 11 years in the GHG industry. Jason has experience associated with the development of corporate greenhouse gas (GHG) inventories (Scope 1, 2, and 3) and leads Anthesis' internal Technical Team for the ongoing development of inventory best practice guidance and procedures. Jason has supported clients in a variety of different sectors including; energy (renewable/non-renewable), tech, manufacturing, chemicals, mining/mineral production, waste, and forest, land and agriculture (FLAG). Jason is a former verifier (auditor) and has experience with quality assurance and quality control (QA/QC) of corporate GHG inventories and offset projects. In addition to Jason's corporate carbon accounting experience he has provided services related to offset project feasibility assessments, offset methodology development, support with corporate sustainability/ESG reporting, ESG related disclosures, reduction targets, and developing & implementing GHG reduction strategies.

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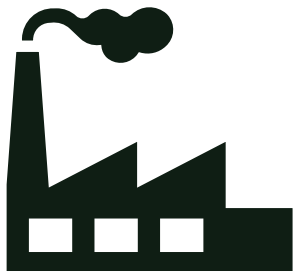
Metric tonne of carbon dioxide equivalent (tCO2e)



Most Common Compounds	Global warming potentials (IPCC AR5)
Tonnes of carbon dioxide **($t CO_2$)**	× 1
Tonnes of methane **($t CH_4$)**	× 28
Tonnes of nitrous oxide **($t N_2O$)**	× 265

Other Compounds:

1 GHG Offset = 1 metric tonne of carbon dioxide equivalent (tCO_2e)

What are offsets and offset projects?

- Offsets are generated from projects that reduce GHG emissions (i.e. are net carbon negative) and go beyond the business-as-usual conditions
- The economic value of the offset credits is intended to provide the incentive needed to develop the offset project
- Project-specific calculation methodologies are required to accurately determine the number of offsets generated based on the activity
- Projects are required to be registered in a compliance or voluntary offset program/registry to create fungible credits
- Project developers can sell offsets to buyers that are aiming to reduce their GHG emissions

Feasibility & Methodology Selection

- Review of on-farm activities that contribute to emission reductions
  - **What are you doing right now?**
    - Understanding the **Baseline** conditions
  - **What could you be doing?**
    - Establishing the **Project** conditions
  - **What is preventing you from doing this?**
    - Yield impacts
    - Increased costs
    - Increased maintenance
    - Transportation and storage
    - Others?

Baseline Emissions – Project Emissions = Emission Reductions/Offsets

Generation of GHG Offsets

Offset calculation protocols govern the generation of offsets from a specific project activity. Offset protocols can also be referred to as calculation methodologies.

Offset Protocols typically…

- Define the applicable project type or activity (i.e. what activity is reducing emissions)
- Identify the requirements for the project activity to be eligible for offset generation:
  - Legal aspects and additionality
  - Regulatory requirements
  - Permanence, as applicable
  - Location
  - Project start date
  - Reporting and crediting periods
  - Other project and location specific requirements
- Set out requirements for monitoring, reporting, and quantification of the Baseline and Project conditions
  - *Baseline Emissions – Project Emissions = Offsets*
- Provide verification guidance

Protocol Components

- **Documentation and Records** – Ensuring proper justification and evidence of the emission reductions achieved as part of the project. *Data must be quantifiable, measurable, and verifiable.*
- Baseline documentation examples:
  - Type and quantities of fuels used (e.g. fuel purchase invoices)
  - Quantities of biomass, consistent across baseline and project (e.g. weigh scale tickets)
  - Location and characteristics of the landfill where biomass would be disposed (e.g. type of landfill, cover conditions, gas collection, etc.)
  - Any other energy use in the baseline condition that would change as a result of the project (e.g. mobile fuel use for equipment)

- Project documentation examples:
  - Quantities of biomass
  - Evidence of energy generation (e.g. heat and electricity meter data)
  - Any fuels used
  - Biomass storage conditions and timing
- **Record Keeping**
  - Any changes to the data (i.e. data gaps and adjustments)
  - Maintenance logs
  - Calibration records
  - Data storage and back-up

Offset Project Development Roadmap

Project Feasibility
- Establish the project activity baseline conditions (i.e., based on business-as-usual operations)
- Understand how offsets will be generated beyond business-as-usual scenarios

Methodology Selection or Development
- Identify an methodology/protocol that is applicable to your project activity
- Use or develop an offset protocol to determine eligibility and quantify the estimated emission offsets

Registry Investigation
- Identify a voluntary or compliance program where the project can be registered
- Develop project specific documentation to form an offset project plan

Registration and Validation
- Register the project with the offset program and begin crediting period
- Perform a validation, as required

Offset Project Operation
- Generate offsets through the operation of the project activity, in accordance with the offset protocol
- Follow the monitoring requirements in the protocol

Verification
- Complete third-party verification of the offset project operation, typically on an annual or bi-annual basis

Offset Credit Issuance
- Offsets are typically issued by the offset program after the verification is complete and the program has completed their review

Support Roles and Resources

Project Feasibility – Can be completed by anyone and is the first step in identifying if an offset opportunity truly exists

Offset Project Developers – Provide specialized support throughout the offset project development process and operation to ensure alignment with the selected methodology

Third-Party Validation and Verification Bodies – Provide an independent audit of the project and associated offset credits

Offset Brokers – Provide support with identifying buyers and the sale of offset credits. Most Project Developers also provide this service

BIOCHAR – CARBON OFFSET PROJECTS

Biochar represents an opportunity to develop high-quality carbon projects with low-high capital requirements, multiple revenue streams, and high profit margins, that are highly scalable.

Turn biomass waste into valuable biochar, to be stored permanently in soils (improving soil health) or in building products – e.g. cement (reducing emissions, improving insulation, and curing stronger). Biochar can be made using 'low-tech' options on-farm, or in purpose-built 'high-tech' industrial facilities. A high-tech facility may cost ~US$25M (CAPEX & OPEX), generating some 60kt of biochar, and 170k tCO2-e/year, with annual revenues of US$30M.

Carbon offset methodologies exist under Verra, CAR and PURO, which can be directly applied or adapted for use in Ontario.

Feedstocks for creating biochar could include:

- Forest residues (Including reducing forest fuels to prevent wildfires);
- Nut orchard recycling, and nut shells;
- Manures (biochars become slow-release fertilizers, driving N_2O reductions);
- Crop residues (corn stalks, cobs etc).

Multiple revenue streams:

- Power purchase agreements (heat & electricity bi-products of biochar production);
- Biochar sales (US$275-$550/dry metric ton);
- Biochar offset credit sales;
- Sustainable cement offset credit sales.

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GHG Offset Fast Facts

- Projects must represents activities **over and above business-as-usual**
  - **As offset project activities become business-as-usual scenarios they may no longer be eligible**
- Some programs require a **formal validation process**
- Offset projects can typically generate offsets for the duration of their **crediting period (often 10 years)** unless a regulation is introduced that requires the project activity to occur
  - **Some offset project protocols and programs allow for the renewal of crediting periods**
- Offset projects cannot be registered in multiple offset programs at the same time, to **prevent double-counting**
- Development of offset protocols can require a significant amount of time and effort
  - **Interaction with stakeholders**
  - **Pilot studies**
  - **Scientific review**
  - **Validation**
- Offset protocols may exist in multiple different programs for the same project type or activity
  - **E.g. there are different forestry protocols in both the Climate Action Reserve's voluntary program and California's compliance program**
- **Offset protocols may be regularly updated and fine-tuned**
- **You cannot typically trade voluntary offsets in compliance markets**

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Reference Materials

Existing Methodologies

Protocol Title	Brief Overview	Protocol Project Registry	Voluntary/ Compliance
Agricultural Nitrous Oxide Emission Reduction	Switching to an integrated set of Beneficial Nitrogen Management Practices for annual cropping systems. Reducing N2O emissions associated with nitrogen fertilizer application.	Alberta Emissions Offset System	Compliance
Energy generation from the combustion of biomass waste v2.2	Applies to biomass wastes and residues; **Further details provided in future slides.**	Alberta Emissions Offset System	Compliance
VM0022 - Quantifying N2O Emissions Reductions in Agricultural Crops through Nitrogen Fertilizer Rate Reduction	Similar to the Alberta protocol	Verified Carbon Standard	Voluntary
VM0042 - Methodology for Improved Agricultural Land Management v1.0	Focused on increasing soil organic carbon storage; reduce fertilizer, improve water management/irrigation, reduce tillage/improve residue management, improve crop planting and harvesting, and/or improve grazing practices.	Verified Carbon Standard	Voluntary
VM0017 - Adoption of Sustainable Agricultural Land Management v1.0	Increases carbon stocks on land; manure management, use of cover crops, returning composted crop materials to the field, and introduction of trees into the landscape. Use of Roth-C model.	Verified Carbon Standard	Voluntary
VM0021 - Soil Carbon Quantification Methodology v1.0	Changes in carbon accrual in soils. Applicable to a range of project activities designed to improve soils, including changes to agricultural practices, grassland and rangeland restorations, soil carbon protection and accrual benefits from reductions in erosion, grassland protection projects, and treatments designed to improve diversity and productivity of grassland and savanna plant communities.	Verified Carbon Standard	Voluntary
VM0026 - Methodology for Sustainable Grassland Management v1.1	Improving the rotation of grazing animals between summer and winter pastures, limiting the timing and number of grazing animals on degraded pastures, and restoration of severely degraded land by replanting with perennial grasses and ensuring appropriate management over the long-term. Focused on Soil organic carbon.	Verified Carbon Standard	Voluntary
VM0032 - Methodology for the Adoption of Sustainable Grasslands through Adjustment of Fire and Grazing v1.0	Grouping, timing, and season of grazing. Altering fire frequency or intensity. Activities occurring on grasslands that have historically experienced SOC loss.	Verified Carbon Standard	Voluntary
Avoided Conversion of Grasslands and Shrublands to Crop Production v2.0	Reductions are based on historical rates of conversion of existing grasslands and shrublands within a county, in addition to the various land capability classes suitable for agriculture at the field level.	American Carbon Registry	Voluntary
Compost Additions to Grazed Grasslands v1.0	Inactive under ACR.	American Carbon Registry	Voluntary
Agriculture Based Carbon Sequestration (in development)	Methodology still in development	Gold Standard	Voluntary
Ecosystems Services Market Consortium Protocol (in development)	Methodology still in development	Gold Standard	Voluntary
Agriculture Based Water Benefit Certificates (in development)	Methodology still in development	Gold Standard	Voluntary

Existing Methodologies Cont.

Protocol Title		Protocol Project Registry	Voluntary/ Compliance
Agriculture Based Water Restoration Certificates	Focused on restoring water flows, natural systems, and improving efficiency. These are not offsets but 1 Water Restoration Certificate (WRC) = 1,000 gallons of water.	Bonnefield Environmental Fund International Markit Environmental Registry	Voluntary
AMS-III.R - Methane recovery in agricultural activities at household/small farm level v3.0	Methane recovery systems that achieve an annual emission reduction of less than or equal to five tonnes of CO2e per system are included in this category (e.g. installation of a domestic biogas digester)	UNFCCC Clean Development Mechanism	Voluntary
AMS-III.BF - Reduction of N2O emissions from use of Nitrogen Use Efficient (NUE) seeds that require less fertilizer application v2.0	Use of a genetically distinct type of seed for crops that will utilize nitrogen more efficiently and therefore require less fertilizer than conventional seeds, thereby reducing N2O emissions.	UNFCCC Clean Development Mechanism	Voluntary
AR-AMS0003 Afforestation and reforestation project activities implemented on wetlands v3.0	Planting forests on existing wetlands; intertidal wetlands, flood plain areas on inorganic soils, and seasonally flooded areas on margin of water bodies/reservoirs	UNFCCC Clean Development Mechanism	Voluntary
Canada Grassland Protocol Version 1.0	Projects that avoid the loss of soil carbon due to conversion of grasslands to cropland, as well as other associated GHG emissions	Climate Action Reserve	Voluntary
Grassland Protocol Version 2.1	Same as above but applicable outside of Canada	Climate Action Reserve	Voluntary
Soil Enrichment Protocol Version 1.0	Projects which reduce emissions and enhance soil carbon sequestration on agricultural lands through the adoption of sustainable agricultural land management activities	Climate Action Reserve	Voluntary
Nitrogen Management Project Protocol v2.0	US focused reduction in N2O emissions; synthetic N rate reduction and use of enhanced efficiency fertilizer. Applicable to the following crops (varies by region); barley, corn, cotton, oats, sorghum, spring wheat, tomatoes, and winter wheat.	Climate Action Reserve	Voluntary

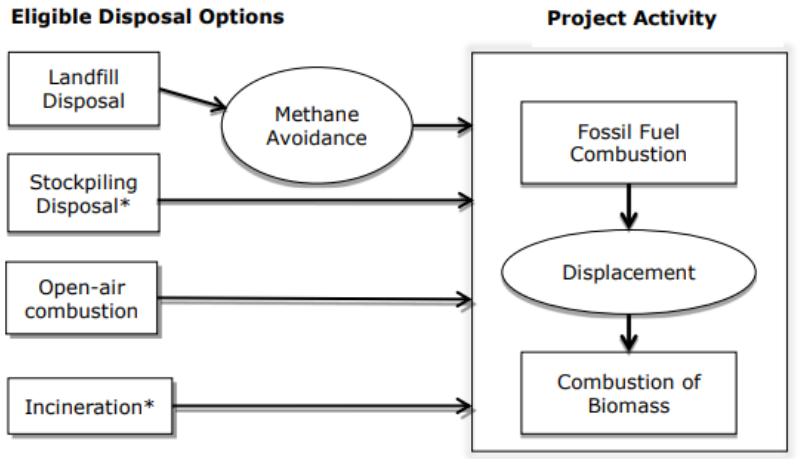
Methodology/Protocol Main Topic Areas

- Nitrogen management and associated N2O reductions
- Improvements to SOC
  - Land management and soil enrichment
- Grasslands and restoration
- Additional related protocols; livestock and cattle focused on methane reduction and wetlands

Energy generation from the combustion of biomass waste v2.2

- Protocol developed by the Alberta Emission Offset System
- Link to full protocol
- Focused on waste and residue streams, purpose grown biomass is ineligible

Figure 1: Emission Offset Generation Opportunity for Changes in Disposal Practices for Biomass Wastes



*Regulated activity (Environmental Code of Practice for Sawmill Plants) which is an eligible feedstock, but where emissions from methane avoidance are not eligible for emission offsets.

Table 1: Biomass Waste Types Eligible in the Protocol

Biomass Source	Project Notes
Forest mill residues (e.g., sawdust, bark, shavings, chips)	Projects must demonstrate origin of the waste biomass and method of disposal in the baseline.
Debris from forest harvesting occurring on Crown land (e.g., branches, tree tops, roots)	Projects must meet sustainability criteria set in their Forest Management Plans.
Agricultural crop residue (e.g., cereal stalks or stems left after harvest)	Projects must meet minimum retention requirements to meet soil conservation needs described in Section 5.1.7.
Agricultural processing residues (e.g., food processing plant wastes)	Projects that were using land application as a baseline disposal option must meet minimum retention requirements to meet soil conservation needs described in Section 5.1.7.
Other agricultural residues (e.g., manure, animal bedding, paunch)	Projects that were using land application as a baseline disposal option must meet minimum retention requirements to meet soil conservation needs described in Section 5.1.7.
Municipal solid waste	The organic fraction of municipal solid waste is eligible.
Standing trees killed by mountain pine beetle or wildfire on Crown land	Stands harvested purely for bioenergy are eligible only when they cannot be salvaged for traditional forest products and stand mortality is greater than 85 per cent.

Emission offsets opportunity exists for projects that avoid GHG emissions by diverting feedstock from landfills or open-air combustion of harvest debris. Specific eligibility requirements for these opportunities are discussed in Section 1.3. Figure 1 provides an illustrative representation of the emissions offset generation opportunities for changes in biomass waste disposal available to offset projects using this protocol.

Protocol Components

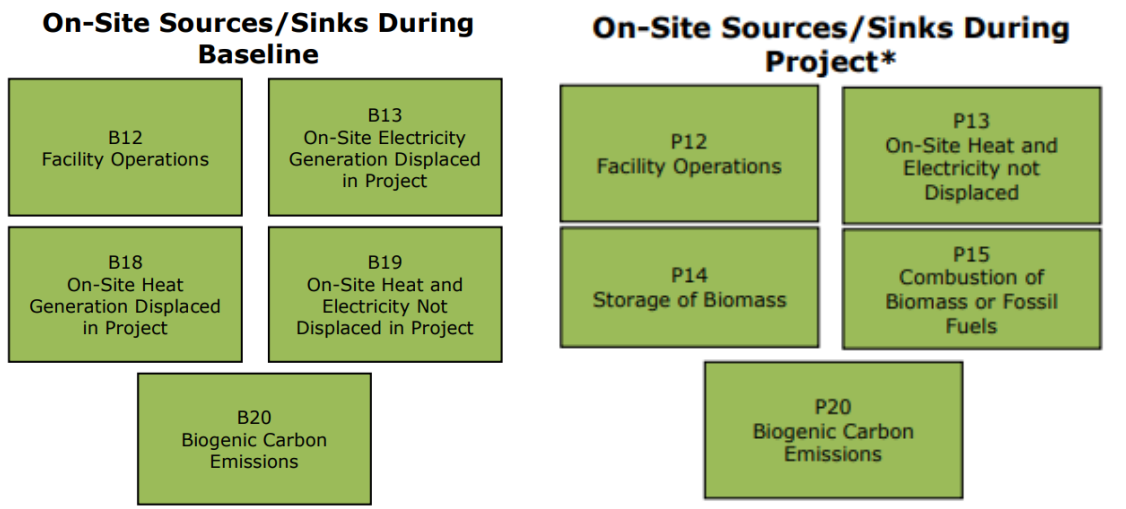
- **Protocol Applicability/Eligibility** – Activities that apply under the selected protocol
  - the energy produced from biomass is offsetting fossil fuel-generated energy;
  - reductions achieved by the project are based on actual measurement and monitoring, as indicated by the requirements of this protocol; and,
  - the project meets the offset system eligibility criteria specified in the Carbon Competitiveness Incentive Regulation, standards and guidance documents for the Alberta Offset System.
- **Protocol Flexibility** – Not in all protocols and sometimes referred to as a deviation →

(1) Diversion of biomass waste from baseline disposal in a landfill. The project developer must be able to demonstrate that the waste stream was being disposed of in a landfill for a period of three years prior to project initiation. If the record requirements are met, this may allow proponents to include the biomass as an eligible waste for fossil fuel displacement, and eligible for offsets from methane avoidance from diversion. See Section 5.1.2 for minimum records requirements

(2) Diversion of biomass waste from open-air combustion. The project developer must be able to demonstrate that the waste stream was being disposed of by open-air combustion for a period of three years prior to project initiation. See Section 5.1.4 for minimum records requirements.

(3) Projects can use an energy balance approach to estimate biomass fuel consumed. If this approach is being used, the project developer must be able to measure, monitor and record the energy flow of all streams into or out of the biomass combustion unit to generate an accurate energy balance for the project. Energy-based combustion emission factors for biomass and fossil fuel combustion are applied to quantify emissions for each stream and to quantify GHG emission reductions.

- **Baseline Condition -** *The baseline condition for all projects under this protocol is the production of energy from fossil fuels for electricity and/or heat occurring either on or off-site.*
- **Sources, Sinks, and Reservoirs (SSRs) –** Activities within the project that contribute to or reduce emissions. The protocol will often identify a wide range of SSRs but only some will be applicable and measurable/quantifiable under the conditions of the project. →



Protocol Components

Baseline Emissions – Project Emissions = Emission Reductions/Offsets

- **Quantification** – Focuses on the applicable SSR's, the monitoring requirements and associated equations that shall be used to determine the baseline and project emissions (tCO2e)

Baseline emission sources include the following:

Emissions $_{Baseline}$ = Sum of the emissions under the baseline condition.

= Emissions from Biomass Disposal (B15)

+ Emissions from Fuel Extraction and Processing (B4)

+ Emissions from Collection, Transfer and Transport of Biomass (B1)

+ Emissions from Processing of Biomass (B3)

+ Emissions from Facility Operations (B12)

+ Emission from Displaced Off-site Electricity Generation (B6)

+ Emission from Displaced Off-site Heat Generation (B16)

+ Emission from Displaced On-site Electricity Generation (B13)

+ Emission from Displaced On-site Heat Generation (B18)

Baseline						
Source/Sink	**Parameter /Variable**	**Unit**	**Measured/ Estimated/Calculated**	**Method**	**Frequency**	**Justify measurement or estimation and frequency**
B1 - Collection, Transfer and Transport of Biomass	Emissions $_{Collection, Transfer and Transport}$ = {Σ [Volume of Fuel$_i$ * EF$_{i, CO2}$]+ Σ [GWP$_{CH4}$ * Volume of Fuel$_i$ * EF$_{i, CH4}$] + Σ [GWP$_{N2O}$ * Volume of Fuel$_i$ * EF$_{i\ N2O}$]} / 1000					
	Emissions $_{Collection, Transfer and Transport}$ Emission from Biomass Collection, Transfer and Transport	tonnes CO_2e	N/A	N/A	N/A	Quantity being calculated in aggregate form as fuel use on-site is likely aggregated for each of these source/sinks. Calculated separately for each fuel type and by carbon levied and non-levied fuels.
	Volume of Fuel$_i$ Volume of each Fuel Combusted	L, m^3, or Other	Measured	Direct metering or reconciliation of volume in storage (including volumes received).	Continuous Metering or Monthly Reconciliation	Both methods are standard practice. Frequency of metering is highest level possible. Frequency of reconciliation provides for reasonable diligence.
	EF$_{i,CO2}$ CO_2 Emission Factor for each Fuel	kg CO_2 per L, m^3 or other	Estimated	Provided in the Carbon Offset Emission Factors Handbook	Annual	Reference values adjusted annually as part of Environment and Climate Change Canada reporting on Canada's emissions inventory.

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