Biofuels, Biomass and Biochar: The 3B's

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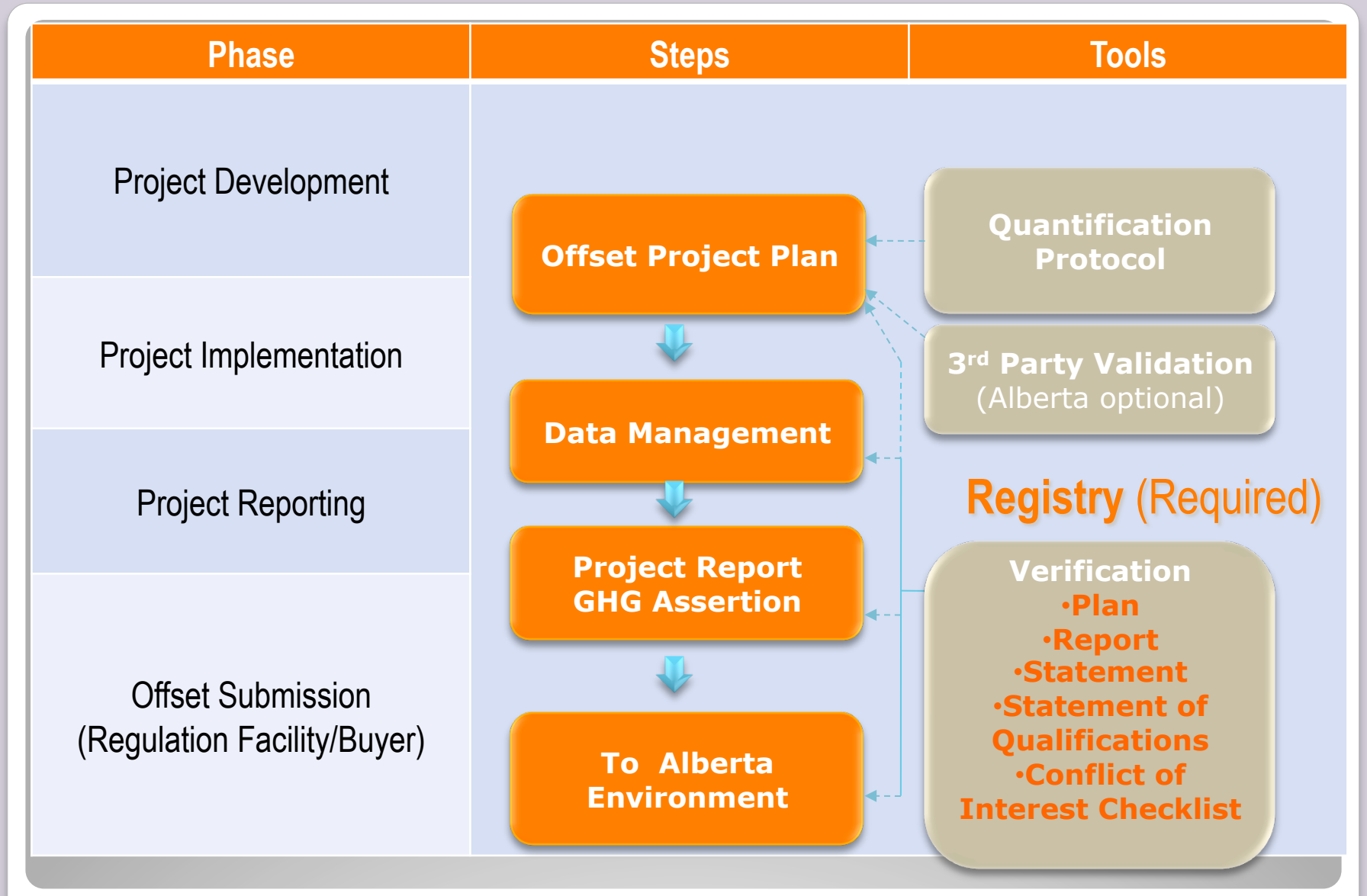
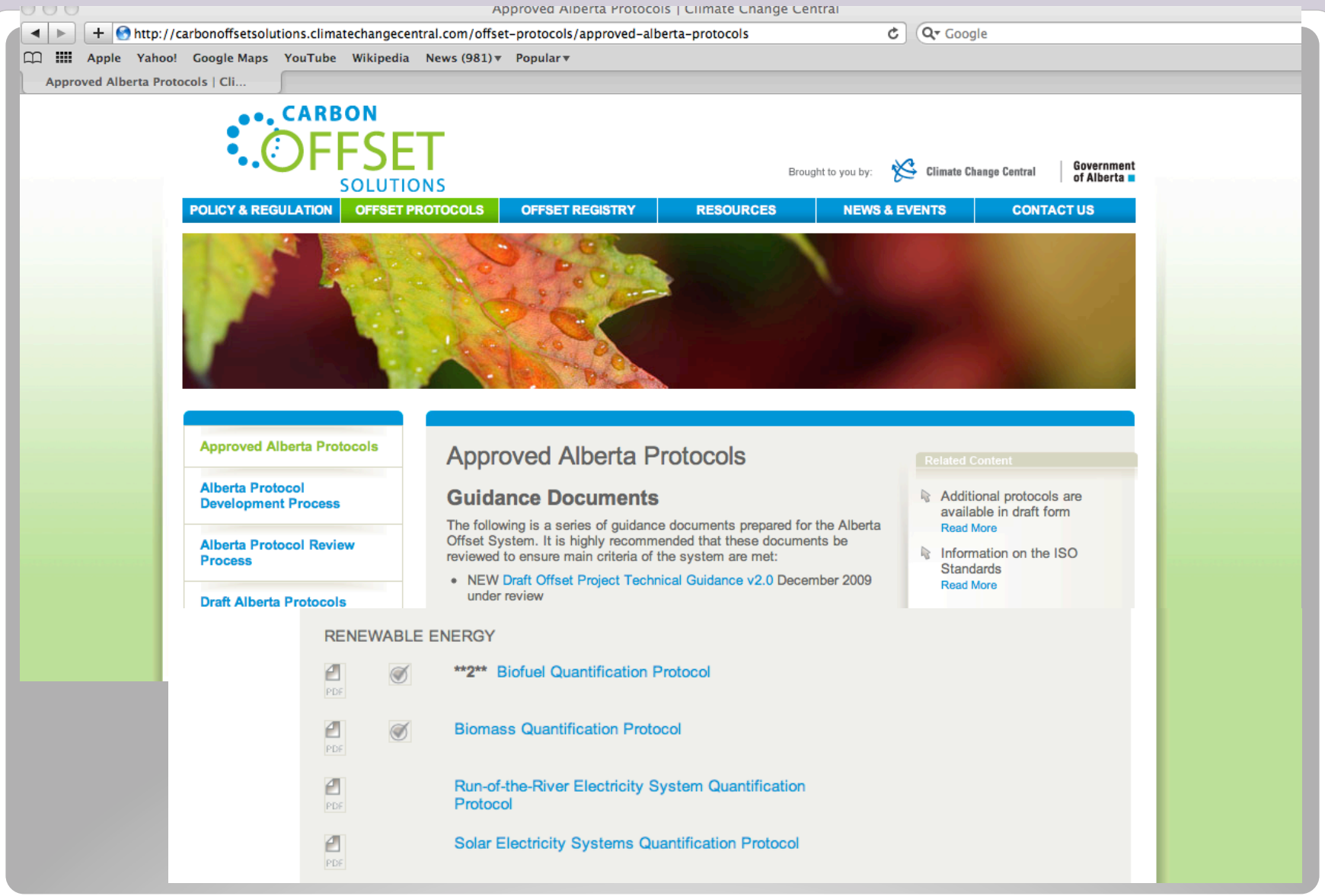
Carbon Trading – Current and Future Opportunities Session
AFGO Forests and Energy Conference

Alberta Offset Criteria

- From activities outside the SGER caps:
  - Un-regulated Facilities < 100,000 tonne CO_2e 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



Alberta's Carbon Offset Path



Protocols -Current Opportunity

Biomass Combustion

- 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

Biomass Combustion

- 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

Biomass Combustion

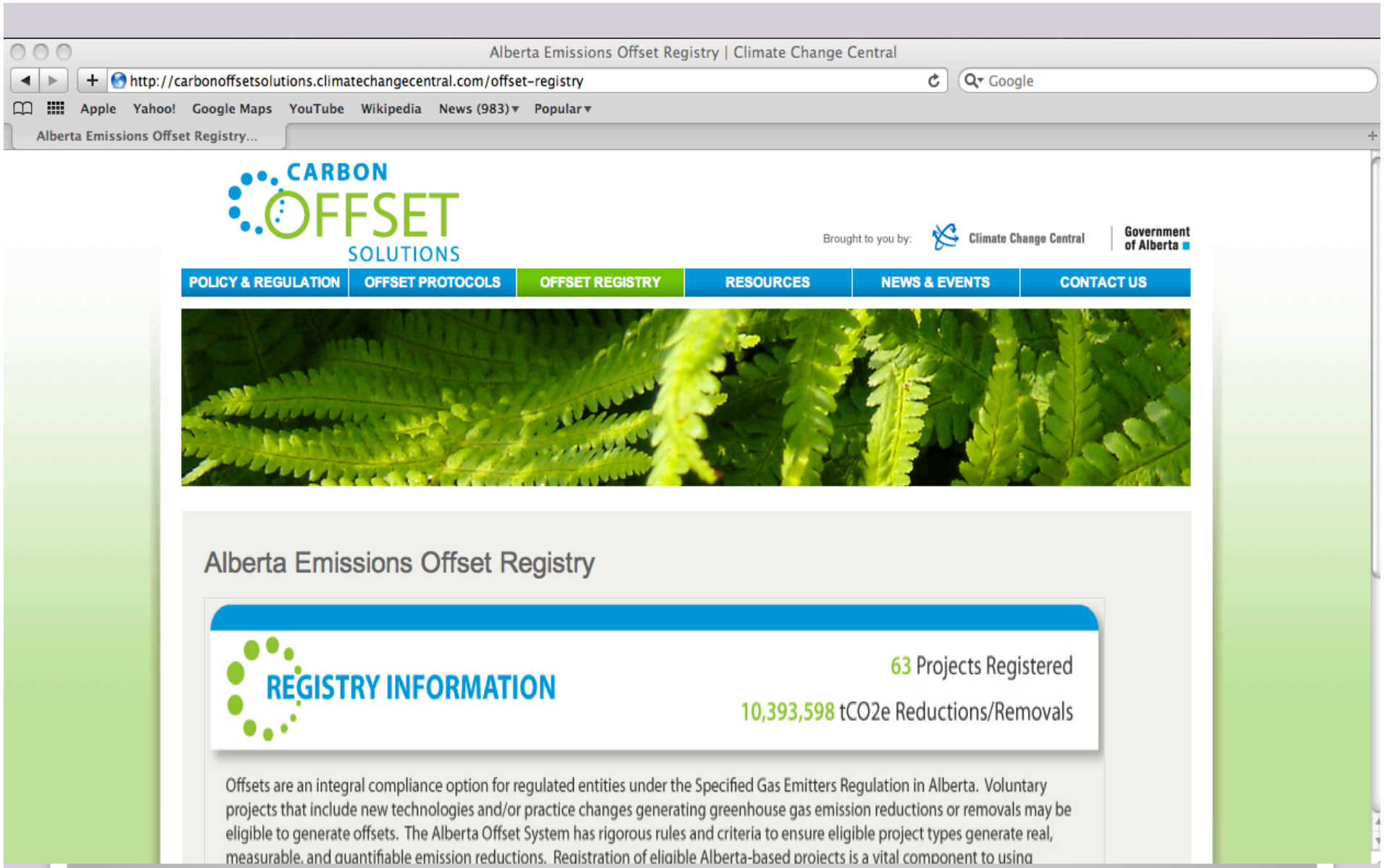
$$\text{Emission Reduction} = \text{Emissions}_{\text{Baseline}} - \text{Emissions}_{\text{Project}}$$

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

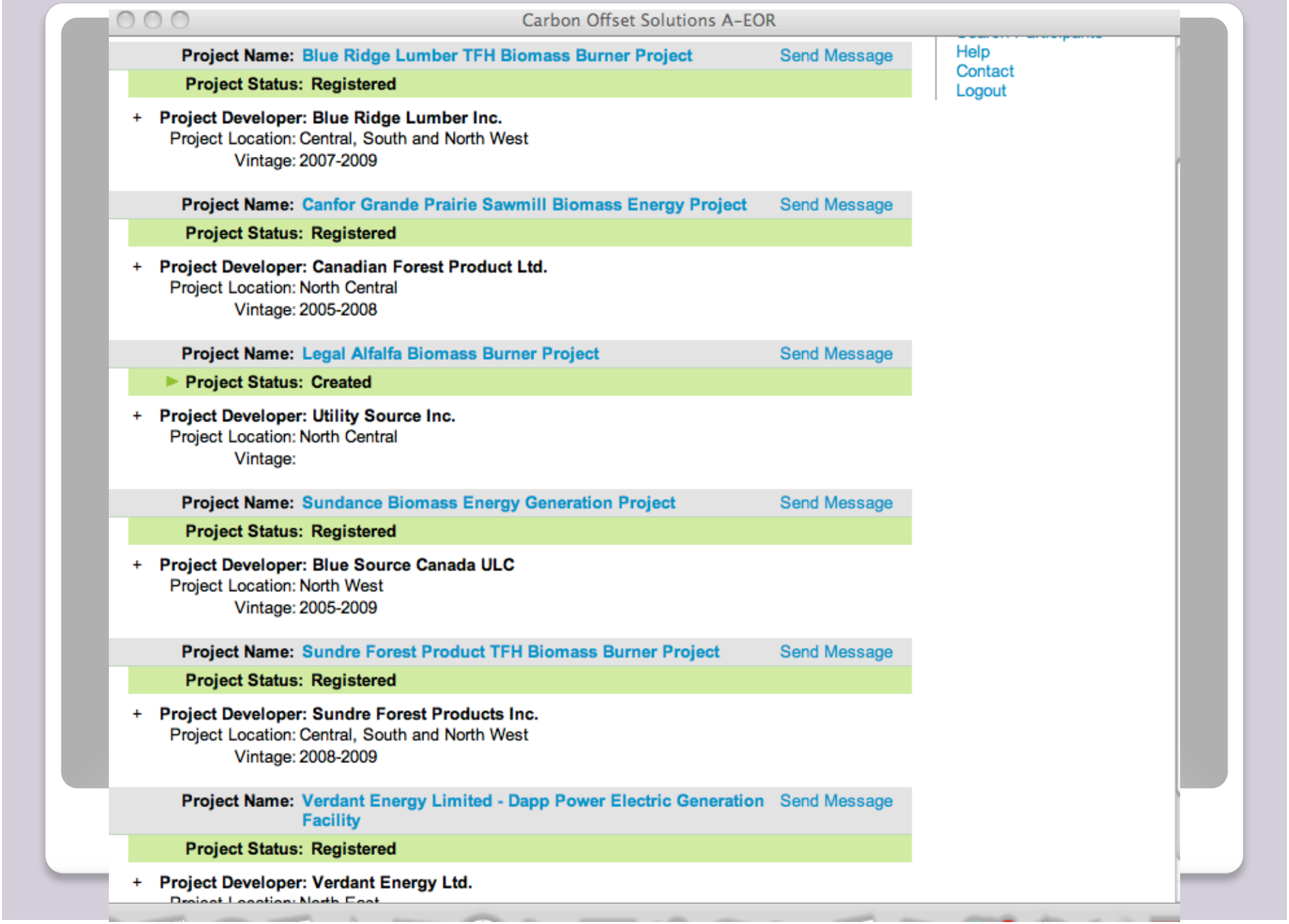
$$\text{Emissions}_{\text{Project}} = \text{Emissions}_{\text{Facility Operation}} + \text{Emissions}_{\text{Combustion of Biomass}}$$

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

Biomass Combustion



Registered Projects


Carbon Offset Solutions A-EOR
Project Name: Blue Ridge Lumber TFH Biomass Burner Project
Send Message
Project Status: Registered
+ Project Developer: Blue Ridge Lumber Inc.
Project Location: Central, South and North West
Vintage: 2007-2009
Project Name: Canfor Grande Prairie Sawmill Biomass Energy Project
Send Message
Project Status: Registered
+ Project Developer: Canadian Forest Product Ltd.
Project Location: North Central
Vintage: 2005-2008
Project Name: Legal Alfalfa Biomass Burner Project
Send Message
Project Status: Created
+ Project Developer: Utility Source Inc.
Project Location: North Central
Vintage:
Project Name: Sundance Biomass Energy Generation Project
Send Message
Project Status: Registered
+ Project Developer: Blue Source Canada ULC
Project Location: North West
Vintage: 2005-2009
Project Name: Sundre Forest Product TFH Biomass Burner Project
Send Message
Project Status: Registered
+ Project Developer: Sundre Forest Products Inc.
Project Location: Central, South and North West
Vintage: 2008-2009
Project Name: Verdant Energy Limited - Dapp Power Electric Generation Facility
Send Message
Project Status: Registered
+ Project Developer: Verdant Energy Ltd.
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Facility	Project Type	Offsets YTD (tonnes)	Lifetime (tonnes)
Blue Ridge THF Biomass Burner	Displaces Natural Gas Use	48, 572	121,600 (to 2015)
Canfor GP Sawmill Biomass	CHP plant Displaces gas/ electricity	115,344	115,344 (to 2012)
Legal Alfalfa THF Biomass Burner	Diversion of waste from landfill/Gas	- (expect 2200 per yr)	17616 (to 2011)
Sundance Biomass Energy	Displaces Natural Gas	65,407	120,000 (to 2013)
Sundre TFH Biomass Burner	Displaces Natural Gas	27,219	117,600 (to 2015)
Verdant Energy-Dapp Power Electric	Electricity Generation	442,473	2,500,000 (to 2013)

Project Summary

- Theoretical Potential: Electricity – 12 Mt/yr

Residue Source	PJ	GWh	tCO_2e/MWh[a]	Potential GHG Reductions (Mt $CO_2e\ yr^{-1}$)
Forest Residues[b]	14	3889	0.65	2.3
Mill Residues[b]	3.2	889	0.65	0.5
Agriculture Surplus Straw[c]	51	16388	0.65	9.7

- b – Based on AFPA harvest statistics and forest company harvest efficiency data
- c –Estimates based on Levelton and ST^2 Consultant's Report - *Bioenergy Opportunities for Alberta: Strategic Feasibility Study*, January 15, 2006, commissioned by the Alberta government.

- Forestry Residue Assumptions:
- ***Potential (GJ) = Residues (m^3) X 0.4 (conversion to Bone Dry Tonnes) X 20 GJ/BDT***
- ***Potential (PJ) = Potential (GJ)/1000000***

- **Current Projects - 0.175 Mt CO_2e/yr**
- (5 more planned biomass plants for the province)

Potential for the Province

Biofuels

- 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

Biofuel Protocol

- 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)

Biofuel Protocol

- 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

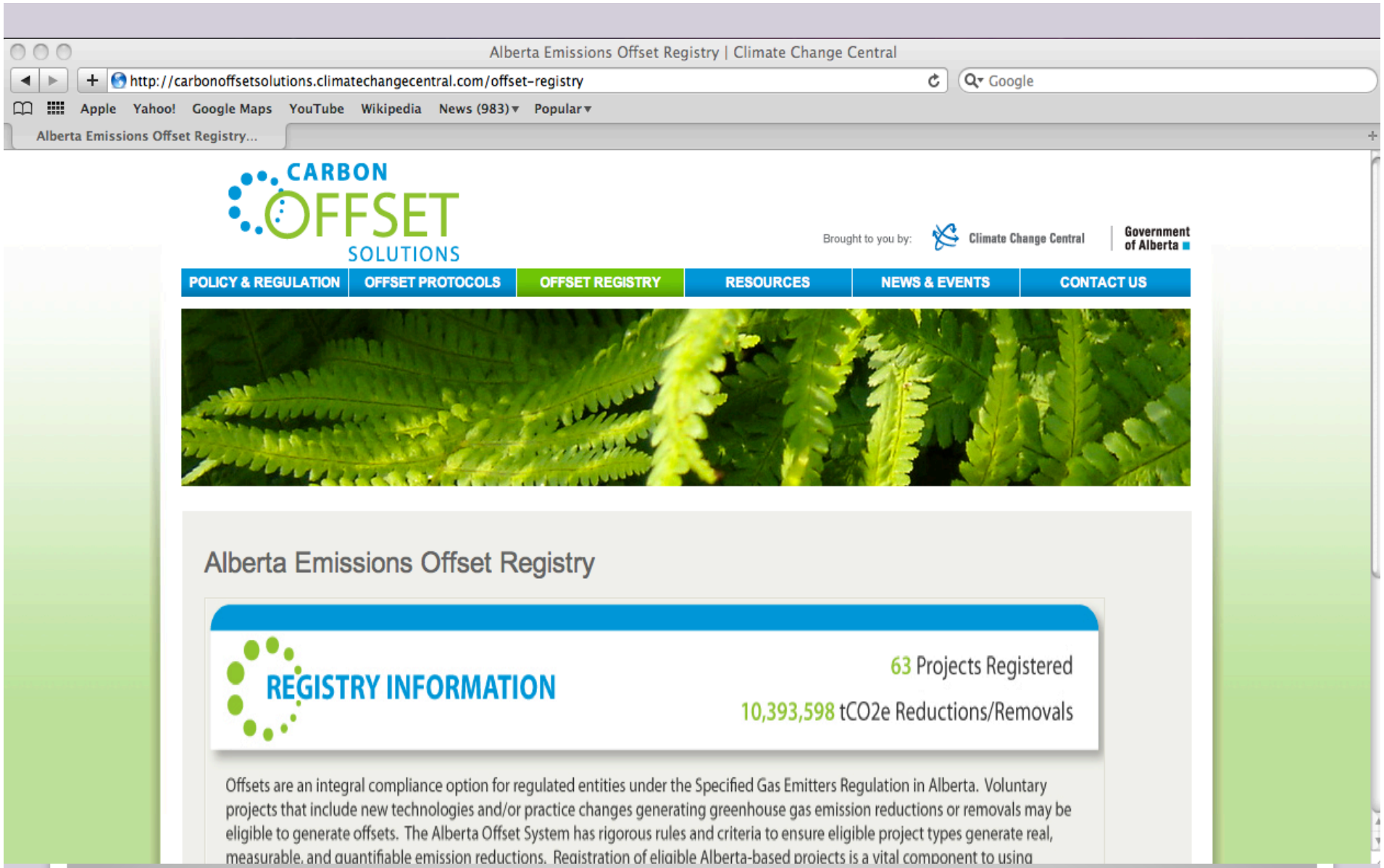
$$\text{Emission Reduction} = \text{Emissions}_{\text{Baseline}} - \text{Emissions}_{\text{Project}}$$

$$\text{Emissions}_{\text{Baseline}} = \text{Emissions}_{\text{Fuel Extraction / Processing}} + \text{Emissions}_{\text{Use of Fuel}} + \text{Emissions}_{\text{Electricity Generation}} + \text{Emissions}_{\text{Gen Heat and Power}} + \text{Emissions}_{\text{Decomposition, Collection and Destruction}}$$

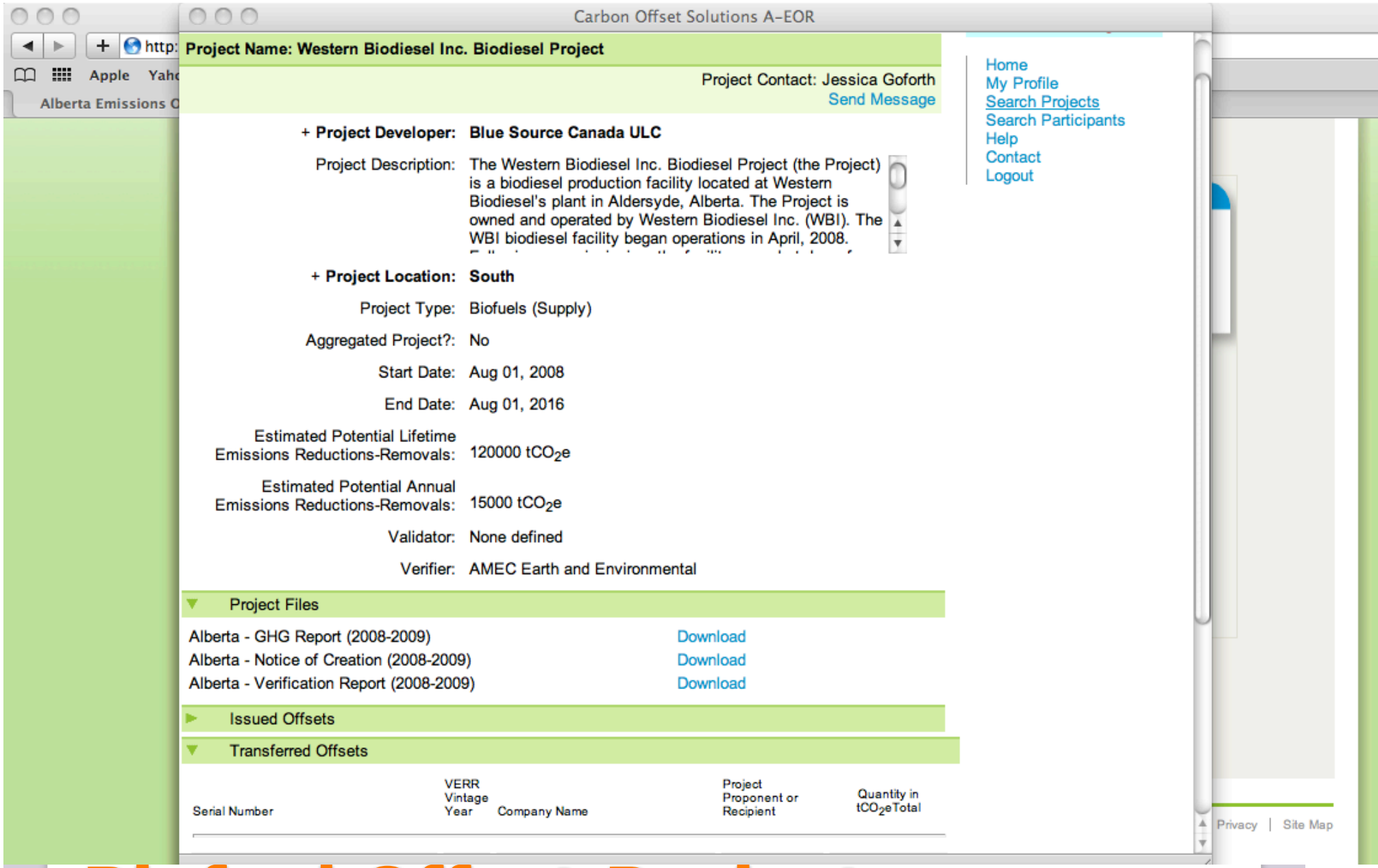
$$\text{Emissions}_{\text{Project}} = \text{Emissions}_{\text{Fuel Extraction / Processing}} + \text{Emissions}_{\text{Facility Operation}} + \text{Emissions}_{\text{Use of Biofuel}} + \text{Emissions}_{\text{Distribute Heat and Power}} + \text{Emissions}_{\text{Gen Heat and Power}} + \text{Emissions}_{\text{Transfer / Conversion}}$$

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

Biofuel Protocol



Registered Projects



Biofuel Offset Projects

- 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

Policy Landscape

- 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

Alberta Policy

Question: Are Alberta biofuels eligible for carbon offsets given an RFS with a carbon intensity-based performance threshold?

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

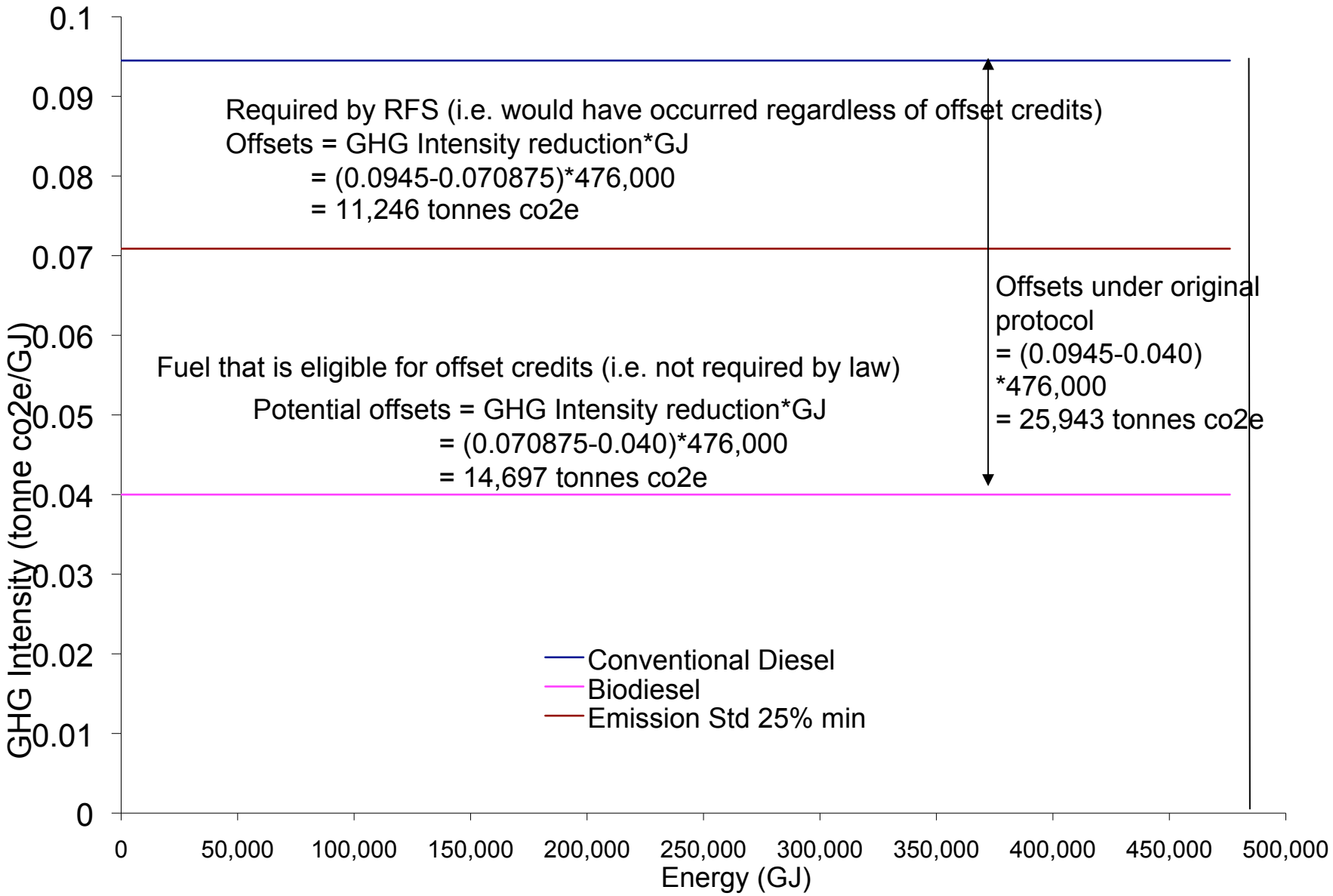
The Options

- 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

Issues

- Facility Production and GHG Intensity of the Fuel vis a vis 25% threshold
- Scenario 1:
  - BDL Facility – 14 Ml/yr = 476,000 MJ
  - Biodiesel LCA Intensity = 0.04 tonnes CO_2e/GJ
  - FF Diesel intensity = 0.0945 tonnes CO_2e/GJ
  - 25% Intensity reduction = 0.0709 t CO_2e/GJ
- GHG Savings:
  - Protocol – (0.09-0.04)*476 kl = 25,492t CO_2e
  - RFS Overlay – (0.07-0.04)*476kl = 14,697 t CO_2e
- 43% reduction in Offsets from Original

Thinking to Date



Diagramatically

- 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_2e/GJ
  - FF Diesel intensity = 0.091 tonnes CO_2e/GJ
  - 25% Intensity reduction = 0.069 t CO_2e/GJ
- GHG Savings:
  - Protocol – (0.091-0.055)*336 kl = 12,286 t CO_2e
  - RFS Overlay – (0.069-0.055)*336 kl = 4,608 t CO_2e
- 62.5% reduction in Offsets from Original

Thinking to Date

- 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

BioChar Protocol - Future

Slides by Keith Driver, MSc, PEng, MBA
Leading Carbon

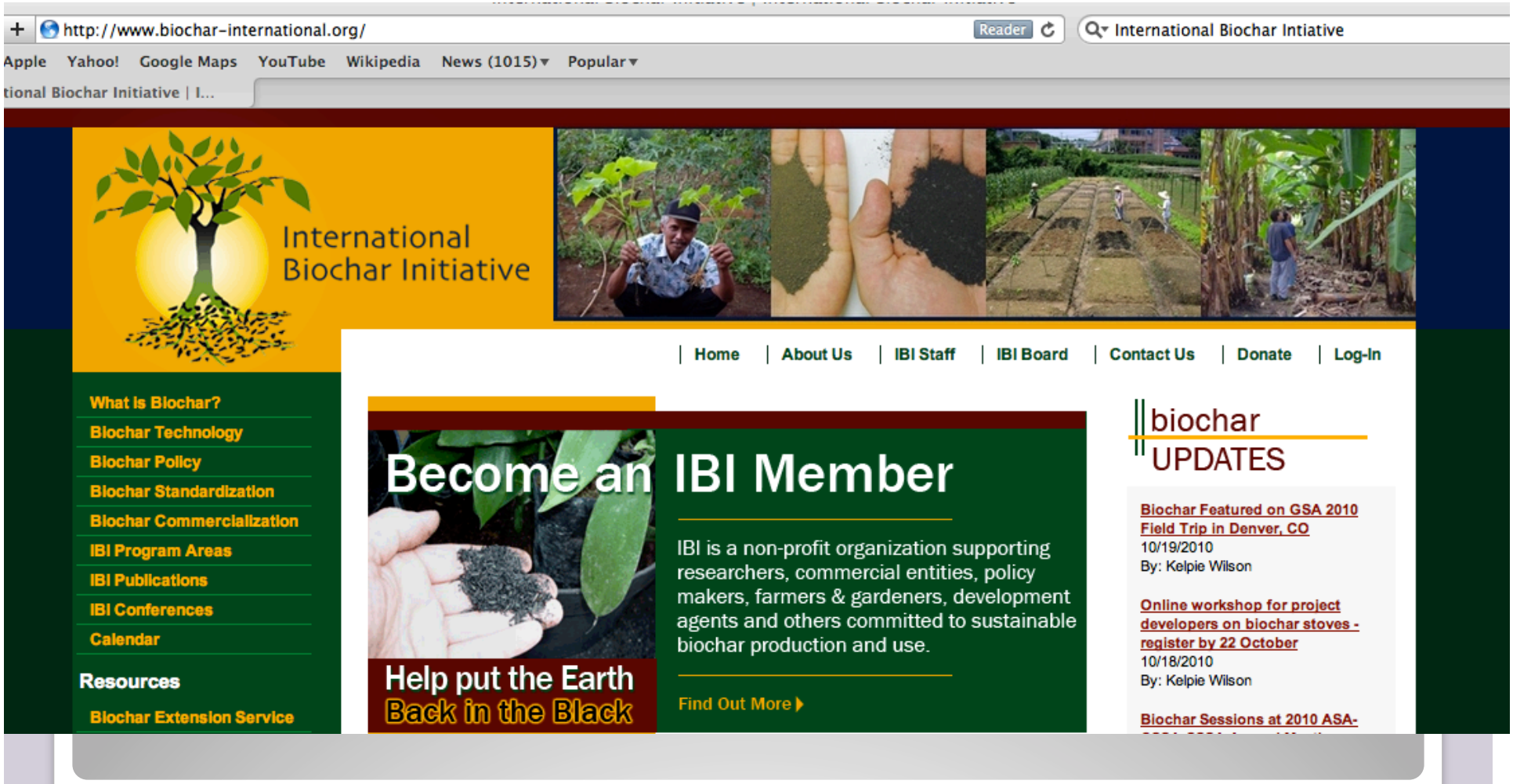
- Biggest Challenges:
  - Numerous Feedstocks (baseline accounting complex – what happened to biomass before)
  - Numerous ways to make biochar
  - Longevity in soils depends on process, feedstocks, soil type, micro-climate, cultivation
  - No direct way to measure biochar fraction
- Means:
  - Difficult to account for secondary emissions and activity-shifting leakage effects through land use change
  - Full GHG Emissions LCA on production, processing, transportation, soil incorporation

Msmt and Accounting Issues

Pyrolysis Mode	Conditions	Liquid/Oil (%)	Char (%)	Gas (%)
Fast	Moderate temperature ~ 500°C Short vapor residence time ~ 1 sec	75	12	13
Moderate	Moderate temperature ~ 500°C Moderate vapor residence time ~ 10–20sec	50	20	30
Slow	Moderate temperature ~ 500°C Very long vapor residence time ~ 5–30min	30	35	35
Gasification	High temperature >750°C Moderate vapor residence time ~ 10–20sec	5	10	85

Source: Brown 2009.

Process/Products Differ



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*

A Product/Characterization Standard

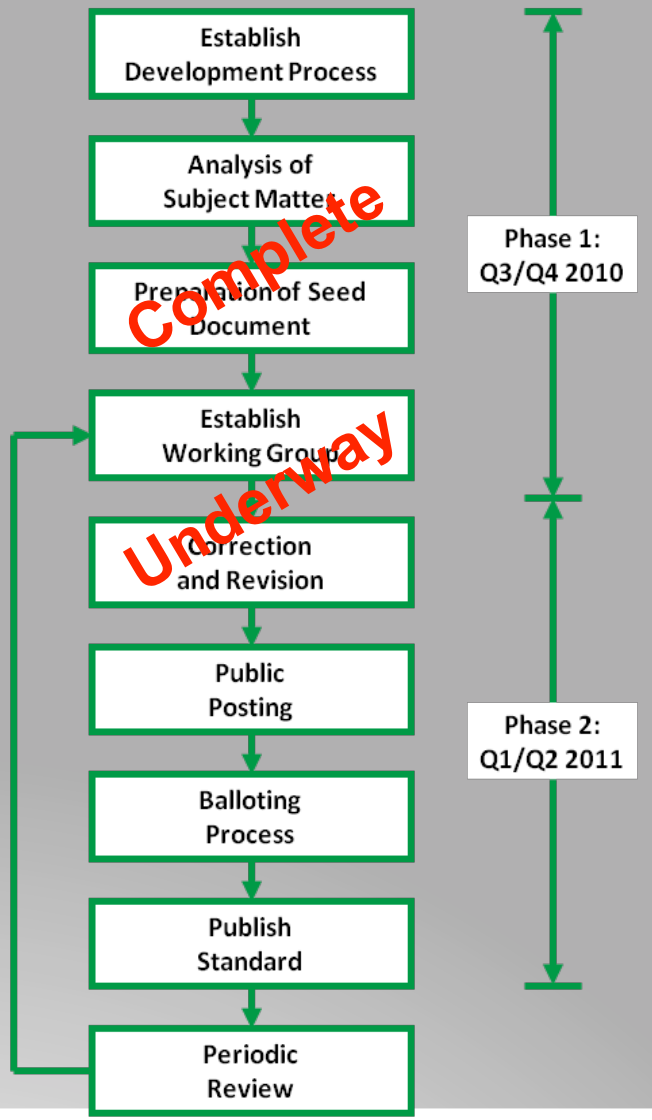
Proposed Approach

- 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

Progress to Date

- 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



Complementary Activities

- Many related tasks that will be done in parallel

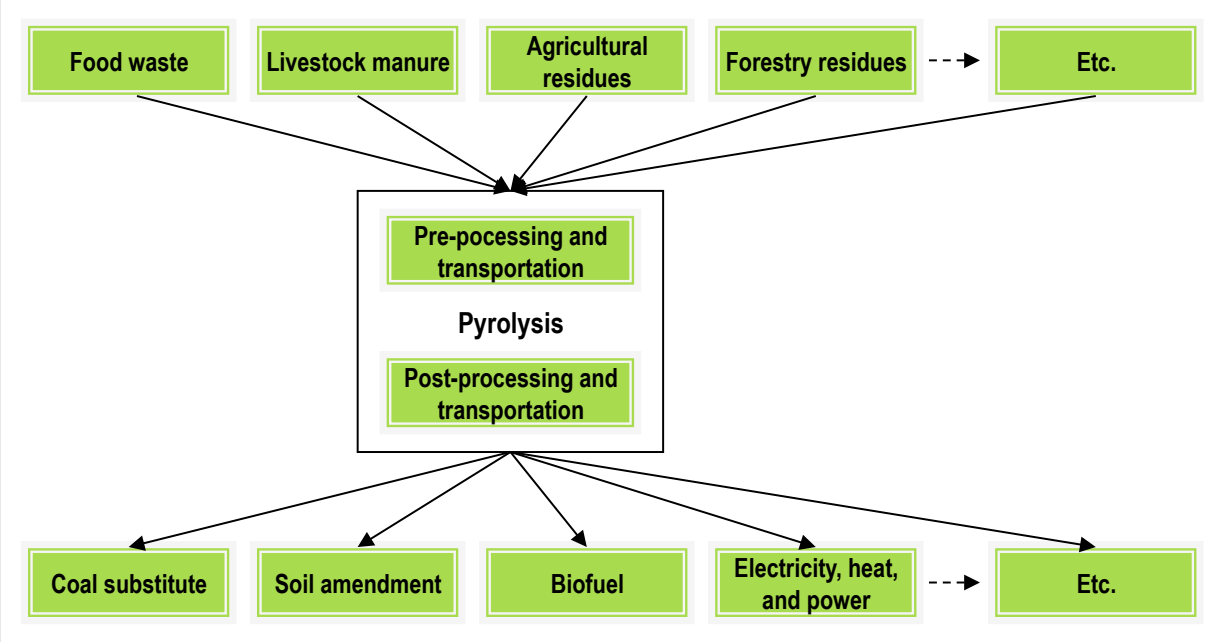
1) Establish business case for standards development and product certification.
2) Communications strategy to support stakeholder engagement.
3) Initiate dialogue with standard setting organizations.
4) Development of Biochar marketing strategy.
   - Link between characterization standard and product marketing
5) Development of a Biochar certification program.

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”

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Emission Reductions & Carbon Sequestration

Mechanisms	Description	Key issues
Waste Diversion	Organic materials diverted from landfills would otherwise degrade anaerobically, producing methane emissions.	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.
Avoided Waste Combustion	Organic materials that would otherwise have been combusted, producing carbon dioxide emissions.	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.
Soil Carbon Accumulation	Conversion of biomass to biochar sequesters carbon. Incorporation of biochar within the soil matrix can lead to the enhanced sequestration of soil carbon.	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.
Fertilizer Efficiency	Biochar may 1) improve the efficiency of fertilizer usage relative to yield, and 2) alter processes that lead to emissions, resulting in lower N_2O emissions from fertilizers and reduced CH_4 production.	Difficult to measure changes in CH_4 and N_2O emissions at a field scale. Modelling of N_2O can be resource intensive and requires a significant research and field data.
Electricity Displacement	Electricity produced from biochar projects may offset electricity produced from fossil fuels.	This is an indirect emission reduction and may not be considered under all programs.
Fossil Fuel Displacement	The heat, power, and biofuels produced from the biochar projects may offset fossil fuel usage downstream.	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.

Most mechanisms have analogies into other markets/protocols

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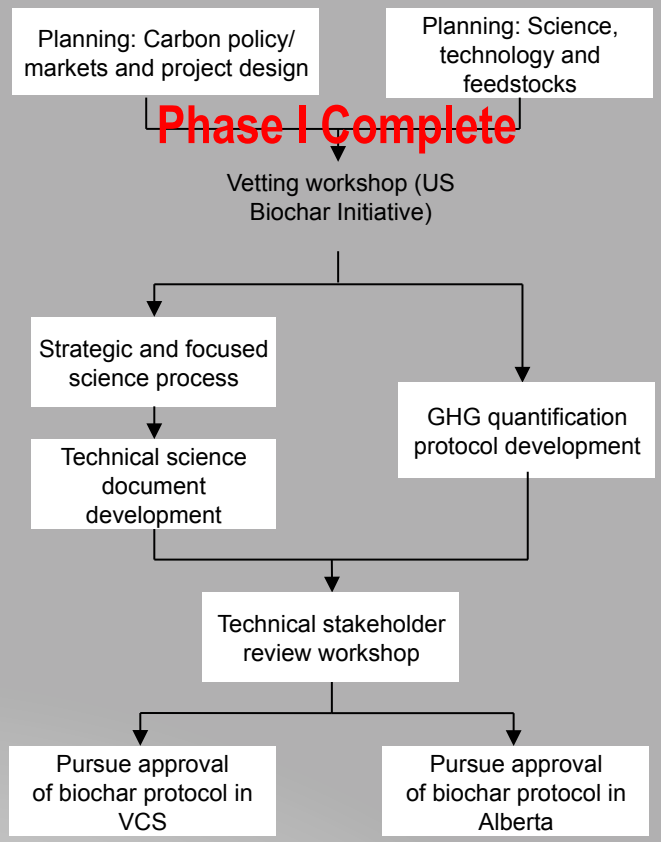
Proposed Path Forward

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)



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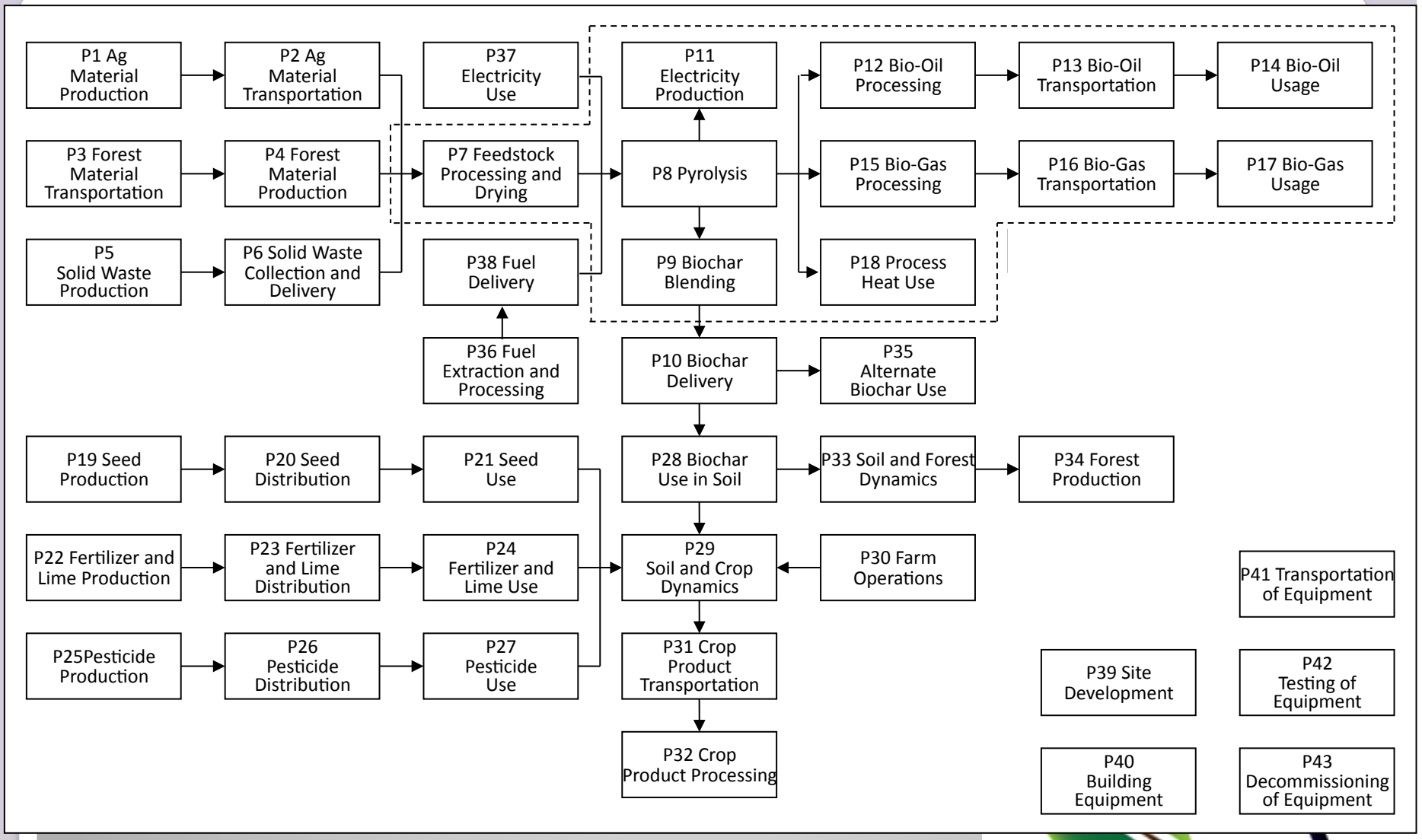
Bringing Biochar Projects into the Carbon Marketplace



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Questions?

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