Biofuels, Biomass and Biochar: The 3B’s

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Leading Carbon

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Carbon Trading – Current and Future Opportunities Session
AFGO Forests and Energy Conference
From activities outside the SGER caps:
◦ Un-regulated Facilities < 100,000 tonne CO$_2$e threshold

Actions after Jan 1, 2002

Real, quantifiable, measureable reductions:
◦ Need a protocol and evidence/documentation

Have clearly established ownership;

Not required by law; beyond business as usual – i.e. Additional

Be counted once for compliance purposes;
◦ Registered, serialized tonnes

Be verified by a qualified third party;

Meet requirements stated in Ministerial guidelines

<table>
<thead>
<tr>
<th>Phase</th>
<th>Steps</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Development</td>
<td>Offset Project Plan</td>
<td>Quantification Protocol</td>
</tr>
<tr>
<td>Project Implementation</td>
<td>Data Management</td>
<td>3rd Party Validation (Alberta optional)</td>
</tr>
<tr>
<td>Project Reporting</td>
<td>Project Report GHG Assertion</td>
<td>Verification</td>
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<tr>
<td>Offset Submission (Regulation Facility/Buyer)</td>
<td>To Alberta Environment</td>
<td>• Plan</td>
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<td></td>
<td></td>
<td>• Report</td>
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<td></td>
<td></td>
<td>• Statement</td>
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<tr>
<td></td>
<td></td>
<td>• Statement of Qualifications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Conflict of Interest Checklist</td>
</tr>
</tbody>
</table>
Approved Alberta Protocols

Guidance Documents
The following is a series of guidance documents prepared for the Alberta Offset System. It is highly recommended that these documents be reviewed to ensure main criteria of the system are met:

- NEW Draft Offset Project Technical Guidance v2.0 December 2009 under review

Related Content
- Additional protocols are available in draft form
- Information on the ISO Standards

RENEWABLE ENERGY

- **2** Biofuel Quantification Protocol
- Biomass Quantification Protocol
- Run-of-the-River Electricity System Quantification Protocol
- Solar Electricity Systems Quantification Protocol

Protocols - Current Opportunity
• Project Condition
  • Implementation of an aerobic biomass combustion facility
    • Utilization of wood waste for thermal energy and electricity
    • Diversion of wood waste from landfill

• Baseline Condition
  • Equivalent energy production
    • Thermal energy production - natural gas, coal
    • Electricity production
  • Disposal of material in landfill
• Functional Equivalence – baseline and project
  • Electricity generation
  • Thermal energy output
  • Landfill of equivalent material

• Emission Reduction Mechanisms
  • Offset fossil fuel production, processing and usage
    • Thermal energy production
  • Offset non-renewable electricity production
  • Diversion of organic materials from landfill
    • Avoid methane production

• Biogenic CO$_2$ emissions
• **Applicability criteria**
  • Fit with project and baseline scopes
  • Biomass claimed as diverted biomass
    • Would have undergone anaerobic decomposition
    • Based on actual measurement of inputs and outputs

• **Flexibility mechanisms**
  • Functional equivalence of transportation not assured
  • Grouping sources and sinks to match data management
  • Modification of measurement and data management
Data Capture

- Mass of biomass diverted / combusted
- Volume of fossil fuels consumed
- Thermal and electrical energy produced
- Landfill characteristics

Data Capture:

\[ \text{Emission Reduction} = \text{Emissions}_{\text{Baseline}} - \text{Emissions}_{\text{Project}} \]

\[ \text{Emissions}_{\text{Baseline}} = \text{Emissions}_{\text{Decomp Biomass}} + \text{Emissions}_{\text{Electricity}} + \text{Emissions}_{\text{Thermal Heat}} \]

\[ \text{Emissions}_{\text{Project}} = \text{Emissions}_{\text{Facility Operation}} + \text{Emissions}_{\text{Combustion of Biomass}} \]
Alberta Emissions Offset Registry

Registry Information
63 Projects Registered
10,393,598 tCO2e Reductions/Removals

Offsets are an integral compliance option for regulated entities under the Specified Gas Emitters Regulation in Alberta. Voluntary projects that include new technologies and/or practice changes generating greenhouse gas emission reductions or removals may be eligible to generate offsets. The Alberta Offset System has rigorous rules and criteria to ensure eligible project types generate real, measurable, and quantifiable emission reductions. Registration of eligible Alberta-based projects is a vital component to using...
<table>
<thead>
<tr>
<th>Project Name</th>
<th>Send Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Ridge Lumber TFH Biomass Burner Project</td>
<td></td>
</tr>
<tr>
<td>Project Status: Registered</td>
<td></td>
</tr>
<tr>
<td>Project Developer: Blue Ridge Lumber Inc.</td>
<td></td>
</tr>
<tr>
<td>Project Location: Central, South and North West</td>
<td></td>
</tr>
<tr>
<td>Canfor Grande Prairie Sawmill Biomass Energy Project</td>
<td></td>
</tr>
<tr>
<td>Project Status: Registered</td>
<td></td>
</tr>
<tr>
<td>Project Developer: Canadian Forest Product Ltd.</td>
<td></td>
</tr>
<tr>
<td>Project Location: North Central</td>
<td></td>
</tr>
<tr>
<td>Vintage: 2005-2008</td>
<td></td>
</tr>
<tr>
<td>Legal Alfalfa Biomass Burner Project</td>
<td></td>
</tr>
<tr>
<td>Project Status: Created</td>
<td></td>
</tr>
<tr>
<td>Project Developer: Utility Source Inc.</td>
<td></td>
</tr>
<tr>
<td>Project Location: North Central</td>
<td></td>
</tr>
<tr>
<td>Vintage:</td>
<td></td>
</tr>
<tr>
<td>Sundance Biomass Energy Generation Project</td>
<td></td>
</tr>
<tr>
<td>Project Status: Registered</td>
<td></td>
</tr>
<tr>
<td>Project Developer: Blue Source Canada ULC</td>
<td></td>
</tr>
<tr>
<td>Project Location: North West</td>
<td></td>
</tr>
<tr>
<td>Sundre Forest Product TFH Biomass Burner Project</td>
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<tr>
<td>Project Status: Registered</td>
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</tr>
<tr>
<td>Project Developer: Sundre Forest Products Inc.</td>
<td></td>
</tr>
<tr>
<td>Project Location: Central, South and North West</td>
<td></td>
</tr>
<tr>
<td>Vintage: 2008-2009</td>
<td></td>
</tr>
<tr>
<td>Verdant Energy Limited - Dapp Power Electric Generation Facility</td>
<td></td>
</tr>
<tr>
<td>Project Status: Registered</td>
<td></td>
</tr>
<tr>
<td>Project Developer: Verdant Energy Ltd.</td>
<td></td>
</tr>
<tr>
<td>Project Location: North East</td>
<td></td>
</tr>
<tr>
<td>Facility</td>
<td>Project Type</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Blue Ridge THF Biomass Burner</td>
<td>Displaces Natural Gas Use</td>
</tr>
<tr>
<td>Canfor GP Sawmill Biomass</td>
<td>CHP plant Displaces gas/electricity</td>
</tr>
<tr>
<td>Legal Alfalfa THF Biomass Burner</td>
<td>Diversion of waste from landfill/Gas (expect 2200 per yr)</td>
</tr>
<tr>
<td>Sundance Biomass Energy</td>
<td>Displaces Natural Gas</td>
</tr>
<tr>
<td>Sundre TFH Biomass Burner</td>
<td>Displaces Natural Gas</td>
</tr>
<tr>
<td>Verdant Energy-Dapp Power Electric</td>
<td>Electricity Generation</td>
</tr>
</tbody>
</table>
### Theoretical Potential: Electricity – 12 Mt/yr

<table>
<thead>
<tr>
<th>Residue Source</th>
<th>PJ</th>
<th>GWh</th>
<th>tCO₂e/MWh&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Potential GHG Reductions (Mt CO₂e yr⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Residues&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14</td>
<td>3889</td>
<td>0.65</td>
<td>2.3</td>
</tr>
<tr>
<td>Mill Residues&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.2</td>
<td>889</td>
<td>0.65</td>
<td>0.5</td>
</tr>
<tr>
<td>Agriculture Surplus Straw&lt;sup&gt;c&lt;/sup&gt;</td>
<td>51</td>
<td>16388</td>
<td>0.65</td>
<td>9.7</td>
</tr>
</tbody>
</table>

- <sup>b</sup> – Based on AFPA harvest statistics and forest company harvest efficiency data

### Forestry Residue Assumptions:
- Potential (GJ) = Residues (m³) × 0.4 (conversion to Bone Dry Tonnes) × 20 GJ/BDT
- Potential (PJ) = Potential (GJ)/1000000

### Current Projects - 0.175 Mt CO₂e/yr
- (5 more planned biomass plants for the province)

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**Potential for the Province**
• Project Condition
  • Implementation of Biofuel Production Facility
    • Range of processes
      (Pyrolysis, gasification, fermentation, distillation, etc.)
    • Range of fuel outputs
      (Biodiesel, ethanol, charcoal, syngas, etc.)
    • Thermal and electricity energy
    • Landfill diversion

• Baseline Condition
  • Fossil fuel production, processing and usage
    • Fuel Usage
    • Thermal energy
    • Electricity production
  • Landfill of similar amount of material
- Functional Equivalence
  - Energy potential of outputs
  - Electricity generation
  - Landfill of equivalent material

- Emission Reduction Mechanisms
  - Offset fossil fuel production, processing and usage
    - Biogenic nature of biofuels
    - Thermal energy production
  - Offset non-renewable electricity production
  - Diversion of organic materials from landfill
    - Avoid methane production

- Reductions occur downstream from the plant (tailpipe combustion, electricity displacement, etc)
**Applicability criteria**
- Fit with project and baseline scope
- Process emissions are not materia
- Assumption that all is combusted somewhere downstream

**Flexibility mechanisms**
- WHR protocol may be applied in conjunction
- Include supplementary heat production
- Transportation emissions may be included
- Accounting for diversion of waste from landfill

**Biofuel Protocol**
Data Capture
- Volume of biofuels produced / consumed
- Volume of fossil fuels consumed / offset
- Thermal and electrical energy produced
- Landfilling characteristics

Biofuel Protocol
Alberta Emissions Offset Registry

Registry Information

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10,393,598 tCO2e Reductions/Removals

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Project Name: Western Biodiesel Inc. Biodiesel Project

+ Project Developer: Blue Source Canada ULC
+ Project Description: The Western Biodiesel Inc. Biodiesel Project (the Project) is a biodiesel production facility located at Western Biodiesel’s plant in Aldersyde, Alberta. The Project is owned and operated by Western Biodiesel Inc. (WBI). The WBI biodiesel facility began operations in April, 2008.
+ Project Location: South
  - Project Type: Biofuels (Supply)
  - Aggregated Project?: No
    - Start Date: Aug 01, 2008
    - End Date: Aug 01, 2016
  - Estimated Potential Lifetime Emissions Reductions-Removals: 120,000 tCO₂e
  - Estimated Potential Annual Emissions Reductions-Removals: 16,000 tCO₂e
  - Validator: None defined
  - Verifier: AMEC Earth and Environmental

Project Files
- Alberta - GHG Report (2008-2009) [Download]
- Alberta - Notice of Creation (2008-2009) [Download]
- Alberta - Verification Report (2008-2009) [Download]

Issued Offsets

Transferred Offsets
Biofuel Protocol – September 2007
AB Renewable Fuel Standard – Apr 1/11
  ◦ EtOH – blended at 5%
  ◦ BioDiesel – blended at 2%
  ◦ Performance Threshold – 25% lower LCA

Federal Policy:
  ◦ EtOH - December 15, 2010 at 5% blend
  ◦ Biodiesel – 2012 at 2% blend

Federal View – no Offset if RFS (June ‘09)
Alberta – still evolving
• Specified Gas Emitters Regulation
  ◦ Large Final Emitters – requirement to reduce emissions intensity
  ◦ Carbon trading system for offsets – cost-effective path to compliance
  ◦ CCEMF – alternative to offsets; higher price but simpler
  ◦ Fines or penalties
  ◦ Covers direct emissions from facilities, not carbon in fuel

• Renewable Fuel Standard
  ◦ Requires bulk fuel vendors to blend in biofuels
  ◦ Biofuels must have lower carbon intensity; achieve GHG reduction
  ◦ Regulates biofuel eligibility based on lifecycle carbon reduction (25% lower)
  ◦ Comparison to petroleum baseline
**Question:** Are Alberta biofuels eligible for carbon offsets given an RFS with a carbon intensity-based performance threshold?

<table>
<thead>
<tr>
<th>Yes, all</th>
<th>Some</th>
<th>No, none</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Biofuel producer owns all of the GHG reduction.</td>
<td>• Extent of additionality must be demonstrated beyond regulation – surplus to RFS volume, surplus to mandated GHG reduction, or by other measure.</td>
<td>• Government claims full amount of GHG reduction from RFS.</td>
</tr>
<tr>
<td>• Clear definitions required to avoid double-counting or leakage.</td>
<td>• Performance standard may provide justification for defining “surplus to what?”</td>
<td>• Lose revenue-neutral market support mechanism.</td>
</tr>
<tr>
<td>• Point of regulation used to determine difference between upstream and downstream emission reduction.</td>
<td>• May require update to Offset Protocol for Biofuel Production and Use.</td>
<td>• Increased requirement for government incentives to achieve domestic market development and competitiveness.</td>
</tr>
<tr>
<td>• Terminals are required to blend; biofuel producers are not directly regulated.</td>
<td>• May require removal of Offset Protocol for Biofuel Production and Use.</td>
<td>• May require removal of Offset Protocol for Biofuel Production and Use.</td>
</tr>
<tr>
<td>• Rising carbon price increases value of offsets and thereby reduces need for biofuel incentives over time.</td>
<td>• Begs question about biofuel volumes used in AB in excess of RFS requirement: Why not eligible?</td>
<td>• Government claims full amount of GHG reduction from RFS.</td>
</tr>
<tr>
<td>• Don’t want to be out of step with Feds</td>
<td></td>
<td>• Lose revenue-neutral market support mechanism.</td>
</tr>
</tbody>
</table>

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**The Options**
• Role of offsets in achieving cost-effective SGER compliance pathway
• Economic value of offsets for domestic competitiveness
• Continued government support for Alberta biofuel production
• Rigour of regulatory-grade offsets (additionality, leakage, etc)
• Compatibility with neighbours’ carbon frameworks
Facility Production and GHG Intensity of the Fuel vis a vis 25% threshold

Scenario 1:

- BDL Facility – 14 Mi/yr = 476,000 MJ
- Biodiesel LCA Intensity = 0.04 tonnes CO$_2$e/GJ
- FF Diesel intensity = 0.0945 tonnes CO$_2$e/GJ
- 25% Intensity reduction = 0.0709 t CO$_2$e/GJ

GHG Savings:

- Protocol – (0.09-0.04)*476 kl = 25,492t CO$_2$e
- RFS Overlay – (0.07-0.04)*476kl = 14,697 t CO$_2$e

43% reduction in Offsets from Original


Required by RFS (i.e. would have occurred regardless of offset credits)
Offsets = GHG Intensity reduction*GJ
= (0.0945-0.070875)*476,000
= 11,246 tonnes co2e

Offsets under original protocol
= (0.0945-0.040) * 476,000
= 25,943 tonnes co2e

Fuel that is eligible for offset credits (i.e. not required by law)
Potential offsets = GHG Intensity reduction*GJ
= (0.070875-0.040)*476,000
= 14,697 tonnes co2e
• Facility Production and GHG Intensity of the Fuel vis a vis 25% threshold

• Scenario 1:
  ◦ EtOH Facility – 14 Ml/yr = 336,000 MJ
  ◦ EtOH LCA Intensity = 0.055 tonnes CO$_2$e/GJ
  ◦ FF Diesel intensity = 0.091 tonnes CO$_2$e/GJ
  ◦ 25% Intensity reduction = 0.069 t CO$_2$e/GJ

• GHG Savings:
  ◦ Protocol – (0.091-0.055)*336 kl = 12,286 t CO$_2$e
  ◦ RFS Overlay – (0.069-0.055)*336 kl = 4,608 t CO$_2$e

• 62.5% reduction in Offsets from Original
• Offsets are Like Airmiles – not a primary driver
• Ag Grains/Oilseeds Biofuels – feedstocks are 70% of the cost; things stalled
• Forestry Biofuels – lots on the go:
  ◦ Enerkem-Edmonton (wood and MSW)
  ◦ Otoka – gasification for power/biorefinery
  ◦ Ensyn – pyrolysis for wood waste to bio-oil
• 10 more projects under development
• RFS mandates will be difficult to fill in short term

Considerations
• Biggest Challenges:
  ◦ Numerous Feedstocks (baseline accounting complex – what happened to biomass before)
  ◦ Numerous ways to make biochar
  ◦ Longevity in soils depends on process, feedstocks, soil type, micro-climate, cultivation
  ◦ No direct way to measure biochar fraction

• Means:
  ◦ Difficult to account for secondary emissions and activity-shifting leakage effects through land use change
  ◦ Full GHG Emissions LCA on production, processing, transportation, soil incorporation
<table>
<thead>
<tr>
<th>Pyrolysis Mode</th>
<th>Conditions</th>
<th>Liquid/Oil (%)</th>
<th>Char (%)</th>
<th>Gas (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td>Moderate temperature ~ 500°C</td>
<td>75</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Short vapor residence time ~ 1 sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderate temperature ~ 500°C</td>
<td>50</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Moderate vapor residence time ~ 10–20sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slow</td>
<td>Moderate temperature ~ 500°C</td>
<td>30</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Very long vapor residence time ~ 5–30min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasification</td>
<td>High temperature &gt;750°C</td>
<td>5</td>
<td>10</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>Moderate vapor residence time ~ 10–20sec</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Brown 2009.
BioChar Standardization
International Biochar Initiative
Guidelines for biochar that can be adopted by producers and retailers

- Use as basis for certification standard
- Definition of the biochar brand

**What it can include...**
- Definition of biochar
- Set of parameters that define the product
  - Source material and processing
  - Properties and contaminants
  - Classification framework

**What it will not include...**
- Complete fit with research requirements
- Sustainability index or GHG quantification
- Absolute perfection
• Build off of congruence in best practice guidance for standard development
  • Strict adherence to process required
• Engage the diverse stakeholder group active in biochar industry
• Rely on existing infrastructure of IBI for leadership
  • Provide oversight to activities
  • Formalize development and review process
• Organize an independent review committee
  • Broad stakeholder coverage (project developers, ENGOs, Researchers, etc.)

Need to understand end-game
Certification of Biochar Products

Proposed Approach
• Defined, step-wise process for product standard development

- Establish the process
- Analysis of subject matter
- Preparation of seed document
- Establish working group
- Correction and Revision
- Public Posting
- Balloting Process
- Process Review
- Publish Standard
- Periodic Review

Progress to Date

Phase 1: Q3/Q4 2010

Phase 2: Q1/Q2 2011

Complete

Underway
Many related tasks that will be done in parallel

1) Establish business case for standards development and product certification.

2) Communications strategy to support stakeholder engagement.

3) Initiate dialogue with standard setting organizations.

4) Development of Biochar marketing strategy.
   - Link between characterization standard and product marketing

5) Development of a Biochar certification program.

Complementary Activities
Biochar Protocol Development
Planned for February 2011 Stakeholder Review
Project Configurations and Platforms

Conceptual Framework

- Structured approach to emission reduction assessment
- Streamline protocol design process
- Providing flexibility between feedstocks and outputs
- Fit with IBI Resources such as the “Biochar Pathways Matrix”
## Emission Reductions & Carbon Sequestration

<table>
<thead>
<tr>
<th>Mechanisms</th>
<th>Description</th>
<th>Key issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Diversion</td>
<td>Organic materials diverted from landfills would otherwise degrade anaerobically, producing methane emissions.</td>
<td>Various models exist for predicting the methane emissions from these sources. However, proving diversion can be challenging in some circumstances, thus adding complexity to establishing the baseline.</td>
</tr>
<tr>
<td>Avoided Waste Combustion</td>
<td>Organic materials that would otherwise have been combusted, producing carbon dioxide emissions.</td>
<td>Various models exist for predicting the GHG emissions from these sources. Emissions from the combustion of organic materials are considered as a biogenic source of emissions.</td>
</tr>
<tr>
<td>Soil Carbon Accumulation</td>
<td>Conversion of biomass to biochar sequesters carbon. Incorporation of biochar within the soil matrix can lead to the enhanced sequestration of soil carbon.</td>
<td>Concerns that carbon sequestration within the soil is not permanent are being applied to biochar, where risks are significantly lower. Soil carbon sequestration is difficult to measure.</td>
</tr>
<tr>
<td>Fertilizer Efficiency</td>
<td>Biochar may 1) improve the efficiency of fertilizer usage relative to yield, and 2) alter processes that lead to emissions, resulting in lower ( \text{N}_2\text{O} ) emissions from fertilizers and reduced ( \text{CH}_4 ) production.</td>
<td>Difficult to measure changes in ( \text{CH}_4 ) and ( \text{N}_2\text{O} ) emissions at a field scale. Modelling of ( \text{N}_2\text{O} ) can be resource intensive and requires a significant research and field data.</td>
</tr>
<tr>
<td>Electricity Displacement</td>
<td>Electricity produced from biochar projects may offset electricity produced from fossil fuels.</td>
<td>This is an indirect emission reduction and may not be considered under all programs.</td>
</tr>
<tr>
<td>Fossil Fuel Displacement</td>
<td>The heat, power, and biofuels produced from the biochar projects may offset fossil fuel usage downstream.</td>
<td>This is an indirect emission reduction and may not be considered under all programs. There may be difficulties in direct measurement given the downstream nature of the emission reduction and conversions between equivalent units of energy.</td>
</tr>
</tbody>
</table>

**Most mechanisms have analogies into other markets/protocols**
Bringing Biochar Projects into the Carbon Marketplace

Proposed Path Forward

Protocol Development Process

- Webinar on technical and science issues June 15th at 8am PDT
- Launch protocol development at US Biochar 2010 Conf.
- Discussion draft to prepared for 2010 IBI conference in Rio De Janeiro (Sept, 2010)
- Alberta Technical Review in Nov./Dec. 2010
- VCS Protocol preparation to follow
- Link to CDM activity as key technical, science and protocol issues resolved

$100,000 to $120,000 being sought to support protocol development initiative (includes VCS double validation)
Questions?
karenhk62@gmail.com