Canadian Council of Forest Ministers

Conseil canadien des ministres des forêts

A Framework for Forest Management Offset Protocols

This report is a project of the Climate Change Task Force of the Canadian Council of Forest Ministers.

Copies of the report can be found online at ccfm.org or by contacting the Canadian Council of Forest Ministers at:

Canadian Council of Forest Ministers Secretariat
Canadian Forest Service
580 Booth Street, 8th Floor
Ottawa, ON K1A 0E

T: (613) 947-9099
F: (613) 947-9033

This report was based on work completed under contract by ÉcoRessources Consultants Inc. with research assistance from Enfor Consultants.

Head Office
825, rue Raoul-Jobin
Quebec City (Quebec) Canada G1N 1S6
Telephone: +1 418-780-0158
info@ecoressources.com

ISBN 978-1-100-13197-9
Cat. no.:Fo4-29/2009E

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FOREWORD

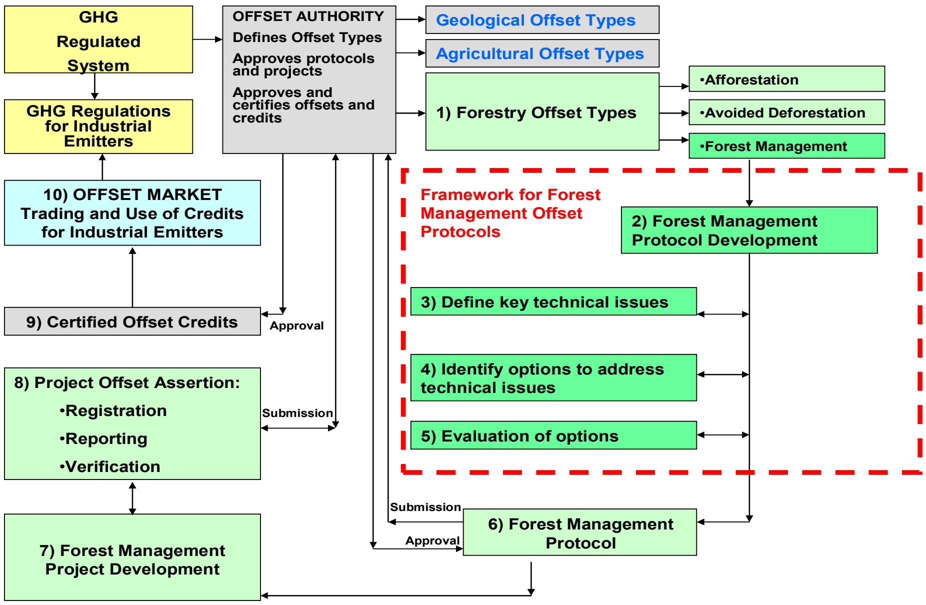
The management of existing forests may become a useful tool for sequestering carbon dioxide (CO_2) away from the atmosphere and reducing its effect on global warming. The Kyoto Protocol and numerous offset systems recognize that potential.

Offset systems are a tool that is increasingly used to provide economic incentives for these carbon benefits, by allowing forest carbon management projects to sell carbon credits to regulated industries to offset emissions. To quantify the exact amount of additional carbon that can be attributed to incremental forest management activities and that would therefore be eligible to receive credits, offset systems require the use of an approved forest management carbon quantification protocol. Currently, quantification protocols have been developed for afforestation, but none exist in Canada for forest management activities.

In January 2008, the provincial Premiers met in Vancouver, BC, and formally requested that the Canadian Council of Forest Ministers (CCFM) look at the development of a common forest carbon management protocol for all jurisdictions to use. In June 2008, a decision from the CCFM Deputy Ministers' meeting held in St. Andrews, NB, directed the Climate Change Task Force to instead develop a framework for forest management offset protocols. Moving from a protocol to a more generic framework was a reflection of the opinion that a single protocol could not adequately cover the diversity of forest conditions and forest management applications across the country and apply to multiple offset systems (e.g., federal, Alberta, Western Climate Initiative). Figure 1 illustrates where such a framework would fit in relation to an offset system.

This document represents the culmination of an extensive effort to produce a Framework for Forest Management Offset Protocols. The objective is not to provide the basis for a forest management protocol but rather to identify and analyze key issues that protocol writers and project proponents are likely to have to consider when drafting a forest management protocol. Overall, the framework is intended to allow quantification protocol developers to "hit the ground running" – thereby reducing development costs and raising the quality of forest carbon management quantification protocols across the country – and to allow sufficient flexibility for jurisdictions to reflect their forest management activities and policies while noting issues that require consistency across all jurisdictions.

FIGURE 1: FRAMEWORK FOR FOREST MANAGEMENT OFFSET PROTOCOLS WITHIN AN OFFSET SYSTEM



The Framework for Forest Management Offset Protocols is intended to provide information on forest management protocol issues and options for addressing them, which can be used by those who are involved in either researching or writing forest management protocols. The framework is targeted at a Canadian audience, but can help inform international forest management protocol efforts as well, particularly when Canadian forests are involved in these systems.

The framework identifies key issues in each of the following areas, which are either critical elements of or directly related to forest management quantification protocols: baselines and incrementality, permanence, measurement, leakage, verification, and crediting. It then assesses options for adequately addressing each technical issue, and provides an assessment of these options based on regulated and jurisdictional forest management requirements.

We see the Framework for Forest Management Offset Protocols as a significant milestone in the conversation around managing for carbon in Canada's forests, and we hope that you will be able to profit from this work in the design of forest carbon management protocols and in the resulting offset projects.

Canadian Council of Forest Ministers

EXECUTIVE SUMMARY

Introduction

Interest in the use of forest management as a tool to help address climate change is growing world-wide. One mechanism for encouraging this is to include in offset systems forest management activities, such as planting improved stocks instead of unimproved stocks, and planting faster-growing species rather than slow-growing species if allowed by site conditions and climate. Carbon credits generated through the reduction of greenhouse gas (GHG) emissions or increased sequestration can be sold to regulated emitters in a market-based solution to reduce Canada's overall carbon emissions.

The Framework for Forest Management Offset Protocols is designed as a reference document that identifies and examines technical issues involved in quantifying forest management carbon benefits. It brings information on the few forestry protocols in use together with research and insight from government, academic, and industry experts on forestry protocols. The target audience consists of those in Canada who are interested in forest management protocol development. The objective of the framework is not to provide the basis for a forest management protocol, but rather to identify and analyze key issues and substantive possible solutions that protocol writers and project proponents can consider as they research and draft forest management protocols.

The framework identifies key issues in each of the following areas, which are either critical elements of or directly related to forest management quantification protocols:

- baselines and incrementality
- leakage
- measurement
- verification
- permanence
- risk management, and
- crediting.

Verification and crediting are not elements of quantification protocols, but they help form the basis for successful forest management offset projects.

Baselines

There are a number of ways in which baselines can be established. They can be set on the basis of historical emission and removal data, projections about future emission and removal trends, or a performance standard. They can also be adjusted or normalized on the basis of aggregated activity levels or regulations. An adjusted or normalized baseline is a hybrid method that includes business-as-usual (BAU) activity levels in the accounting, with a discount based on performance standards or other constraints. For example, the Climate Action Reserve (CAR) forest protocol mandates a bottom-up modelling projection but imposes additional constraints based on average carbon stocks. The Regional Greenhouse Gas Initiative (RGGI) applies an average carbon stock approach based on data from the US Forest Service Forest Inventory and Analysis Program (FIA), but applies a discount to the amount of credits generated based on original carbon stocks at project start.

Baselines could be set for the duration of a project (static baseline). However, given that the economic, social, and physical conditions in which a project is taking place can change over time, it might be important to periodically reconsider the baseline upon which emission reductions/removals are assessed (dynamic baseline).

It is likely that baselines would need to remain fixed (static) for a given period of time in order for project investors to have some certainty about offset generation prospects. Assuming that project conditions are more likely to undergo change as time goes by, the period for which baselines are fixed would determine the capacity of a baseline to promote environmental integrity while minimizing market uncertainty. This trade-off is not unique to forestry projects; however, the long time scale over which some forest management projects are expected to generate credits makes this issue more relevant for forest management.

Given the need to be conservative while maintaining procedures that are as objective, transparent, and technically sound as possible, an adjusted approach to baseline-setting may be the best way to take each of the legal, physical, natural, and market variables into account with the greatest accuracy while providing more transparent and objective criteria. An adjusted approach thus seems best suited to promoting economic efficiency while safeguarding the environmental integrity of the scheme. A reliance on bottom-up modelling based on all legal, physical, and financial constraints is well understood within the forest practitioner community, and along with a modest use of top-down standards or constraints presents a viable hybrid option.

Permanence

Permanence risks are unique to forestry, certain agriculture projects, and carbon capture and storage projects. Forest management protocols must therefore include provisions and methodologies for assessing and managing permanence risks. Several major issues have been identified as needing attention in addressing permanence risk, including:

- assessing and measuring risk of reversal
- managing risk of reversal
- liability for reversal
- due diligence required to ensure that the program authority does not bear disproportionate risk
- addressing permanence at project end.

A complete risk assessment would need to account for the most important risk a project faces. In some cases this would be a straightforward exercise, while in others it might require a combination of one or more of the main reversal risk assessment options (macro level, micro level, quantitative, and qualitative).

With regard to the question of where liability for reversal should sit, the options are not necessarily mutually exclusive and could be combined in a number of ways. Liability for some risks could be placed on one entity, while liability for other types of risk could be placed on another. For example, the CAR forest protocol distinguishes between unintentional reversal (due to natural disturbances) and intentional reversal (due to harvest), with the program authority accepting liability for unintentional reversals but making forest owners liable for intentional reversals.

Managing risk of reversal is an insurance problem. Along with insurance products, there are different mechanisms that could be adopted to provide insurance against the damage of a reversal. The questions revolve around distribution of the risk and distribution of responsibility for the cost of mitigating the risk. The main options are reserves (basically offset asides or buffer pools), discounting, and traditional insurance products.

It is also important to consider transition measures. The best practices of today may not be the best practices of tomorrow; nevertheless, today's best practices are the ones that can be implemented to facilitate a functioning forest management offset initiative. The program authorities could opt to wait for better mechanisms to emerge, such as forest management offset project insurance, but at the cost of viable projects potentially being lost because the offset incentive is missing.

As a starting point, the program authority would ultimately be liable for reversals. However, reversal risk could be attached to project proponents or a third party through a combination of contract provisions and program rules. Individual risk, however, could be reduced through the traditional avenue of "pooling" risk and assessing a risk premium on each project in the pool. A project proponent with many projects could create its own risk management pool, but the most efficient option would likely be for a program authority to actively manage a reserve based on several projects. Protocols should specify a risk management approach to determine the percentage of offsets that a project must set aside or discount.

The handling of crop insurance, with its risk attached to weather vagaries, offers much instructive knowledge and experience in the search for ways to deal with forestry offset reversal risk. Coming up with an approach that successfully pools risk within as large a pool as possible is likely the option that will remove a significant barrier to forest management offset projects being considered seriously. In the near term, however, it is unlikely that there will be sufficient projects to form a viable risk-sharing pool. In the absence of a risk-sharing mechanism, prospective proponents will be hesitant to forge ahead and bear all the risk, and this could prove to be a major barrier to getting the first group of major projects under way.

A major part of the dialogue about reversal risk has focused on the arrangements for ending a project. The options include a permanent commitment realized through a covenant, a variable duration contract, the aforementioned temporary crediting (which is allowed under the Clean Development Mechanism [CDM] system), a long-term contract (100-year), or an evergreen agreement (for a suggested 25-year period). An evergreen agreement approach would allow more flexibility than either a covenant or 100-year contract, while providing more assurance of permanence than does a variable duration contract. It is also a familiar practice in the Canadian forestry industry, as several provinces issue long-term tenures that incorporate evergreen provisions.

Approaches to addressing the due diligence issue could include setting eligibility requirements to impede the registration of projects deemed too risky; the implementation of risk management systems to mitigate risks of project failure or natural disturbances; or the application of a deductible for reversals in order to promote good management.

Measurement and monitoring

Fundamental to the Framework for Forest Management Offset Protocols is the need to provide guidance on accurately measuring and monitoring changes in carbon stock, including increases or decreases in emissions to the atmosphere. The main issues include what carbon pools must be measured, whether harvested wood products (HWP) should be measured (and if so, how), and what the protocol requirements should be for measurement.

In agreement with the Kyoto Protocol, all forest carbon pools should be accounted for, including living biomass (above-ground biomass and below-ground biomass), dead organic matter (dead wood and litter), and soil organic carbon. Protocol developers, however, should be given the flexibility to exclude elements of pools where they can be shown to be immaterial under the protocol's materiality or *de minimus* rules.

Because of the ongoing dialogue at the international level about inclusion of and accounting for HWP in national inventories, it might be best not to make HWP a mandatory or required pool, and instead leave the matter of HWP pool inclusion to the discretion of project proponents.

Incorporating into forest management protocols highly prescriptive requirements for measurement methodologies and tools, such as models, could lead to considerable resistance within the Canadian professional forest practitioner community. There is a Canada-wide base of professional and academic expertise in forest resource measurement, and forest carbon measurement is simply an extension of timber supply modelling and vegetation resource inventories. The key to high-quality measurement and monitoring is likely an emphasis on an outcomes-based approach through the inclusion of accuracy targets in forest management protocols.

Leakage

Leakage refers to GHG emissions that are shifted from a project area to an area outside the project boundaries as a result of project activities, thereby partially or completely cancelling the GHG benefits generated by the project. It is essential to the success of an offset system that leakage be accounted for and either mitigated or discounted from offsets generated.

The main issues in dealing with leakage in forest management protocols are the need to carefully define project sources, sinks, and reservoirs (SSR) and the market and ecological effects of forest management offset projects.

The ISO 14064 standard requires that a project proponent identify relevant SSR for surveillance and justify the exclusion of any SSR. The objectivity of this process could be enhanced by setting clear requirements for the measurement of controlled and associated SSR (pools, materials/products, and energy fluxes for activities and under certain conditions). This method could be based on decision trees for the identification of key SSR similar to those provided in the Intergovernmental Panel on Climate Change's (IPCC) good practice guidance documents (IPCC 2006). For example, in the CAR forest protocol, planners must estimate the amount of GHG emissions produced by machinery used in management activities (CAR September 2007).

Most interviewees considered entity-wide reporting at the Forest Management Area level necessary for avoiding the creation of perverse leakage incentives. While this approach could be well suited to large-scale timber operations on Crown land, there are difficulties with applying this method to projects in private forests.

Market leakage refers to the impact on SSR of shifts in supply and demand for wood products caused by a forest management project. An increase in timber extraction in existing managed forests and the development of new timber extraction activities on formerly unmanaged land are examples of negative market leakage that could result from a decrease in supply. Application of eligibility criteria, such as a project having to maintain timber yields, and use of a discount based on estimated leakage are seen as the two main options for addressing this matter.

The literature and interviews did not point to an obvious way to address the issue of market leakage. The application of a simple 2% sustainable timber extraction criterion proposed by the California Climate Action Registry (CCAR) seems to be the most promising option for dealing with market leakage; however, it would likely disadvantage forest conservation projects.

Neither the ISO 14064 standard nor the CDM methodologies deal explicitly with the possibility that leakage may occur through ecological processes. While the potential options are the same as for market-based leakage, ecological processes are complex and difficult to quantify with an acceptable degree of certainty. However, the carbon implications may be important.

Verification

Emission reductions and removals must be verified in order to generate offset credits. Clear, transparent, and accurate verification procedures must be established in order for the various offset market stakeholders to have confidence in the environmental integrity of their underlying GHG reductions. The verification issues identified are:

- clarity and comprehensiveness of verification guidance
- inclusion of a recognized forestry professional on verification teams, and
- verification period or cycle.

In terms of clarity and comprehensiveness of verification guidance, the right balance should be struck between what the offset system program authority can require from verifiers and what they are required to do or committed to doing as professionals who follow international verification standards and rules of conduct. Verification guidelines that apply to groups of similar projects could help streamline the verification process; however, well-designed quantification and monitoring protocols, in combination with an emphasis on "professional reliance," could reduce the need for adopting specific verification guidelines for each project.

With regard to the composition of the verification team for a forest management offset project, requiring that verification be undertaken by qualified recognized professionals – for example, members of a professional association – could help ensure the quality of the verification process. In the case of forest management protocols, mandating that at least one recognized forestry professional be a member of a verification team would have important advantages.

In terms of the verification period, there is a need to strike the right balance to ensure that carbon stock variations are well accounted for and that project proponents face acceptable payback periods and verification costs. As such, there appears to be consistency among different offset markets and standards in the verification interval not exceeding five or six years in order to account for changes in carbon stocks. There are advantages and disadvantages to both having this interval fixed for all projects and allowing project proponents to decide on the verification period. But allowing for some flexibility might not significantly affect the environmental integrity of the system, and could reduce transaction costs.

Crediting

Crediting occurs when a program authority issues the amount of offset credits that a given emission reduction/sequestration project has generated between two verifications. Given the temporary nature of forest carbon, various credit certification mechanisms have been proposed to reflect the non-permanent nature of forest credits, creating a different carbon commodity that takes into account the risk of non-permanence.

Crediting issues are prominent topics in discussions about forest management offset projects. Although not a protocol matter, they are addressed in the framework because of their direct relationship with forest management offset project viability. The issues addressed in the framework are temporary crediting (as is allowed by the CDM system), *ex-ante* credits, and duration of the crediting period.

Although the ability to issue temporary credits for forest-based carbon projects has had little traction in the CDM offset marketplace, temporary credits could help preserve the environmental integrity of the system because they would account for the non-permanent nature of forest sinks. Temporary credits could also be an efficient way to mitigate non-permanence risks. Nevertheless, the CDM system experience shows that offset buyers have shown little interest to date.

Ex-ante crediting is seen by many in the forest industry as a means to bringing more projects to market, as it would allow project proponents to obtain the carbon benefits of their projects before they actually occur. In existing offset systems, credit allocation generally occurs *ex-post* – that is, after the delivery and verification of carbon benefits. For example, under the Offset Quality Initiative (2008), credits are issued only on an *ex-post* basis. However, the proponents of *ex-ante* credits argue that, because of the long time frame involved in generating climate benefits in the case of forest management projects, *ex-post* crediting could prove financially unfeasible for project proponents.

Advanced payments are possible under offset buying contracts, but the payments would still be made on the basis of the project proponent delivering *ex-post* credits. They would not become official credits until the reduction/removal enhancements had occurred and been verified. The advanced payment option is a typical risk issue between contractor and contractee. A basic tenet of offset projects has been the use of verified credits – that is, reductions/removals that have already occurred. Any project proponent, not just parties behind forest management offset projects, could ask for *ex-ante* credits. It is not that *ex-ante* credits are an impossibility; mechanisms could be devised to identify and accommodate their risks, but the disadvantages of paying for future performance are greater than the benefits of creating additional forest management offset projects. The well-established advanced payment option would provide a basis for creating worthwhile projects while avoiding the problems of *ex-ante* credits.

Allowing for long crediting periods would provide more economic certainty for project proponents and could make their projects more viable. However, long crediting periods could compromise the environmental integrity of the system if the baseline is susceptible to change during that period. Shorter crediting periods could be more environmentally robust if the baseline scenario is expected to change during the crediting period, but would be less financially attractive to project proponents. This dilemma could be solved by allowing for one or several renewals of the crediting period, conditional to a revision of the baseline scenario.

1. INTRODUCTION

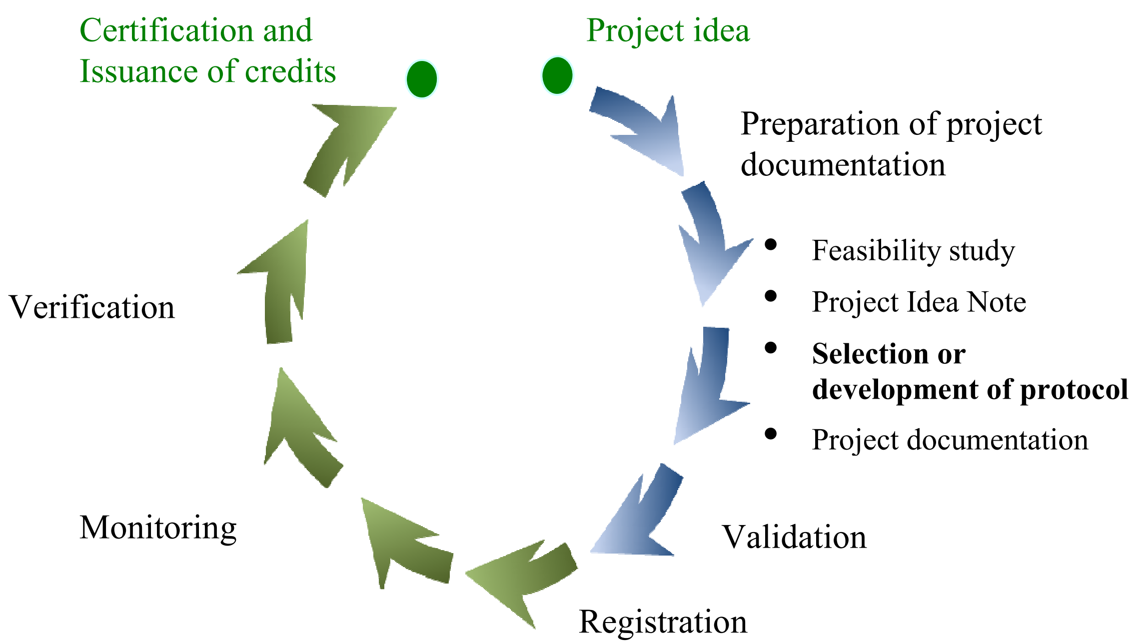
1.1. Framework purpose

This report on a framework for forest management offset protocols has been prepared at the behest of the Canadian Council of Forest Ministers (CCFM). The CCFM felt that there was a need for a document that would bring together information on the few forestry protocols in use and research and insight from government, academic, and industry experts on forestry protocols. The target audience is those in Canada who are interested in forest management protocol development. Although it is targeted at a Canadian audience, the framework can also help inform U.S.-based forest management protocol development efforts. The objective of the framework is not to provide the basis for a forest management protocol, but rather to identify and analyze key issues and substantive possible solutions that protocol writers and project proponents can consider as they research and draft their forest management protocols.

Providing a review and assessment of the various structural issues will facilitate the creation of high-quality and widely accepted protocols that can be applied to the development of forest management offset projects in Canada. Figure 2 shows where the development of a protocol generally occurs in the offset project development cycle.

More specifically, the framework identifies key issues specific to the Canadian and broader North American context that protocols will need to address, and provides options and solutions for addressing them, as well as a detailed discussion on the strengths and weaknesses of each of these options.

FIGURE 2: OFFSET PROJECT DEVELOPMENT CYCLE



This work has been guided by the best available practices and draws from the knowledge and experience of those who have been involved in developing offset protocols and projects in the forestry sector, crafting and applying forest inventory methods, and verifying forest carbon practices and offset creation systems. Along with the standards and best practices in the current small suite of forestry protocols, there are standards, rules, and best practices from other offset systems and project types that can inform the forest management situation. Researchers in governments, NGOs, and universities, as well as actors from the offset marketplaces and industry were brought into the process in order to include several relevant viewpoints.

1.2. Framework structure

The framework identifies key issues in each of the following areas, which are either critical elements of or directly related to forest management quantification protocols:

- baselines and incrementality
- permanence

- measurement and monitoring
- leakage
- verification, and
- crediting.

Verification and crediting are not elements of quantification protocols, but they help form the basis for successful forest management offset projects. In addition, risk management has been addressed in various places in the framework, mainly in the chapter on permanence, rather than in a stand-alone chapter.

Various technical issues in addition to the overarching issues listed above were identified through the extensive research undertaken by the consultants. Options for addressing the many technical issues were researched and assessed. The pros and cons for each option were determined on the basis of a set of evaluation criteria. Recommendations were made for an issue when an option was clearly recognized as a best practice, but arriving at recommendations was secondary to identifying issues, options, and pros and cons for each option. Some recommendations highlight the need for additional research on specific issues or options.

The following chapter structure has been employed for each overarching issue:

- identification and explanation of potential technical issues
- identification and explanation of the options for addressing each technical issue
- evaluation of the options according to a set of pre-defined criteria, and
- conclusions.

1.3. Context: Canadian and North American initiatives for forest management protocol development

It is commonly acknowledged that forestry projects can play an important role in mitigating the impacts of climate change. They have been the basis for offsets in existing offset systems – for example, the Clean Development Mechanism (CDM), which allows for afforestation and reforestation offset projects. In North America, there are several initiatives that either allow or plan to allow forest management offset projects in offset mechanisms of compliance systems.

The Government of Canada's "Turning the Corner" plan to reduce greenhouse gas (GHG) emissions, unveiled in 2007, has the objective of assigning emission reduction targets to the nation's largest emitters. The plan proposes the creation of a national offset system, allowing large emitters to meet their targets by purchasing offsets. "Turning the Corner" led to the publication of the *Draft Guide for Protocol Developers* in fall 2008, which highlighted different types of offset projects that would be given priority for approval in the coming Canadian offset system, as well as the most promising protocols to draw from. Two forestry protocols were referenced in the *Draft Guide for Protocol Developers* to guide the development of forestry protocols in Canada, namely the protocol for afforestation activities applicable under the Alberta Offset System and the Climate Action Reserve's forest project protocol. Alberta has adopted its own offset system within its baseline and credit trading system, thereby allowing non-regulated emitters to develop afforestation offset projects and sell credits to regulated emitters. The British Columbia government structured its *Greenhouse Gas Reduction Targets Act* (GGRTA) Offset Initiative to serve as a tool that BC public service organizations can use to obtain offsets to help achieve their statutory carbon neutrality targets.[1] Forest management and afforestation offset projects are allowed under this BC offset system.

In the United States, the Climate Action Reserve (CAR), a division of the California Climate Action Registry (CCAR), is in the midst of revising its forest project protocol. It covers afforestation/reforestation, conservation, and forest management projects. The first compliance market GHG emissions trading system in the US is the Regional Greenhouse Gas Initiative (RGGI), which involves 10 eastern and mid-Atlantic states and is focused on regulating CO_2e emissions from electricity production.[2] The RGGI allows offsets from afforestation projects and has come up with its own quantification protocol.[3] Likewise, the planned Western Climate Initiative (WCI), a multi–province and state endeavour, proposes a "cap, credit, and trade" system that regulates approximately 90% of emissions within participating jurisdictions. *Design*

[1] The *Emission Offsets Regulation* was approved and ordered by the BC Cabinet under the authority of the *Greenhouse Gas Reduction Targets Act* (GGRTA) on December 8, 2008. It sets out legal requirements for projects or actions to be recognized as emission offsets for the purposes of the GGRTA.

[2] Pre-compliance trading began in February 2008 and the initial auction of allowances occurred in September 2008.

[3] The RGGI Staff Working Group asked a group of organizations to present recommendations on including new forest offset categories (active forest management and avoid deforestation). Recommendations were submitted in June 2008 (Maine FS et al. 2008).

Recommendations for the WCI Regional Cap-and-Trade Program, released September 23, 2008,[4] states that participating jurisdictions would be able to use carbon offsets/offset credits acquired from non-regulated entities or allowances from other WCI-recognized regulation systems for up to 49% of their jurisdiction's total emission reductions. Forest management is expected to be an allowed activity for offset projects within the WCI scheme.

In the US, other state-based and voluntary market offset initiatives are underway, notably in Oklahoma, Georgia, and through the Chicago Climate Exchange. Voluntary market offset standards like the Voluntary Carbon Standard (VCS) Gold Standard and the Climate Community and Biodiversity Alliance (CCBA) are also contributing to improving knowledge on how to create forest-based offsets that generate real climate benefits.

This framework draws from the many other regional and international initiatives, attempting to synthesize existing knowledge and identify gaps to guide the development of forest management protocols applicable to the Canadian context.

1.4. Forest management activities

Forest management activities in Canada can be categorized by their GHG emissions or carbon impact pathway. It is important to note that there is still much uncertainty about the effects of forest management activities on carbon pools in the forest, and the carbon benefits of such activities must be proven using adequate baselines. For example, some activities may increase removals (e.g., fertilization, brush and weed control, site rehabilitation, conversion to faster growing species), others may reduce emissions (e.g., reducing site degradation, thinning), and still others may reduce the risk of emissions (e.g., increased pest infestation and fire control). The framework also briefly references forest management activities that modify a production profile to include a higher proportion of longer-lived wood products, namely harvested wood products.

The structural issues that may arise in creating a forest management carbon quantification protocol will vary depending on the activities that are targeted by the protocol. The framework does *not* attempt to identify forest management practices that may be easier to address in protocol development, or that are most promising. Rather, it aims to provide a wide-reaching survey of issues and optional solutions for protocol developers that are generally applicable to any forest

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[4] It is expected to be operational on January 1, 2012. More information is available at www.westernclimateinitiative.org

management activity, while recognizing that some activities require specific approaches to address an issue, such as baseline establishment. A key consideration for protocol developers will be to craft protocols that are supportive of (and do not detract from) sustainable forest management principles and objectives.

1.5. How to use the framework

The Framework for Forest Management Offset Protocols is a synthesis of key issues and corresponding options in forest management protocol development in Canada. It should not be read as a prescriptive work and does not claim to address all circumstances in which forest management projects take place in Canada. It is based on a wide-ranging research process that included interviews with 23 experts from across Canada and in the US.

Chapter 2 provides an overview of the technical issues that arise in the development of forest management quantification protocols. Chapter 3 defines "forest" and "forest management," and discusses key issues for consideration in determining acceptable forest management activities. The qualitative criteria that were used to evaluate the pros and cons of the options are laid out in Chapter 4. The key topic areas are then addressed in six chapters, with several technical issues presented in each, along with corresponding options and a qualitative evaluation of the pros and cons of each option:

- Chapter 5 – Baselines and Incrementality
- Chapter 6 – Permanence
- Chapter 7 – Measurement
- Chapter 8 – Leakage
- Chapter 9 – Verification
- Chapter 10 – Crediting

For each issue, a conclusion either identifies an established or emerging best practice or suggests areas where further research is needed.

2. Technical Issues in Forest Management Offset Protocols

The ultimate objective of Canadian offset systems is to facilitate the achievement of national and provincial GHG emission reduction targets while helping to minimize the costs of achieving emission reductions. The design of an offset system will have profound implications for its ability to successfully contribute to this objective. In order for offset systems to contribute to achieving the stated objective, they must ensure that emission reductions are real, measurable, and verifiable (environmental integrity) while providing sufficient incentives for offset project proponents to participate in the mechanisms (economic efficiency). Although we appreciate that many issues need to be addressed to ensure an environmentally credible and economically efficient offset system, notably political, legal, social, economic, financial, and technical issues, the framework focuses on the main pillars of GHG emission quantification protocols: baselines, additionality, leakage, quantification/measurement, verification, permanence, risk management, and crediting. With the exception of permanence, these issues are not unique to forest management activities.

2.1. Baselines and incrementality: How to develop appropriate baselines to demonstrate additionality

The concepts of "incrementality" and "additionality" arise from the need to establish a clear distinction between emission reduction/removal enhancements attributable to voluntary efforts by project proponents that go beyond a given referential scenario and contingent phenomena that would occur normally. This principle is recognized by the United Nations Framework Convention on Climate Change (UNFCCC) and is considered crucial for the success of any offset system.

To guarantee that a GHG reduction and/or CO_2 removal enhancement from which offsets are generated is indeed incremental or additional, one must establish a "baseline scenario" that represents the most likely or reasonably likely[5] course of action in the absence of the project activity. Accordingly, only the net difference in emissions or removals between the project's performance and the baseline scenario is credited. In the case of forest management offsets, an important challenge is to develop clear procedures for baseline establishment that allow

[5] The rules for offset systems will vary on this requirement for baseline scenarios.

assessment of incrementality/additionality while remaining practical and cost-effective in the field.

There are a number of challenges in choosing a baseline establishment procedure. Ideally the choice of a baseline:

- takes into account the legal, economic, social, and physical conditions in which a project is taking place in order to best represent the activities that would have taken place in the absence of the offset incentive
- does not generate a "premium" for actors involved in past actions that caused important GHG emissions, and
- does not generate perverse incentives to not act and/or fail to acknowledge early movers.

Baselines can be established through a number of means: historical emission/removal data, projections about future emission/removal trends, and a performance standard. Baselines can also be adjusted or normalized on the basis of aggregated activity levels or regulations. An adjusted or normalized baseline is a hybrid method that includes business-as-usual (BAU) activity levels in the accounting, with a discount based on performance standards or other constraints.

A baseline can be set for the duration of a project (static baseline). However, given that the economic, social, and physical conditions in which a project is taking place can change over time, it may be important to periodically reconsider the baseline upon which emission reduction/removals are assessed (dynamic baseline).

Some approaches have been accepted in certain systems or jurisdictions; others have no precedent at the policy implementation stage. A central difficulty is verification of baselines that are counterfactual.

2.2. Permanence: How to provide adequate assurance that carbon credits will be valid, given that forests are susceptible to disturbance or harvest

Due to the temporary nature of carbon sequestration in vegetation and soils, offset systems that allow forest management projects need to address the issue of permanence either through temporary crediting or the use of measures to assure the permanency of the offset generated by a given project. Only by adopting such measures can offset systems generate offset credits from forest management projects that obtain reasonable prices from offset buyers and are fully fungible with other types of credits.

An offset is an environmental commodity and its pricing and marketing reflect the characteristics of a commodity marketplace. Forest management offset projects have to adjust to the strictures of this marketplace and not vice versa.

2.3. Measurement and monitoring: How to accurately and most economically measure forest carbon stock changes

The success of an offset system depends on accurate measurement of carbon stock changes. There is general agreement that methods deemed to be precise enough to serve the requirements of a forestry offset system exist for above-ground carbon stocks (and probably for below-ground carbon stocks). However, while the measurement techniques and technologies are available, few if any forestry operations currently apply them routinely for monitoring; operational systems will therefore have to be developed. Very precise systems may be costly to develop, and in some cases existing information (forest surveys and modelling, for example) can be used to reduce the costs of achieving the quantification requirements of an offset system.

2.4. Leakage: How to identify and account for a project's credit-generating activities causing increased carbon emissions elsewhere

Leakage refers to GHG emissions that are shifted from a project area to an area outside the project's boundaries as a result of project activities, thus partially or completely cancelling the GHG benefits generated by the project. It is essential to the success of an offset system that leakage be accounted for and either mitigated or discounted from offsets generated. In some cases, leakage may be accounted for by increasing the spatial and temporal scale of the accounting system. For forest management offset projects, leakage may be created by market effects (external leakage). Measuring leakage may therefore require measuring and reporting of carbon stock changes on non-project lands. This can be done through modelling or full carbon accounting on a national or regional scale. International leakage is very difficult to deal with and has so far been ignored by national offset systems.

2.5. Verification: How third-party verification will be conducted, who will conduct it, and what the costs will be for project proponents

Emission reductions/removals for which offset credits are generated must be verifiable. In order for offsets to have value, clear, transparent, and accurate verification procedures must be established. It is also generally recognized that verification must be performed by a properly accredited, third-party, independent firm or organization.

2.6. Crediting: How to handle timing of credit allocation and allocation periods

In existing offset systems, credit allocation generally occurs *ex-post* – that is, after the delivery and verification of carbon benefits. However, due to the long time frame involved in generating these climate benefits in the case of forest management projects, *ex-post* crediting may prove financially unfeasible for project proponents. For some activities, *ex-ante* crediting may make some project types more financially viable. The length of the crediting period – the time frame during which a project can receive credits for reducing emissions/increasing removals – will have a direct impact on the financial viability of a project.

3. Canadian Forest Management Activities for Forest Management Offset Projects

3.1. Defining forest management

Definitions will have significant implications for the activities that are included in an offset system. The most basic and important definition is that of "forest." A first option is to use the definition Canada employs for international reporting and accounting: "Forest land includes all areas of 1 ha or more where tree formations can reach 25% crown cover and 5 m in height in situ" (Environment Canada May 2008). Another option is to use definitions that are relevant to specific provinces; however, this could seriously impede the application of common protocols across Canada.[6]

Different definitions of "forest management" have been brought forward in discussions surrounding emission reductions and removals from the Agriculture, Forestry and Other Land Uses (AFOLU) sector. At the international level, the United Nations Framework Convention on Climate Change (UNFCCC) distinguishes between afforestation and reforestation activities (the conversion of non-forest to forest land), deforestation (the conversion of forest to non-forest land), and forest management (activities taking place on forest land remaining forest land). To guide our work, we have chosen to define "forest management" in the same way as the UNFCCC does.[7] Therefore, "forest management" in the context of this framework excludes all activities that involve land-use change.

Looking to carbon offset schemes in other parts of the world, there is limited guidance available to help Canada define activities that might be acceptable here. Most other schemes tend to consider forest management activities primarily as reforestation, afforestation, and conservation.

[6] There is no common international definition of "forest" for offset projects. For example, the definition in the draft version of CAR's Forest Protocol 3.0 is "lands that support, or can support, at least 10 percent tree canopy cover and that allow for management of one or more forest resources, including timber, fish and wildlife, biodiversity, water quality, recreation, aesthetics and other public benefits." According to the Kyoto Protocol a "forest" has a minimum tree height of 2–5 m, minimum crown cover of 10–30%, and minimum area of 0.05–1 ha. The Canadian definition is consistent with the Kyoto Protocol definition. To facilitate CDM forestry offset projects, qualifying countries must come up with a definition that lies within the parameter ranges of the Kyoto Protocol definition (Neeff et al. 2006).

[7] The Marrakech Accords define forest management as a *system of practices for stewardship* and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic, and social functions of the forest in a sustainable manner.

For example, other offset schemes generally characterize “forest management activity” as forest enrichments (Chicago Climate Exchange) or “improved forest management” (Climate Action Reserve)[8], but seldom consider the full range of forest management activities that might result in a net positive effect on carbon balance.

The Intergovernmental Panel on Climate Change (IPCC) guidelines for reporting under UNFCCC (*Good Practice Guidance for Land Use, Land-Use Change and Forestry* [GPG-LULUCF], 2003; *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use*) suggest two possible definitions: either specified forest management practices, such as fire suppression, harvesting, or thinning, undertaken since 1990, or a broad classification of land subject to a system of forest management practices, without the requirement that a specified forest management practice has occurred on each land area.[9]

Canada’s GHG Inventory states that “not all Canadian forests are under the direct influence of human activities, prompting the non-trivial question of what areas properly embody the ‘managed forests.’ For the purpose of the GHG inventory, managed forests are those potentially subject to harvesting or to measures of fire protection” (Environment Canada May 2008).

The 2006 IPCC guidelines address all five forest carbon pools (above-ground biomass, below-ground biomass, dead wood, litter, and soil organic matter) as well as transfers of carbon between different pools within the same land areas. In addition, the 2006 guidelines provide guidance on accounting for harvested wood products.

The Framework for Forest Management Offset Protocols addresses technical issues based on these most recent IPCC guidelines for accounting for carbon stock changes and the definitions of “forest” and “managed forest” used in Canada’s GHG Inventory.

[8] Forest management is defined as “the commercial or noncommercial growing and harvesting of forests” in the most recent version of the CAR forest protocol.

[9] In the 2006 IPCC guidelines, forest management activities are defined as “carbon stock changes on managed forests due to human activities such as establishing and harvesting plantations, commercial felling, fuelwood gathering and other management practices, in addition to natural losses caused by fire, windstorms, insects, diseases, and other disturbances.”

3.2. Key issues

A number of key issues need to be considered in determining acceptable forest management activities. These include the following.

3.2.1. Forest regime and jurisdiction

When considering which forest management practices might occur across Canada, it is important to consider whether forests might be managed differently based on the jurisdiction in which they are located. Jurisdictions include:

- private land (fee simple)
- First Nations
- federal Crown land
- provincial Crown land (with differences across provinces)
- municipal land.

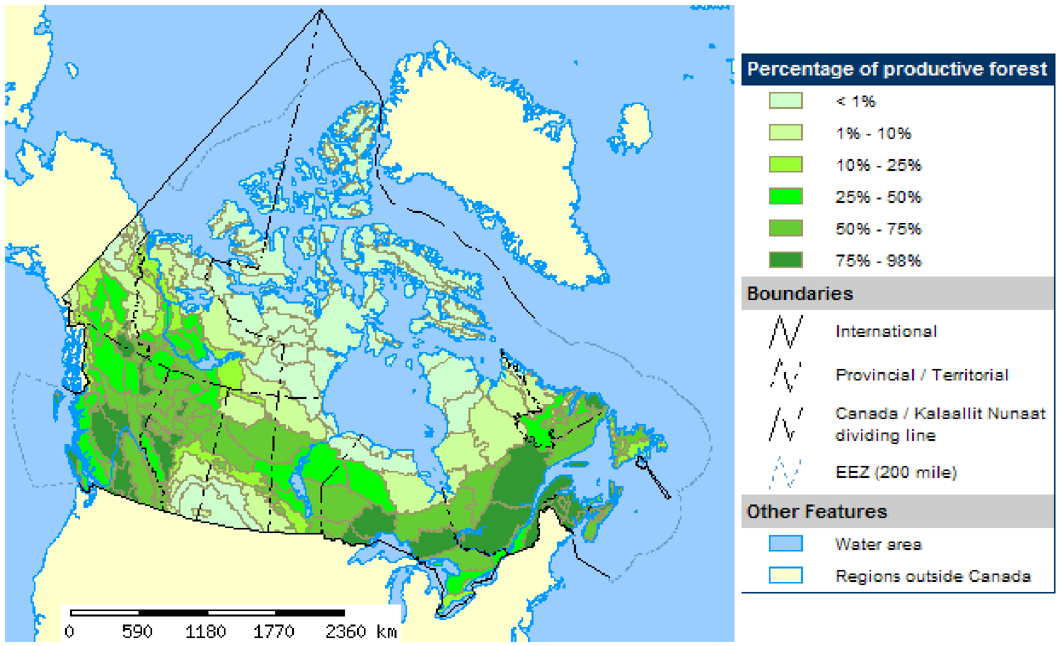
Practices are expected to be similar across Canada. For example, fertilization practices are similar in all areas of Canada. Any slight variations that may arise between biomes, such as the Pacific Maritime and the Boreal Shield, would be expected to be accounted for in the quantification.

Perhaps one of the greatest opportunities available in Canada is that our forests are vast and often controlled by public entities, such as provincial governments and the federal government. Forested area is therefore available for management at both the stand level and the much larger landscape level, where broad applications are possible.

3.2.2. Forest land

Canada's forests vary widely, ranging from temperate rainforests on the West Coast to forests in arctic conditions in the North, to forests of the Taiga Shield in the East and the wide-ranging boreal forests throughout central Canada. Only a certain portion of Canada's forest land is considered commercially and ecologically viable for forest management.

FIGURE 3: PRODUCTIVE FOREST LAND IN CANADA (SOURCE: NATURAL RESOURCES)[10]



It is therefore suggested that only forest lands that would be considered as available for sustainable forest management be considered available for offsets under a protocol.

Some jurisdictions may have a different view of which forest lands are acceptable for forest management activities. Ultimately, it would be useful for the CCFM or some other pan-Canadian authority to establish criteria that qualify forest land for management. Suggested criteria include, but are not limited to:

- land managed as sustainable forest land under CSA, FSC, SFI, or other major recognized forest certifications, and/or
- land that contributes directly to an officially recognized allowable annual cut, either provincial or private, and/or
- land that could reasonably be managed in a sustainable manner for the production of timber products, including forest biomass.

[10] Canada http://atlas.nrcan.gc.ca/site/english/maps/environment

3.2.3. Scale of management

Projects may be undertaken at the stand, landscape, or regional level. The scale under which forest management activities occur might influence the decision as to whether or not to include the activity. Some activities might be undertaken only at the stand level, whereas others might have an influence on carbon budgets only when evaluated in aggregation at the landscape level, forest level, or regional level.

Scale should not be a deterrent or cutoff for prospective project proponents, although it does make sense to mandate aggregated projects for projects below a certain size for administrative and cost-effectiveness reasons. The costs to quantify, validate, monitor, and verify a project at a smaller scale might make the project financially untenable. Other offset project types run up against the same overhead problem, but it is particularly acute with forestry projects because of their measurement and monitoring costs.

It will be important to know the scale of operation under which projects might be considered, as there is no policy on the size of entity that might apply. Should the entity be a company that manages an entire forest management unit, or could a project be submitted for just 100 ha of a management unit? This is a policy decision that will need to be made by an offset program authority.

3.3. Forest management activities

This section includes a list of sustainable forest management activities that are currently applied in Canada and **could** increase CO_2 removals, reduce GHG emissions, or store carbon above approved BAU baselines. This list is intended only to demonstrate the types of activities that might be considered; it is not exhaustive.

It is noteworthy that provincial, regional, or local forest regulations and policies could eventually influence the types of activities deemed eligible as forest management offset projects in a future Canadian offset system. Some of these regulations or policies could provide incentives for or limit the implementation of certain forest management activities.

However, these considerations aside, we have attempted to categorize possible forest management activities by GHG emission action, as follows:

- increasing removals
- reducing emissions
- reducing emissions and increasing removals
- reducing risk of forest hazards that result in emissions.

Finally, it is important to highlight the fact that there is uncertainty about forest management effects on forest carbon pools and forest products pools. Depending on the chosen management options and site condition, carbon benefits can materialize quickly or require several decades. That is why the following table only lists the available option and their carbon goal. Ongoing work using tools like the Carbon Budget Model is done in Canada to address this knowledge gap.

3.3.1. Increasing removals

Activities aimed at increasing removals do so by speeding up the growth of trees, establishing trees faster, increasing tree density and biomass growth, or decreasing competition. This results in the sequestering of more carbon and/or increasing the number of harvest removals of stored carbon from the forest.

Management Options	Definition or Goal of the Activity	Carbon Goal	Typical Business As Usual
Fertilization	To add nutrients to increase growth	To increase carbon sequestration of stands Reduce rotation age so more wood can be available for forest products or biomass	Unfertilized stands

Management Options	Definition or Goal of the Activity	Carbon Goal	Typical Business As Usual
Tree improvement	To breed trees that have better growth, better wood quality and/or increased pest resistance	To increase carbon sequestration of stands Reduce rotation age so more wood can be available for forest products or biomass	Planting non improved or less improved trees
Brush and weed control	To reduce competition in newly established forests so desired species can grow freely	To increase carbon sequestration of desired species	No brush and weed control
Planting after natural disturbance	To reforest promptly after natural disturbance	To accelerate carbon sequestration	Natural regeneration after natural disturbance
Reducing regeneration delays by planting	To establish trees after harvest faster than would occur with natural regeneration	To accelerate carbon sequestration	Natural regeneration after harvest

Management Options	Definition or Goal of the Activity	Carbon Goal	Typical Business As Usual
Site rehabilitation or conversion to faster-growing species	To increase growth and yield by planting fast-growing species instead of slower-growing species or natural regeneration	To increase carbon sequestration	Conventional growing stock or natural regeneration
Scheduling harvests closer to the biological maximum	To increase harvest by cutting stands when they reach their highest mean annual increment	To increase production of harvested forest products	Apply the harvest schedule determined by current forest management plans

3.3.2. Reducing emissions

Forest practices that seek to reduce emissions do so by either reducing the amount of fibre left on site to decompose, or reducing fossil fuel or GHG emissions during forest management processes.

Management Options	Definition or Goal of the Activity	Carbon Goal	Typical Business As Usual
Salvage harvest	To salvage damaged timber that would be lost to produce forest products	To reduce carbon emissions from wood decay To use the fibre to substitute non-woody material and fossil fuels	Leave timber to decompose in the field

Management Options	Definition or Goal of the Activity	Carbon Goal	Typical Business As Usual
Modifying forest management systems to lower emissions	To reduce fossil fuel use during forest management activities	To reduce GHG emissions	GHG emissions by current equipment
Using forest logging slash and residuals for forest products	To use logging slash and residuals for uses such as biofuels or biomass firing	To offset fossil fuel emissions by using logging slash and other forest residues	GHG emissions from decaying slash and residuals
Reducing slash pile burning	To reduce the human induced burning of slash piles and let them decompose on site	To slow the release of CO_2 to the atmosphere from burning.	GHG emissions related to burning slash piles. Caution must be taken to monitor methane (CH_4) if slash pile decomposition becomes anaerobic
Avoiding harvesting on peatlands	To protect peatlands from harvesting because they are important carbon pools (timber and peat).	To protect carbon storage in timber and peat	Timber harvesting on peatlands where permitted

Management Options	Definition or Goal of the Activity	Carbon Goal	Typical Business As Usual
Forest conservation	To reduce planned harvest	To maintain stored carbon	GHG emissions related to forest harvesting in the forest carbon pool and the forest product carbon pool
Variable retention harvesting and selection silviculture systems	To use harvest activities that leave a portion of the forest intact for a future harvest	To increase the storage period of carbon in standing timber	Total harvest

3.3.3. Reducing emissions and increasing removals

Forest management practices that seek to reduce emissions and increase removals do so by avoiding site-degrading practices and/or rehabilitating areas that affect the balance of carbon on the site.

Management Options	Definition or Goal of the Activity	Carbon Goal	Typical Business As Usual
Rehabilitating and reforesting access roads, trails, and landings	To reforest access roads, trails, and landings	To recover lost carbon pools	Leaving access roads, trails and landings to slowly regenerate naturally or not at all

Management Options	Definition or Goal of the Activity	Carbon Goal	Typical Business As Usual
Minimizing site degradation	To avoid intense soil disturbance during harvest operations by using low ground pressure equipment	To reduce carbon emissions from soil carbon pool	Standard rules regarding soil disturbance
Thinning	To remove some trees in a stand to improve growth of remaining trees	To reduce carbon emission from dominated trees that would eventually die and decay Produce forest products that can replace non-woody material or fossil fuels before final harvest	No thinning
Extending forest harvest ages or deferring the harvest	To harvest stands at a later age thus allowing trees to grow bigger	To enhance the forest carbon pool and keep it longer	Harvesting according to current management plan
Harvested wood products	To adjust forest management goals to produce bigger trees that can enhance production of longer-lived products	To produce more forest products to replace non woody materials and fossil fuels	Current management goals

3.3.4. Reducing risk of forest hazards that results in emissions

Forest management activities that seek to reduce the risk of hazards that lead to emissions do so by removing or reducing the hazards.

Management Options	Definition or Goal of the Activity	Carbon Goal	Typical Business As Usual
Increasing pest infestation control (insect, disease, wind throw)	To reduce the spread of insects and disease	To maintain carbon pools and carbon sequestration	Current level of pest infestation control
Increasing fire suppression	To reduce forest area burned	To maintain carbon pools and carbon sequestration Reduce GHG emissions Note: fire-suppressed forests **can increase** the risk of spread of fires to larger forested areas if the natural disturbance pattern is altered by suppression activities.	Current level of fire suppression
Landscape manipulation to reduce impact of natural disturbances	To reduce the impact of natural disturbances by creating a forest that is resilient, such as by using pest-resistant tree species, creating buffers, and manipulating the forest to create fuel breaks	To maintain carbon pools and carbon sequestration	Current level of landscape management

4. Criteria for Options

Given the multitude of approaches used to address the overarching technical issues identified in Chapter 3, we needed to establish evaluation criteria with which to assess the pros and cons of each approach and then provide protocol developers with guidance on which approach might be more appropriate to their particular conditions.

It is generally recognized that the success of an offset system depends on two central principles: environmental integrity (ensuring that emission reductions are real, measurable, and verifiable) and economic efficiency (ensuring cost-effectiveness and minimizing administrative and transaction costs) (OECD 2008; IEA 2005). Using these two principles, we established more refined evaluation criteria to guide our analysis of the different options for addressing the technical issues. Table 1 summarizes the criteria for analyzing the pros and cons of different approaches. It is important to note that not all criteria were used to assess the technical issues. Only those deemed appropriate or applicable to each specific issue were used.

TABLE 1: Summary of Evaluation Criteria

<table>
<tr><th colspan="2">Principle</th><th>Criterion</th></tr>
<tr><td colspan="2" rowspan="4">Environmental integrity</td><td>Ability to guarantee that reductions are real and incremental/additional</td></tr>
<tr><td>Ability to quantify (measurable, verifiable, and unique)</td></tr>
<tr><td>Robustness of approach (integrity, quality, and rigour of data collection methods)</td></tr>
<tr><td>Environmental co-benefits</td></tr>
<tr><td rowspan="8">Economic efficiency</td><td rowspan="3">Transaction costs</td><td>Administrative effectiveness (technically sound, transparent, and objective)</td></tr>
<tr><td>Approach is built on best practices, and has been successfully used before</td></tr>
<tr><td rowspan="2">Applicable to a range of activity types</td></tr>
<tr><td rowspan="5">Market efficiency</td></tr>
<tr><td>Incentives are well designed (perverse incentives and premiums)</td></tr>
<tr><td>Risks are mitigated/minimized</td></tr>
<tr><td>Fungibility with other carbon markets</td></tr>
<tr><td>Economic co-benefits</td></tr>
</table>

Forest management projects can generate a number of environmental and economic co-benefits and co-costs.[11] Factoring co-benefits and co-costs of forest management offset projects into their benefit-cost analysis can result in an outcome significantly different from a situation where only carbon impacts are considered. However, quantifying co-benefits or co-costs of different forest management activities is very complex and beyond the scope of this framework. This analysis cites but does not analyze co-costs and co-benefits.[12]

4.1. Environmental integrity

An offset credit is a financial instrument. In this case, it is an environmental commodity, although not a physical commodity: it is an intangible asset that is nevertheless real and has a monetary value. The value of this intangible asset is directly tied to trust in the environmental integrity of the underlying reduction or removal.

4.1.1. Ability to guarantee that reductions are real and incremental

To ensure that forest management activities that sequester or avoid the release of carbon result in real, additional emission reductions, one must demonstrate that the associated removals or avoided emissions would have not happened in the absence of those activities. To do so, one must first assess and estimate the GHG that would have been released or sequestered had the activity not taken place, and compare this projected scenario (the baseline scenario) with the emissions that are released or sequestered by the activity (the project scenario). Only by doing so can one demonstrate that the implemented activity generates real CO_2 removals or avoids GHG emissions and has a measurable impact on the atmosphere.

The credibility of this claim relies solely on how the baseline scenario is defined and measured. Although it is difficult to determine with precision what would have happened to different carbon stocks in the absence of a given forest management activity, it is nonetheless possible to take a conservative approach in order to avoid under-estimating the removals or over-estimating the

[11] The CCFM's extensive indicator framework for sustainable forest management communicates this breadth and diversity of benefits.

[12] For those interested in exploring how co-benefits can be included in protocol design, the past experience with the CDM is instructive, as forestry projects had to demonstrate that they did not generate negative externalities (co-cost). Also instructive are new approaches, such as the Climate Community and Biodiversity Standards (CCB), which incorporate methods to demonstrate environmental and social co-benefits generated by forest carbon projects.

emissions of the baseline scenario and avoid attributing a given project activity with more CO_2 removals or reductions than it actually generates. Credible offset markets therefore require the adoption of a conservative approach for assessing the baseline scenario and the removals and reductions linked to a given activity. Conservative, rigid, and thorough methods are more likely to guarantee that the removal enhancement or emission reduction generated by a given activity are real and incremental (Greenhaigh et al. 2006).

4.1.2. Ability to quantify

The feasibility of measurement and verification is essential to guaranteeing the environmental integrity of an offset system. Quantification methods can be assessed according to their degree of comprehensiveness, their accuracy and conservativeness, and the degree to which and ease with which measurement can be independently verified. Ultimately, the credibility of an offset system relies heavily on how removal enhancements and emission reductions are accounted for and whether these measurement methods are grounded in solid science and can be verified by independent third parties.

4.1.3. Robustness of approach

Solid, robust measurement and monitoring methods depend on data availability, data integrity, and the rigour of the project proponent's data collection methods. Robust measurement and monitoring methods are also based on peer-reviewed science and should be firmly rooted in best practices. The credibility of an offset system, and of the offsets it generates, is heavily dependent on the availability, quality, and integrity of the data used to estimate and measure CO_2 removals and GHG emissions.

4.1.4. Environmental co-benefits

Forest management projects can indeed provide a number of ecosystem services, such as reduction of sedimentation, improved water quality, and biodiversity benefits. Furthermore, forest management activities may provide adaptation benefits by increasing the resilience of ecosystems in the face of climate change. It is also important to consider the fact that some project types may be detrimental to biodiversity conservation, or may lead to pollution and health hazards.

4.2. Economic efficiency

In order for an offset system to deliver maximum environmental benefits at the lowest possible cost, it should strive to minimize administration costs for the offset program authority (project and credit registration, project reviews and approvals) and transaction costs for project proponents (contractual agreements; validation, monitoring, and verification requirements), while maximizing market efficiency (coverage, fungibility, and incentives).

4.2.1. Administrative effectiveness

Technically sound, transparent, and objective approaches can significantly reduce administration costs by simplifying project design and registration and approval procedures and reducing risk of litigation.

4.2.2. Approach built on best practices, and successfully used before

An approach that builds on best practices and has been successful in the past is likely to be far easier and less costly to implement than a novel approach. Quantification methods, for example, can build on existing information that is gathered periodically, such as forest surveys, to significantly reduce measurement and verification costs. Furthermore, it is easier to draw clear conclusions about the strengths and limitations of existing approaches than to extrapolate from hypothetical options.

4.2.3. Applicable to a range of activity types

Approaches applicable to a range of activities are likely to reduce transaction costs for project proponents by reducing the efforts that actors involved in various forest management activities have to put into developing different quantification protocols for the different activities. A far-reaching approach could speed up the implementation of various project types, increase the number of projects that will provide offsets, and ensure a greater supply. Having a widely applicable protocol could also create economies of scale and increase the incentives for companies to adapt their practices (measurement and reporting), given the possibility of creating greater offset volumes in a wider variety of settings. Furthermore, a widely applicable protocol could facilitate comparability between forest management projects across the country and across different countries (see 4.2.6. Fungibility with other carbon markets).

4.2.4. *Incentives are well designed*

The potential economic incentives offered by the offset scheme to different market players will ultimately have an impact on the environmental benefits that will be generated, with carefully placed incentives inducing greater emission reductions/removals. The design of an offset system, notably the types of activities it rewards, has variable economic implications, depending on where the incentives are placed. Some activities and/or actors will be more sensitive to price signals than others. An offset scheme could also generate perverse incentives for GHG-emitting activities, as well as “premiums” for GHG emission reduction/removals that would have taken place in the absence of the carbon incentive, thus reducing the economic efficiency of the scheme.

4.2.5. *Risks are mitigated*

The design of an offset system has important implications for the risks assumed by project proponents, with greater certainty about the volume of credits and the period in which credits will be generated, inducing higher investment in offset projects.

4.2.6. *Fungibility with other carbon markets*

There are a number of factors that may influence fungibility of offsets across markets and borders.

In order to be fungible, offsets have to be generated by activities accepted by the partner emission-trading schemes. There are many compliance schemes that in the future could partner in trading emissions. Current schemes include the European Union Emission Trading Scheme (EU ETS) in Europe, the Regional Greenhouse Gas Initiative (RGGI) in the eastern US, the Greenhouse Gas Reduction Scheme (GASS) in the Australian state of New South Wales, the GGRTA Offset Initiative in BC, and the Alberta Offset System. Other systems are under development: the Western Climate Initiative (WCI) has a 2012 start-up date; various cap, credit, and trade bills are before the US Congress; and the Australian federal government is consulting on an emissions trading system. Although we recognize the difficulty of predicting how each scheme would eventually handle forest management offsets originated in Canada, some have clearly demonstrated openness to accepting credits generated by forestry projects, as well as credits originated outside of their boundaries. It is possible, therefore, even at this early stage, to look at which of these other schemes might be accessible to Canadian forest management offset projects.

Fungibility will be enhanced by the adoption of comparable approaches to baseline setting, measurement, reporting, verification, and permanence. Approaches can be compared on the basis of the following:

- Baseline procedures set in a manner comparable to or more stringent than those of the partner system will increase the likelihood of fungibility between systems.
- A similar understanding of project boundaries or sources, sinks, and reservoirs (SSR) (for instance, SSR as defined in the ISO 14064 standard), as well as similar considerations for leakage,[13] will enhance the likeliness of fungibility between schemes.
- Compatibility of measurement/estimation approaches (including similar concepts of accuracy uncertainty between projects/programs) will increase the likeliness of fungibility.
- There should be a similar level of rigour in verification techniques and requirements.
- Fungible credits will need to be valid for the same time horizons. The permanency requirements should therefore be similar under linked schemes. In the absence of similar permanency requirements, a replacement mechanism acceptable to partner emission trading schemes could possibly address the time-horizon issue.

4.3. Economic co-benefits

Forest management offset projects can generate quantifiable economic benefits, such as increased employment and timber quality. However, it is important to mention that projects may also reduce employment and/or face opposition from local communities for a range of reasons.

4.4. Trade-offs

There are inevitable trade-offs between preserving the environmental integrity of the emissions trading scheme and maximizing economic efficiency. However, environmental integrity must be paramount if an offset system is to fulfill its prime objective of reducing the impact of GHG emissions on the atmosphere. Indeed it is essential that forest management offsets adhere to the same core principles and meet the same criteria as high-quality offset projects in well-established

[13] Setting boundaries appears easy for forest management projects, given that boundaries can be set geographically and carbon stock changes can be measured within those geographical boundaries. However, for harvested wood products, it may be more difficult to assess what the boundaries of a project are. Furthermore, the choices that are made as to definitions of project boundaries and affected carbon pools not only have implications for leakage measurement, but ultimately have important implications for the amount of credits that are generated.

compliance systems in Canada and around the world. Failing to do so would provide an unjustified (from a carbon standpoint) advantage to forest management projects (vis-à-vis other offset project types), weaken the integrity of the overall compliance system, and eliminate fungibility opportunities.

5. Baselines and Incrementality

Background

A major challenge in the development of a forest management protocol is to establish a method to determine a BAU scenario (generally referred to as the baseline scenario) against which credits are awarded for a given activity. Indeed, baseline establishment procedures have the most significant impact on the amount of credits that are generated by forest management offset projects (Galik et al. 2008).

Additionality versus Incrementality

Additionality and incrementality are directly related concepts, but the latter was referenced and defined in the draft overview of Canada's Offset System for Greenhouse Gases released summer 2009.

There are five components of the incrementality criterion in the draft Overview of Canada's Offset System for Greenhouse Gases:

- Projects must have started on or after January 1, 2006.
- Reductions must have occurred on or after January 1, 2011.
- Reductions achieved must go beyond the baseline defined for the project type.
- Reductions must be surplus to all legal requirements (federal, provincial/territorial, and regional).
- Reductions are beyond what is expected from receipt of other climate change incentives (federal, provincial/territorial).

It is our interpretation that the concept of incrementality focuses on having project reductions go beyond the baseline. Demonstrating incrementality (at least in the federal plan) did not require that projects pass an additionality test based on a financial or barriers analysis, as is the case for Clean Development Mechanism (CDM) projects. The Climate Action Reserve (CAR) forest protocol takes a similar incrementality approach, although it uses the term *additionality*. (The CAR definition is "Forest project practices that exceed the baseline characterization, including any applicable mandatory land use laws and regulations.") The Alberta Offset System and BC GGRTA Offset Initiative incorporate the concept of additionality, although tailoring it to their offset system framework.

To meet the objectives of an offset system, baseline establishment procedures should ensure that the emission reductions that are credited as offsets are additional to what would have happened in the absence of the activity. In other words, offsets must be equal to real, extra GHG reductions from the global atmosphere, something that can only be assessed by weighting the reductions against a pre-defined baseline scenario. Therefore, defining a baseline scenario and assessing incrementality/additionality are intimately connected. The more that a given baseline scenario accurately depicts the most likely situation in the absence of the project activity, the more "additional" will be the reductions linked to the activity. Hence, conservative and comprehensive baseline establishment methods are more likely to guarantee that the emission reductions generated by a given activity are real and incremental.

Approaches that allow for the establishment of baseline scenarios that diverge largely from the most likely BAU will be more prone to creating non-additional reductions/removals, thereby compromising the environmental integrity of the scheme. There is an implicit economic benefit to preserving environmental integrity in the case of baseline setting, as doing so will avoid creating premiums and perverse incentives and generate more emission reductions/removals per dollar spent. The challenge therefore lies in choosing a baseline scenario that accurately depicts the most likely BAU and in measuring the reductions/removals associated with it.

For forest management activities, the BAU carbon stocks may be extremely difficult to project over time, as they are influenced by a number of physical variables as well as economic and legal variables.

Time variability of forest carbon stocks from planned management activities

Emissions associated with forestry are highly variable through time, with high-emission years followed by zero-emission years. On a year-to-year basis, removals are highly variable because of growing conditions. This is a question of degree of difference, as all project types will feature some year-to-year variability; however, many types of projects are relatively more constant than are forestry projects.

Age structure effects

The age structure of the forest is the result of past management practices. Age structure effects will play an important role in the carbon budget of a managed forest for many years. For example, two forests under the same management regime may have very different carbon budgets over the same accounting period because of age structure effects. A forest that has recently been clear-cut may be a net carbon sink on a 30–50-year horizon, whereas a similar forest that is near harvesting will be a net source over this same period. This is a key factor to consider in assessing additionality/incrementality in the case of forest management. The BAU age structure effect on carbon stocks is relatively straightforward to assess.[14]

Other physical variables

Other physical variables affecting BAU include slope, ecosystem productivity, climate, and access via roads or streams. Although these factors can change over time (for example, roads can be built), they are relatively constant through time. However, it may be very difficult to assess the impact of climate change on ecosystem productivity, making it difficult in turn to distinguish between voluntary emission reduction/removal and contingent phenomena.

Natural disturbances

Natural disturbances are highly variable in time and their impacts on carbon stocks in Canada are enormous. Furthermore, future disturbances are difficult to predict, especially when considering climate change impacts on pest and fire incidence.

Variations in legal requirements

Additional emission reductions/removals should be "surplus" to what is required by regulation. The legal requirements for management practice should therefore be taken into account in the baseline. In the Canadian context there are virtually no such requirements for privately owned forests; however, there are numerous legal requirements for forest management on Crown land. Furthermore, the application of provincial policies and approved forest management plans will also greatly influence forest management practices, especially in cases regarding specific practices to be implemented. Such policies and legal requirements can change through time; however, the uncertainty associated with them is small and their interpretation is objectives-based.

Market factors

Market factors affecting the baseline, such as supply and demand of wood products, are constantly changing in the dynamic lumber, pulp, and paper markets. Creating a baseline procedure to account for this uncertainty and variability is challenging.

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[14] However, the effect of forest age on the incidence and intensity of natural disturbances may not be so straightforward to assess (Black et al. 2008).

Forest management is peculiar in the sense that forest management schemes, unlike factories or power utilities, can be readily changed on short notice and are therefore prone to higher variability. High production schemes for one rotation could be conservation schemes or short rotation biomass schemes the next. This is particularly relevant to establishing baselines for small-scale projects or stand-level activities.

Administrative effectiveness

To ensure that baseline establishment procedures are practical and economically efficient, offset systems should strive to develop baseline establishment approaches that can easily be used by project proponents. Some approaches may be easier to implement than others for a range of reasons (see 4.2.1. Administrative effectiveness and 4.2.2. Approach built on best practices).

Scale and applicability

An important point is that some variables are highly relevant to some types of activities and not to others. Whether the activity considered is applied at the stand level, such as fertilization and thinning, or the landscape level, such as fire or pest control, scale will generally determine which physical, natural, legal, and economic variables are relevant to the baseline.[15] Therefore, it may be possible and desirable to apply certain baseline options at the stand level but not at the landscape level, and vice versa (J. Williams pers. comm.).

A one-size-fits-all baseline approach, such as the one developed by CAR, has proven long and complicated to develop (D. Broekhoff pers. comm.; S. Carney pers. comm.). The Regional Greenhouse Gas Initiative (RGGI) also adopted a similar approach. One of our interviewees suggested that baseline establishment procedures could be greatly simplified if we separated specific management strategies and developed specific baseline guidance for each of them. The Voluntary Carbon Standard (VCS) proposes such a strategy by identifying specific categories within forest management. The categories identified in Section 4 could serve as the basis for separating activities.

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[15] For example, natural disturbances are not dependent on market conditions.

Forest management activities under the Voluntary Carbon Standard

Improved forest management practices, in both upland forests and wetland forests (e.g. peat swamps, mangroves), that qualify as eligible activities under the VCS include:

1. Conversion from conventional logging to reduced impact logging (RIL)
2. Conversion of logged forests to protected forests (LtPF) including:
   a) protecting currently logged or degraded forests from further logging, and
   b) protecting unlogged forests that would be logged in the absence of carbon finance
3. Extending the rotation age of evenly aged managed forests (ERA)
4. Conversion of low-productive forests to high-productive forests (LtHP).

Different baseline establishment procedures are used for these different forest management activities. (VCS 2007)

The following issues and options for addressing them are included in this chapter:

5.1. Baseline duration

- Option a: Static baseline
- Option b: Dynamic baseline

5.2. Baseline establishment

- Option a: Projection
- Option b: Historical baseline
- Option c: Average carbon stock
- Option d: Performance standard
- Option e: Adjusted or normalized

5.1. Issue: Baseline duration

Whether they are established using projections, historical data, mean stocks, or any form of performance criteria, baselines can be set for the duration of the project (static baselines) or be periodically reassessed to reflect changing conditions (dynamic baselines).

Environment Canada has indicated that it will consider both types of baselines during the protocol development process. Under static conditions, an emissions profile for the baseline activity remains unchanged over the proposed crediting period, with input parameters and quantification methodologies remaining constant. Under a dynamic baseline, the quantification methodology does not change, but input parameters could shift as a result of a range of factors (e.g., regulation and common practice), potentially leading to future changes in an emissions profile.

5.1.1. Options

Option a: Static baseline

Static baselines do not reflect changing conditions, which can lead to a significant over- or under-estimation of additional reductions/removals. However, the use of static baselines, set for the length of a project crediting period, helps to strengthen investment certainty and improve a project's economics by lowering the risks associated with uncertainty about the offsets that will be generated.

Option b: Dynamic baseline

Dynamic baselines can be used to reflect changing market, legal, and physical/natural conditions affecting the project area, and a change in the performance criteria that constitute the baseline (standard management practices, local/regional average carbon stocks, sustainable forest management criteria, new forest inventory data, and new yield curves). Dynamic baselines reflect changes in a number of direct and indirect factors, including changes to regulation, new emission factors/modelling, or shifts in market activity, as well as base information changes outside of the project's hands, such as new forest inventory data or changes to yield curves. This has the advantage of considerably improving the environmental integrity of the scheme in the face of changing conditions. However, dynamic baselines have the disadvantage of creating uncertainty about the offsets that will be generated and thus the attractiveness of the project for investors (in comparison to alternative offset project types).

It is perhaps useful to distinguish between a dynamic baseline where input parameters are frequently adjusted (e.g., on an annual basis) and periodic baseline re-assessment between crediting periods. We could envision a system where baselines are set for a given crediting period (say 10 years), after which they are reassessed based on the new context. The American Carbon

Registry proposes that forest management baselines be fixed (static) for a period of 10 years (American Carbon Registry 2009).

5.1.2. *Evaluation*

Options a and b are presented in Table 2 and analyzed according to the evaluation criteria presented in Chapter 4.

TABLE 2: EVALUATION OF BASELINE DURATION OPTIONS

Option	Description	Pros	Cons
Option a: Static baseline	• Baselines are fixed for the period of the projects	• Reduces risks for investor: creates greater certainty about the offsets that will be generated by the project	• Compromises the environmental integrity of the scheme (significant under- or over-estimation of BAU emission if context changes)
Option b: Dynamic baseline	• Baselines are periodically adjusted as input parameters change to reflect changing context	• Promotes the environmental integrity of the scheme (changes in the project context are incorporated in the baseline)	• Increases risks for investors: creates uncertainty about the offsets that will be generated by the project

5.1.3. *Conclusions*

It is likely that baselines will need to remain fixed (static) for a given period of time in order for project investors to have some certainty about offset generation prospects. Assuming that project conditions are more likely to experience change as time goes by, the period for which baselines are fixed will determine the capacity of a baseline to promote environmental integrity while minimizing market uncertainty. This trade-off is not unique to forestry projects; however, the long time scale over which some forest management projects are expected to generate credits makes this issue more relevant for forest management. In the event of an economic downturn reducing BAU harvesting levels, the use of a static baseline could generate large premiums for forestry companies.

5.2. Issue: Baseline establishment

Determining an accurate baseline scenario for forest management activities is complex because forest management projects (like most other offset projects) are often implemented for reasons other than carbon benefits (e.g., economic gains and co-benefits). Hence, differentiating actions that would have occurred anyway (the baseline scenario) from voluntary actions that reduce emissions and/or enhance removals can be highly prone to interpretation.[16]

5.2.1. Options

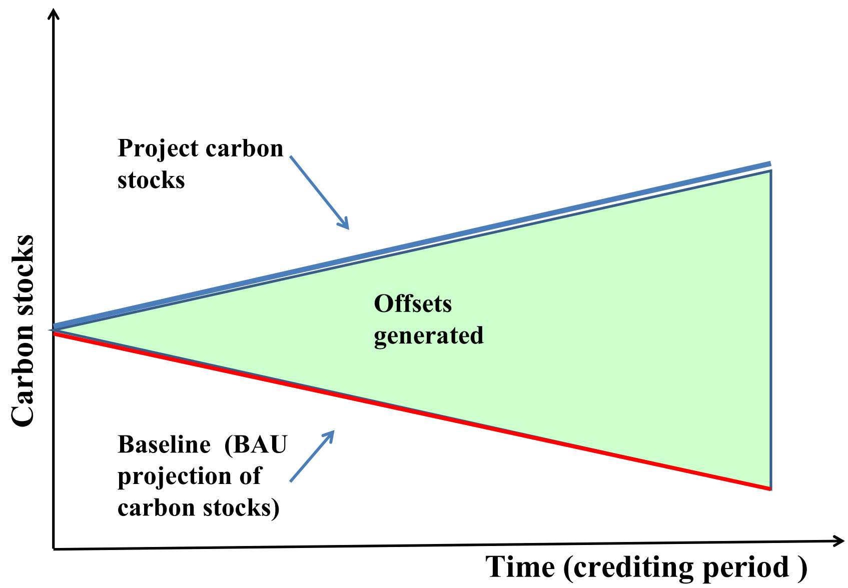
Several baseline establishment approaches have been proposed in various compliance-based and voluntary market–based offset systems. These include projections, historical data, mean stocks, and different kinds of performance criteria (e.g., cohort performance and sustainable forest management [SFM] criteria). The accuracy, robustness, and workability of different baseline establishment approaches vary among these options.

Option a: Projection

A commonly used option in baseline establishment is to let the project proponents develop a model projection of future carbon stock changes. This baseline projection is based on existing physical, economic, and legal conditions; inventory trends prevailing in the project area; and forest management activities existing on similar landscapes. Figure 4 gives a simple illustration of the option. A number of estimation techniques (demonstrating varying degrees of likely accuracy) can be used to make such projections.

[16] There are many factors that make it difficult to establish a credible, accurate, and widely applicable baseline scenario for forest management activities. However, this is not an additionality/incrementality issue *per se* but rather a baseline issue. Coming up with an appropriate baseline approach in the forest management context will make the issue of additionality/incrementality no more or less complex than for any other offset context. Hence, additionality/incrementality is not considered to be an issue specific to the forest management context.

FIGURE 4: PROJECTION (STATIC BASELINE)



Because of their counterfactual nature, projections are seen as less objective than some other options and can lead to less consensus among key stakeholders.[17] A number of models and methodologies can be used in the development of baseline projections, yielding different results. The designation in a protocol of a single carbon budget model, as in the CBM-CFS, could be considered, as it would bring consistency across projects, thus providing a more solid basis for

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[17] In theory, projections can account for all natural/physical factors, and because they are intended to come as close as possible to representing BAU, this approach has the potential to minimize premiums and perverse incentives due to age structure effects, thus contributing to the environmental integrity of the scheme (more tCO_2/$). However, there are limitations to this approach, as scientific uncertainty remains high in the forecasting of ecosystem productivity and total carbon fluxes. It is difficult for baselines to account for changes in natural impacts that could take place as a result of climate change (e.g., CO_2 fertilization, warmer weather). Natural disturbances are also hard to predict. It may be possible to identify a baseline on the basis of modelled trends in the long term or to set the baseline on the basis of historical data on disturbances, but such predictions would remain highly uncertain.

Projection can easily take into account current policy and legal requirements; however, projection using a static baseline would fail to account for future changes in requirements affecting carbon stock changes. A dynamic approach that periodically reviews the baseline to incorporate new legal requirements would address this issue.

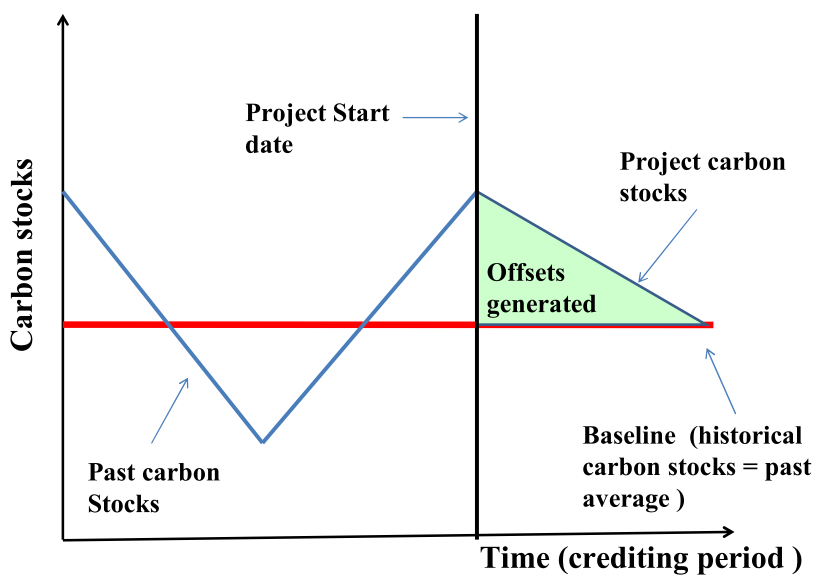
Market factors affecting the baseline, such as supply and demand of wood products, are very difficult to predict. The future may be influenced by a number of factors in dynamic markets. This is true in both the short term (e.g., the current market downturn) and the long term (an industry may disappear or its supply chain may be altered). Again, a dynamic approach that periodically reviews the baseline to incorporate new market conditions could help minimize the effect of market conditions on the environmental integrity of the scheme, but it would create uncertainty for investors. This is of particular relevance for forest management offsets that are expected to be generated over a long time horizon, where BAU is difficult to predict.

comparison between projects. However, there is an extensive and sophisticated experience in Canada with timber supply models, and current practice is to allow flexibility in the choice of models for timber supply modelling, subject to discussion among key stakeholders.[18] In addition, the trend in forestry management is towards professional reliance on outcomes- or results-based management rather than the creation of extensive lists of prescriptive rules.[19]

Option b: Historical baseline

Another approach is to establish the baseline on the basis of either the carbon stocks in the project area at the start of the project or the average carbon stocks over a period in the past (e.g., 5, 10, or 15 years). Any emission reduction/removal beyond this historical baseline is considered additional. Figure 5 illustrates the historical baseline approach.

FIGURE 5: HISTORICAL BASELINE (STATIC)



Due to forest structure effects, the choice of a base year or a historical base period can generate a

[18] See the DFAM-based Timber Supply Review (TSR) and Sustainable Forest Management Plan (SFMP) processes in BC.

[19] The CBM-CFS model requires data input from a growth and yield model, which brings up the question of whether or not a growth and yield model would similarly have to be designated in the protocol in order to gain consistency in projection practice across projects. Since there are several well-established growth and yield models that are successfully used in Canada, the merits of designating one such model are highly dubious and would likely be met with strong resistance from the cadre of highly experienced timber supply analysts and modellers across Canada.

premium for areas where forests have not been managed sustainably, resulting in lower baseline carbon stocks. This would reward past unsustainable practices and penalize forests that have been more sustainably managed.

Historical carbon stock changes will not reflect changes in reduction/removal (growth rate, decomposition rate, etc.) resulting from a changing climate. They will also fail to account for projected increases or decreases in the occurrence of disturbances as a result of climate change.[20] Given the high inter-annual variability in emissions from disturbances and the long time scale over which disturbance cycles affect carbon stocks, particular attention must be paid to the time scale (period) considered in the creation of the baseline. Including or excluding high disturbance years in the baseline will have important implications for the baselines. This has enormous carbon implications because of the very large emissions reduction potential associated with these activities (Graham 2003).

A historical baseline could account for past legal requirements, but would fail to capture future constraints; furthermore, a historical baseline may fail to account for recent changes in regulation, the effects of which have not yet been fully reflected in carbon stocks.

Historical market conditions are easier to assess than future conditions. However, past market conditions are not necessarily a good representation of the future. An industry may have thrived in the past, resulting in high levels of timber extraction and high emissions but lose profitability in the future, resulting in lower extraction rates and lower emissions.

The historical approach is relatively straightforward. Historical records can be reported and verified in a transparent and technically sound way. This approach is applicable to a range of project types so long as data on past carbon stock changes are available. Given the existence of past forest inventories for many forests, the historical approach could build on existing practices.

Option c: Average carbon stocks

As illustrated in Figure 6, a third approach is to set the baseline according to the average carbon stocks of the forested region surrounding the project area.

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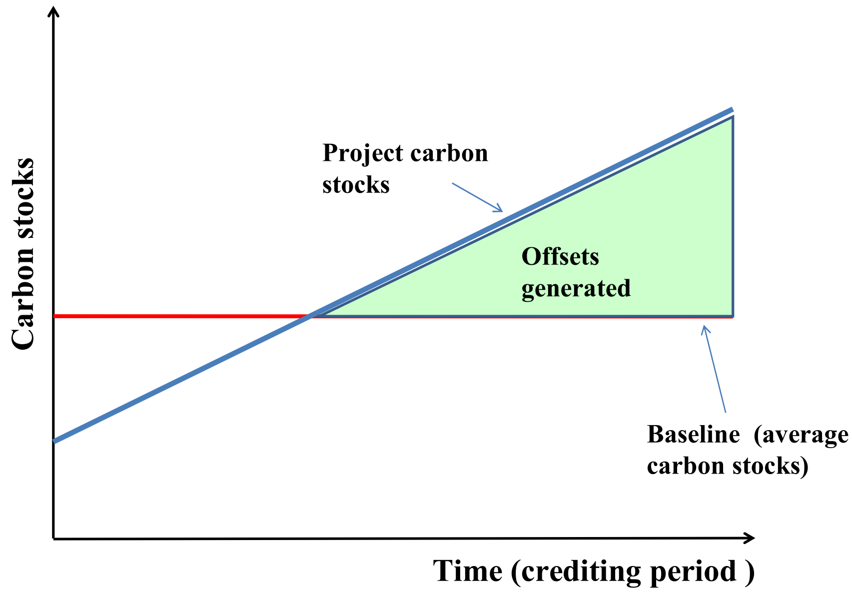
[20] While a historical baseline may not fully capture the impact of some natural factors in the project period (e.g., CO_2 fertilization, the long-term in-situ effect of which is being downgraded), when the comparison to the project impact occurs there is some cancelling out, so the residual amount of the natural impact included could be very small (perhaps within level of uncertainty).

FIGURE 6: AVERAGE CARBON STOCKS (STATIC BASELINE)



The average carbon stock approach is not applicable to a project aiming to reduce the risk of emissions (natural disturbance) or a large-scale project at the landscape level for which activity levels depend on disturbances (such as forestry salvage). Nonetheless, this approach is applicable to a range of project types at the forest stand management level, as well as for large-scale timber extraction or conservation projects.

By comparing a project with all other managed forests, the mean carbon stock approach allows for mitigating or eliminating the premium for forests with lower-than-average carbon stocks due to age structure effect (young forest) and/or "bad" past practices. It could therefore solve some of the core problems resulting from the base year/historical approach.[21] However, this method generates a premium for forests that have higher-than-average carbon stocks resulting from age structure effects (older forests), and also penalizes forest management on lands of lower productivity. The extent to which these shortcomings affect the environmental integrity of the scheme would largely depend on the time horizon over which accounting and crediting occur.

[21] This of course depends on which activities are credited. Only above the mean or also providing crediting with a discount below the mean as in RGGI.

A mean carbon stock approach would fail to account for legal requirements applying to a specific managed forest area within the assessment area. For example, a managed area encompassing more lakes and streams is often required to leave buffers, leading to higher-than-average carbon stocks, which are clearly not additional. In some cases, however, these problems may be minimal and/or could be addressed by placing additional constraints on baselines.

Markets are implicitly factored into this approach by assuming that forests in the assessment area used to calculate average carbon stocks are submitted to the same market conditions. However, this approach does not acknowledge the fact that some actors have lower-than-average opportunity costs due to low timber value, steep slopes, or lack of access roads.

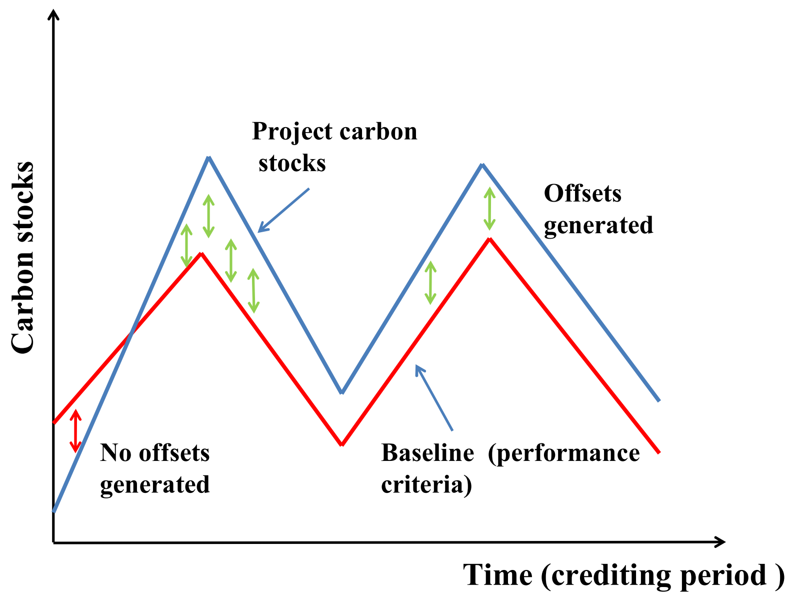
Setting baselines according to a local or regional carbon stock average can be a transparent, objective, and technically sound process. Defining the assessment area (local or regional) over which the average is calculated could, however, be rather subjective. Options include leaving this up to the system authority or building on existing practices by utilizing assessment areas currently in use for inventories.

Option d: Performance standard

Alternatively, baselines could be established according to a performance standard set by the offset system authority. A practice that results in more emission reductions/removals than the current or standard practice in Canada could be considered incremental/additional. For activities aimed at increasing growth and removals at the stand level, this could involve setting a cohort performance standard based on existing data and crediting carbon stocks above this standard. For activities practiced at the landscape level, the baseline criterion could be an approved sustainable forest management plan. Figure 7 shows how offsets are generated using a performance standard approach to establish the baseline.

Applying these performance baseline standards generally presents the same problems as the average carbon stock option: it might compromise the environmental integrity of the scheme and reduce tCO_2/$ by creating a "premium" for actors that have been using better-than-standard practices and would go on doing so even in the absence of the carbon incentive. However, these problems would be minimized by allowing a performance standard to better reflect the specific context of a project – for example, by factoring in buffer requirements, slope, road access, and the commercial value of species.

FIGURE 7: PERFORMANCE CRITERIA

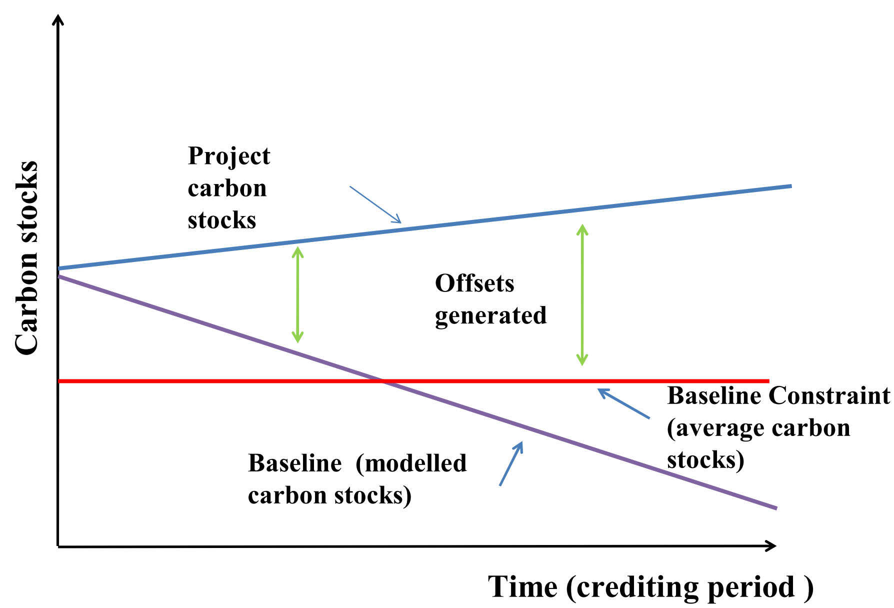


Performance criteria set by the program authority can be technically sound, objective, and transparent, reducing the administrative and transaction costs of baseline setting. However, determining what current or standard practices are in the various existing contexts in Canada may not be so straightforward. Nonetheless, this approach is applicable in a wide range of cases and could build on existing best practices across Canada. For example, although there is no uniform standard, management plans are a requirement for managed forests on Crown lands across Canada, and many managed forests are third-party certified to sustainable forestry standards, such as the CAN/CSA-Z809 SFM Standard. These sustainable forest management plans and certification best practices could form the basis of a baseline establishment criterion.

Option e: Adjusted or normalized

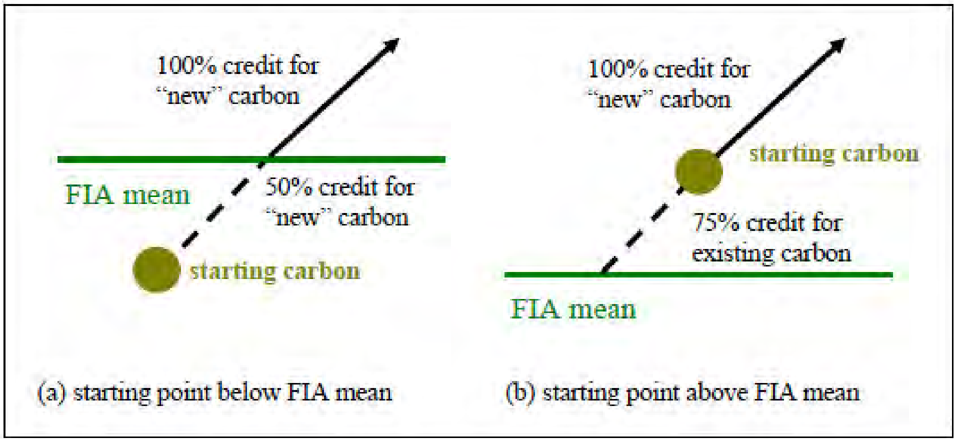
Baseline approaches are not necessarily mutually exclusive. Combining one approach with another may help address the shortfalls of these approaches when they are employed individually. For example, CAR establishes the use of modelled projections to create baseline scenarios, but places additional constraints on scenarios, stating that these will be compared to averaged carbon stock within the assessment area (CAR September 2007) (see Figure 8). For a forest with above-average stocks, the modelled baseline activity cannot deplete stocks below the landscape average established by the system authority, even if such activity may be legal and feasible. For a forest with below-average stocks, the average stock for the baseline activity cannot fall below the initial stock (CAR September 2007). The CAR representatives interviewed believe that the main benefit of the adjusted approach is that it strengthens the environmental integrity of the scheme by generating baseline scenarios that are systematically more conservative (D. Broekhoff, pers. comm.).

FIGURE 8: ADJUSTED BASELINE (CAR APPROACH)



Another example of an adjusted approach is seen in the Regional Greenhouse Gas Initiative (RGGI), which applies an average carbon stock approach based on data from the US Forest Service Forest Inventory and Analysis Program (FIA), but applies a discount to the amount of credits generated based on original carbon stocks at project start (see Figure 9) (Maine Forest Service et al. 2008).

FIGURE 9: ADJUSTED BASELINE (RGGI APPROACH)



Source: Galik et al. 2008

5.2.2. Evaluation

The preceding five options are presented in Table 3 and analyzed according to the evaluation criteria presented in Chapter 4.

TABLE 3: EVALUATION OF BASELINE ESTABLISHMENT OPTIONS

Options	Description	Pros	Cons
Option a: Projection	• Baseline is set on the basis of model projection of future carbon stock changes	• Promotes environmental integrity and provides the right incentives (models can in theory account for all factors affecting BAU) • Applicable to a range of project types • Extensive timber supply modelling expertise and experience to draw upon	• Susceptible to conflicts and litigation, which compromises administrative effectiveness (model results can vary from model to model and are uncertain due to their counterfactual nature)
Option b: Historical baseline	• Baseline is set on the basis of carbon stocks in a base year or base period in the past	• Promotes administrative effectiveness (technically sound, transparent, and objective) • Promotes robustness (provided data is available) • Applicable to a range of project types	• Compromises environmental integrity and generates premiums (fails to account for age structure effects)

Option c: Average carbon stock	• Baseline is set on the basis of average carbon stocks in an assessment area made up of similar forest land (e.g., ecodistrict, ecoregion)	• Promotes administrative effectiveness (technically sound, transparent, and objective) • Promotes robustness (provided data is available)	• Compromises environmental integrity and generates premiums (fails to account for age structure effects and for project-specific physical conditions)
Option d: Performance standard	• Baseline is set on the basis of a performance standard determined by the project authority	• Promotes administrative effectiveness (technically sound, transparent, and objective) • Promotes robustness (provided data is available) • Applicable to a range of project types • Builds on best practices (existing SFM plans, other certification)	• Could have a negative effect on environmental integrity and generates premiums (likely a smaller negative impact than with the average stock approach)
Option e: Adjusted or normalized	• Baseline setting is done by combining approaches (e.g., CAR uses projection but imposes additional constraints based on average carbon stocks)	• Combines the strengths of projection and average carbon stock approaches • Already in use (CAR) • Extensive timber supply modelling expertise and experience to draw upon	• Higher project costs, as must come up with average carbon stock estimate as well as project baseline projection

5.2.3. Conclusions

Baseline establishment procedures that use a measurable starting point, such as a base year or historical average or the average carbon stocks in an assessment area, will promote the administrative effectiveness of the scheme, as they are objective, technically sound, and transparent methods. However, all of these approaches will create environmental integrity and incentives issues. Conversely, projections will address environmental integrity and incentives issues, but their counterfactual nature makes them prone to conflicts and possibly litigation.

Given the need to be conservative while maintaining procedures that are as objective, transparent, and technically sound as possible, an adjusted approach to baseline setting may be the best way to take each of the legal, physical, natural, and market variables into account with the greatest accuracy while providing more transparent and objective criteria. An adjusted approach thus seems best suited to promoting economic efficiency while safeguarding the environmental integrity of the scheme. However, it is important to recognize that while it is desirable to create a baseline approach that is applicable to a range of activities, a single adjusted baseline approach may not be applicable to both stand-level and landscape forest management activities that are expected to contribute to climate change mitigation.

It is difficult to assess which approaches are likely to generate more fungible credits. Conservative approaches that are similar to those of the partner markets increase the likelihood of fungibility (see Chapter 4).

Baseline-setting rules generate discussion across offset project types because of the tension between efforts to ensure the environmental integrity of the offsets and a desire to keep project costs down in order to make them more financially feasible. Financial implications are an important consideration, but environmental integrity should be given more weight in setting baseline rules, in part because perceptions of diminished environmental integrity will end up being reflected in poor offset liquidity and lower selling prices.

6. Permanence

Background

There is considerable concern that credits issued for carbon sequestration activities in forests are subject to certain risks that may lead to emissions of sequestered carbon. Different forest management project types or activities are exposed to different economic or natural situations that may contribute to either attenuating or intensifying the reversal risk. The Voluntary Carbon Standard's (VCS) *Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination*[22] includes a detailed list of several of the risks that may lead to a reversal. Important risks that are present in the Canadian context include:

- **Human risks (intentional reversal):**
  - ⇒ Project risks:
    - Risk of unclear land tenure and potential for disputes
    - Risk of financial failure
    - Risk of technical failure
    - Risk of management failure
  - ⇒ Economic risks:
    - Risk of rising land opportunity costs that cause economic pressure to abandon project activities
- **Natural disturbance risk (unintentional reversal):**
    - Risk of devastating fire
    - Risk of pest and disease attacks
    - Risk of extreme weather events (e.g., floods, drought, winds)

The distinction between the two broad categories of reversal risk is important, as the ways of dealing with each are different.

These permanence risks are unique to forestry, certain agriculture projects, and carbon capture

[22] Available at http://www.v-c-s.org/docs/Tool%20for%20AFOLU%20Non-Permanence%20Risk%20Analysis%20and%20Buffer%20Determination.pdf

and storage projects. Forest management protocols must therefore include provisions and methodologies to assess and manage these permanence risks.

The following issues and options for addressing them are included in this chapter:

6.1. Assessing and measuring risk of reversal

- Option a: Macro-level risk assessment
- Option b: Micro-level risk assessment
- Option c: Quantitative risk assessment
- Option d: Qualitative risk assessment

6.2. Liability for reversal

- Option a: Project proponent
- Option b: Forest land (owner)
- Option c: Buyer
- Option d: Aggregator
- Option e: Program authority
- Option f: Private third party

6.3. Managing risk of reversal

- Option a: Insurance
- Option b: Reserves and buffers
- Option c: Discount on forest management credits

6.4. Due diligence

- Option a: Risk management systems and procedures
- Option b: Eligibility requirements
- Option c: Geographical diversification

6.5. Addressing permanence at project end

- Option a: Permanent commitment
- Option b: 100-year contract
- Option c: Long-term contracts (25-year evergreen agreement)
- Option d: Flexible contracts and opting out
- Option e: Temporary credits

6.1. Issue: Assessing and measuring risk of reversal

Assessing and measuring the risk of reversal will inform the ways through which projects can mitigate and manage risks. To assess whether a given forest management activity is particularly exposed to risks that may lead to a reversal, project proponents need to assess the factors that influence these risks, as well as their relative importance. Given that different forest management projects will face different conditions, it is important to understand what factors may increase or decrease the chances of a reversal for different forest management practices and assess their relative importance. Understanding the probability and extent of a carbon reversal for different forest management activities is an important input into the process of establishing appropriate measures for mitigating and insuring against risk. Different approaches have been proposed to assess and measure the risks that can cause a reversal.

There are many approaches to and tools for assessing risks. The approach best suited to an assessment depends on the risks a project faces. Two key points need to be taken into account:

- Natural risks can be quantitatively assessed on the basis of historical statistics and/or projections, whereas human risks are difficult to quantify and require a qualitative analysis.
- Some natural risks are project-specific and need to be assessed at the micro level, while other risks are not specific to a project and can be assessed at a macro level (ecozone, ecoregion, ecodistrict).

Generally speaking, the more risks that are addressed at the macro level (broader resolution) the less costly and burdensome risk assessment is likely to be, thus increasing the administrative effectiveness of the scheme. In some cases, a macro assessment at the ecozone level may accurately represent risks for a project, while in other cases risk assessment may require a finer resolution, at the ecoregion, ecodistrict, or even project level. A finer resolution will generally contribute to preserving the environmental integrity of the scheme, as well as contributing to its economic efficiency, by differentiating less risky projects from riskier ones. Once again, striking the right balance between reducing administrative and transaction costs and fulfilling the other objectives of the scheme is at the centre of the choices to be made.

6.1.1. Options

Option a: Macro-level risk assessment

For the macro-level assessment of natural disturbance risks, a few key points need to be taken into account. There are undoubtedly important variations in disturbance incidence and intensity between ecozones across Canada (IRMG December 2005). In the case of fires, differences within ecozones may or may not be very important. However, if there are significant differences in fire mitigation and management practices, resulting in changes in basic fire risk (incidence and intensity) over time, these will need to be taken into account. Fire-related risks could be assessed by the offset system's authority using publicly available data, and a "fire risk" could be determined for different ecodistricts, ecoregions, or ecozones. This would reduce the burden on project proponents to demonstrate and measure the fire risk specific to their project, as well as minimizing the risk of litigation. Such an approach could be more cost-effective and less burdensome administratively. This option could be well suited to landscape-level projects where risk of reversal from fires is diffuse, unpredictable, and not project-specific.[23]

Option b: Micro-level risk assessment

Pest attacks are forest species–specific, and tree susceptibility and therefore damage and mortality levels are age-dependent (IRMG December 2005). This implies that forests of differing composition and age structure will be characterized by different risks of pest disturbance. For example, homogeneous forests (monoculture) may be considerably more at risk of pest infestations than biodiverse forests. As some forest management practices involve more risk than others, a risk assessment would need to take project type into account. Variation in the species composition and age structure of forests is likely to be more important at the stand level, but could also be observed at the landscape level within ecozones, ecoregions, or ecodistricts. Another important point is that pest infestations, unlike fires, are not random, but display clear cyclical patterns.

Therefore, assessing the risk of pest attacks is likely to require finer resolution, taking into account species composition and age structure; these may vary considerably among forest stands, especially in cases where forest management activities are intensive. It might be more appropriate, therefore, to require project proponents to assess the risks of pest attacks, as they are more project-specific. Such an approach may be more accurate than using regionally derived risk factors.

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[23] Old growth forests may be more at risk of fires.

Option c: Quantitative risk assessment

In all cases of natural disturbance, risk factors would be based on the incidence and intensity (i.e., carbon stock losses) of the disturbance. The availability of suitable, high-quality data for all stakeholders (symmetry of information) will considerably enhance the robustness of risk assessment methods. In the case of fires, data is independently collected and collated by the Canadian Forest Service, which ensures both quality and symmetry of information. Using this centrally collected data to assess risks would greatly contribute to the administrative effectiveness of the scheme, be applicable to a range of projects (particularly at the landscape level), and clearly build on best practices. In the case of pest infestations, however, the data is more fragmented; a national database is not currently available (J. Williams, pers. comm.).

Option d: Qualitative risk assessment

Human-related risks, such as risk of project failure, should probably be assessed on a project-by-project basis, taking into account specific project context. Protocols could develop risk assessment tools that would guide this assessment. The VCS proposes such an approach by requiring an assessment of the project's potential for future carbon loss carried out by the project proponent. Assessing risk can be subjective and prone to litigation, which is why the VCS also requires that this assessment be reviewed by an independent third-party expert. A second party is supposed to review the work of the first and both must agree with the final project assessment. This approach is likely to be more burdensome than a risk assessment based on independent data, but it may be a suitable option for addressing risks that are more difficult to quantify.

The Climate Action Reserve forest protocol (CAR September 2007) applies a quantification method for risk assessment; however, the quantitative analysis is based on project proponents' subjective response of "high," "medium," or "low" to a series of questions. The risk factors derived from these answers were developed through expert consultation (D. Broekhoff, pers. comm.). This method is likely to be refined in the future; the risks of natural disturbance will be assessed using historical records and statistical techniques for projections.

6.1.2. Evaluation

The preceding four options are presented in Table 4 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 4: EVALUATION OF OPTIONS FOR ASSESSING AND MEASURING REVERSAL RISK

Option	Pros	Cons
Option a: Macro-level risk assessment	• Reduces costs of risk assessment • Promotes administrative effectiveness (technically sound, transparent, and objective)	• Fails to capture risk differentials between projects within the same risk assessment area • Reduces economic efficiency and creates perverse incentives for risky projects
Option b: Micro-level risk assessment	• Increases costs of risks assessment • Reduces administrative effectiveness (subjective and prone to litigation)	• Could allow capture of risk differentials between projects • Increases economic efficiency and provides incentives for good projects
Option c: Quantitative risk assessment	• Promotes administrative effectiveness (technically sound, transparent, and objective)	• Does not allow capture of qualitative risks
Option d: Qualitative risk assessment	• Reduces administrative effectiveness (subjective and prone to conflict and litigation)	• Does not accurately capture quantifiable risks

6.1.3. Conclusions

A complete risk assessment will need to account for the most important risk that a project faces. In some cases this will be a straightforward exercise, while in others it may require a combination of one or more of the four presented options.

6.2. Issue: Liability for reversal

Within a cap-and-trade framework, the risk that forest management projects could experience aggregate losses in excess of aggregated emission reductions/removals lies with the offset project authority, to the extent that it would mean that the volume of offsets in Canada (or a Western Climate Initiative province) does not correspond directly to Canada's GHG Inventory (or the WCI province). The offset project authority will therefore ultimately be liable for reversals. However, reversal risk can be placed on project proponents or a third party. Individual risk, though, can be reduced in the traditional way of "pooling" risk and assessing a risk premium on each project in the pool. The question of who bears the risk can be handled in different ways. Risk pooling for forest management offset projects and who should be liable for reversal risks, between the project proponent, the buyer, the program authority, or a mix of players, is an unresolved issue.

Placing a liability on producers and users (buyers) of offsets may be effective in some cases. In others it may be constraining and seriously limit participation in the system, making it more desirable for the program authority to accept liability and develop a system-wide pooling insurance mechanism against the risk of reversal.

6.2.1. Options

Option a: Project proponent

Placing liability responsibilities on the project proponent will provide the strongest risk prevention incentive, as project proponents are in the best position to minimize risk, given that they are responsible for project design, management, and execution (Murray and Olander 2008). However, issues may arise in cases where the forest owner is not the same as the project proponent. This could occur as a result of the sale of the land or in cases where the project proponent is a lessee. In such cases, how liability is shared between parties could be established by contract. One option would be to attach liability to the forest land (owner). It is noteworthy that in "Turning the Corner" Environment Canada has stated that liability for reversals would stay with project proponents.

Option b: Forest land (owner)

In cases where liability is attached to the forest land, the responsibility for ensuring that permanence risk is properly addressed falls on the owner of the land. This is the approach used by CAR.

In the Canadian context, many projects could be developed by forestry corporations operating on Crown land. In such cases, placing liability on the forest land is the equivalent of making governments liable for permanence. Governments are generally capable of accepting greater liability and making long-term commitments because of their taxation and borrowing powers. However, this option creates a perverse incentive for project proponents not to carefully address risk in project design, management, and execution (the principal-agent problem).[24]

[24] This principal-agent problem will also arise when the project proponent and the owner of the credits are not the same (see 10. Crediting).

In the case of private forest lands, either the land owner or the project proponent could be small entities with limited capacity to accept liability. This raises the issue of foreclosure and bankruptcy, in addition to the general concern about the ability of smaller entities to cover liabilities (Murray and Olander 2008).

Option c: Buyer

Making the buyer liable for reversals is equivalent to having the liability transfer with the ownership of the credit. In the case of a reversal, the credit becomes worthless and the buyer must find replacement credits to meet his or her compliance requirements. In this case, risk will be priced into the value of the credit, much like default risk is factored into the price of a bond. This means that credits stemming from different projects will trade at different prices. This could affect fungibility; however, there are many examples of similar but differentiated commodities trading in a common market. Different grades of beef or risk-rated bonds are examples (Murray and Olander 2008). In fact, risk-adjusted credits could increase fungibility by making tonnes of CO_2e more comparable, and such is the case in the European Union Emission Trading Scheme, where Clean Development Mechanism credits are traded at a discount to emission reduction units (ERU).

Another reason why this may be desirable is that buyers under the cap are already responsible for ensuring that they have enough allowances to meet the cap. Requiring that they also be made responsible for replacing cancelled offsets would provide them with a strong incentive to put the quality of the offset at the forefront of the purchase criteria (Murray and Olander 2008; Keohane and Raustiala 2008). However, depending on carbon market conditions, this could cause them to avoid riskier forestry offsets altogether.

Option d: Aggregator

In many cases transactions would not involve direct trading between project proponents and buyers. For example, in the case of private lands, group of projects may be bundled together by an aggregator before they are sold. In such cases the aggregator could be made liable. By pooling risks the aggregator would be able to accept greater liability without running the risk of default or bankruptcy. Furthermore, the aggregator would be able to mitigate its risk through geographical diversification (see 6.5.1. Option c: Geographical diversification). However, this option would require that the aggregator assess the risks of each individual project that it aggregates, which may entail important costs.

Alternatively, liability could be assigned in a consistent manner with standard contracts to allow credits to flow through the market. This option may be attractive, but the current mortgage-backed securities crisis suggests that such homogeneous bundles can create large, unobservable risks (Murray and Olander 2008).

Option e: Program authority

It is also possible that the program authority could accept the liability for reversal. For example, the program authority might judge this to be necessary to cover against risks of natural disturbances, which can have disastrous sudden effects on carbon stocks and are to a large extent beyond the control of project proponents. In this case the program authority would bear the costs (or reap the benefits) of an under-performing (over-performing) system. This raises the moral hazard problem, as projects that under-perform will not be responsible for their losses and projects that perform well will not be rewarded.

Option f: Private third party

A third party could be used to pool the reversal risks from several projects. This approach could be handled in much the same way that other insurance pooling initiatives are undertaken. The project proponents could be made wholly or partially responsible for the premium, likely some combination of offset reserve and financial payment. It could also be undertaken via a government entity in the same way that some crop insurance programs are delivered to agricultural producers.

6.2.2. Evaluation

The preceding five options are presented in Table 5 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 5: EVALUATION OF LIABILITY FOR REVERSAL OPTIONS

Liable entity	Pros	Cons
Option a: Project proponent	• Strongest risk mitigation incentive	• Project proponents may not be able to bear the consequences of a reversal, leading to higher risk of default and bankruptcy • Problematic in cases where project proponent and owner are not the same • Advantages of pooling foregone

Option b: Forest land (owner)	• Can address changes in ownership • In the case of Crown land it generates increased capacity to accept liability	• Private landowners may not be able to bear the consequences of a reversal, leading to higher risk of default and bankruptcy • Advantages of pooling foregone
Option c: Buyer (Liability travels with the credit holder)	• Incentive to buy good offsets • Easy to monitor (extension of the monitoring for compliance under the cap-and-trade system)	• Economic efficiency (may cause compliance buyers to avoid risky forestry projects) • Higher transaction costs (may complicate transactions) • Advantages of large scale pooling foregone
Option d: Aggregator	• Risk pooling generates increased capacity to accept liability (reduced risk of default and bankruptcy)	• Likely higher transaction costs for aggregators • Many aggregators are not likely to have sufficient expertise in this complicated risk area • The pool of projects will be smaller than when an offset program-wide or industry approach is used
Option e: Program authority	• Greatest risk pooling generates greatest capacity to accept liability	• Creates moral hazard
Option f: Third party	• Risk pooling generates increased capacity to accept liability • Leverages expertise of insurance experts • Third-party independence in assessing risk and premiums	• Likely requires a government initiative to get it started with a view to eventual full privatization

6.2.3. *Conclusions*

These liability provisions are not necessarily mutually exclusive and can be combined in a number of ways. Liability for some risks may be placed on one entity, while liability for other types of risks may be placed on another. For example, the CAR forest protocol distinguishes between unintentional reversal (due to natural disturbances) and intentional reversal (due to harvest). The CAR program authority accepts liability for unintentional reversals but attaches liability for intentional reversals to forest owners.

The possibility of unintentional reversals raises the question of how far liability should go in terms of carbon stock change. It seems reasonable that the liable entity should not be liable for the whole of the carbon stock but only for those SSR for which credits have been issued (P. Graham, pers. comm.).

It is also important to note that if Canada does not accept liability for emissions from natural disturbances at the international level, then it may not be necessary for entities to accept such liability at the domestic level. This position, however, may considerably reduce the fungibility of offsets generated through such a mechanism (P. Graham and T. Lemprière, pers. comm.).

Liability for risk reversal could be a fundamental barrier to getting many forest management offset projects under way. Although reversal risk is specific to forest management offset projects, the options for addressing the problem come from traditional insurance experience. In particular, the handling of crop insurance, with its risk attached to weather vagaries, offers much instructive knowledge and experience to the search for ways to deal with forestry offset reversal risk. Coming up with an approach that successfully pools risk within as large a pool as possible is likely the option that will remove a significant barrier to getting forest management offset projects looked at seriously.

6.3. Issue: Managing risk of reversal

While it may be possible to mitigate the risks that can cause a reversal, these risks will remain. To preserve the environmental integrity of the offset scheme, it is essential to develop ways to ensure that reversals will be accounted and compensated for. There is no consensus as to which mechanism is the best fit to insure against the risks. The choice of mechanism may have a significant impact on project proponents, as well as on the overall effectiveness and contribution of forest-based offsets in the system.

No matter who is liable for a reversal in the end, liability can be managed with a range of tools. The liable entity could be allowed to manage risk in the manner that it judges as most suitable. However, to preserve the environmental integrity of the system, protocols could include provisions requiring projects to manage risk in a specific way. For example, protocols could require that projects contract insurance, create physical buffers, or place a certain amount of offsets in reserve. Furthermore, in cases where liability falls on the program authority, the latter may want to protect the integrity of the scheme by applying a discount on forest management offsets to safeguard against risks.

6.3.1. Options

Option a: Insurance

Protocols could require project proponents to obtain a certain type and claim level of insurance. An insurance company could agree to either cover loss of offsets at an agreed value per tonne or replace the offsets by purchasing them on the market. Because forest carbon reversal insurance is a new product with a very short track record it is likely that insurance companies will initially set a high premium. In a "short market" for offsets, replacement offsets may be too expensive to acquire for insurance companies or project proponents, thus creating a market risk.

There are currently no functioning insurance mechanisms for forest management offset projects. The CAR representatives and carbon brokerage firms interviewed indicated that some insurance companies had shown interest but that the current financial crisis has delayed progress on the development of this tool (J. Nickerson, pers. comm.; S. Carney, pers. comm.).

Insurance premiums could be set annually (in the conventional manner), set for the lifetime of the project (similar to a life policy), or use a combination of these two options. Premiums in a conventional property insurance policy are payable at the start of each year and reflect the insurer's expected losses for that year (plus profit margins). Premiums in subsequent years will be adjusted to reflect the actual loss experience, either for that project or for all insurance holders. This option will negatively affect the project's economics, as project proponents will have no certainty as to what overall premium costs might be. Project proponents may be unable to finance future premiums, and ultimately the program authority may have no way to mitigate its loss (IRMG December 2005).

Furthermore, due to the novelty of this product and the associated uncertainty, premiums are likely to be high in relation to offset revenues. While the premium may be reduced as the market matures and the loss rate is better understood, once the premium has been paid, the excess would be unlikely to be rebated in the future.

Provided that the same quality of information is available to all parties, private insurers should be able to determine the appropriate premiums.[25] However, if the program authority opted for a single mandatory insurance program with centrally set premiums, competitive pressures would not apply and arbitrage opportunities would not arise. In cases where risks are similar between projects, a "one size fits all" premium might be adequate, but in cases where risks vary, applying the same premium for all projects would inevitably entail a level of cross-subsidy from less risky to more risky projects, compromising the economic efficiency of the scheme.

Option b: Reserves and buffers

Protocols could require that projects maintain adequate buffer reserves of non-tradable carbon credits to cover unforeseen reversals. Such a buffer method could also cover unforeseen quantification errors.

Reserves limit the amount of credits that can be traded, thus reducing the supply of offsets and financial viability of projects. The amount of reserves determine the extent of this effect. In turn, the amount of reserves should depend on the severity of the risks. The risk assessment method will have large impacts on the reserve that will be required from different offsets. The issues are therefore similar to those raised for insurance.

A project could be required to place a fixed percentage of offsets in reserve. For example, the Chicago Climate Exchange (CCX) requires that 20% of the measured carbon stock increases be placed in a reserve pool to be used in the event of reversals. This is a technically sound, transparent, and objective approach (which would contribute to administrative effectiveness); however, as is the case with a "one size fits all" premium, this approach would penalize less risky projects and cross-subsidize riskier projects.

The CCX partially mitigates this problem by reverting credits to the project owner at the end of the contract period (if the reserve credits have not been needed to cover reversals). This removes the penalty for less risky projects but does not address the perverse incentive to develop risky projects (i.e., projects with expected reversals greater than 20%). To address this last problem,

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[25] However, in cases where premiums are set at project initiation, "first" insurers could be left to losses in the event that new information concerning loss experience allows a higher geographical resolution risk assessment. "Second" insurers would be able to "cherry-pick" less risky projects by offering them significantly lower premiums.

protocols could require that project proponents or land owners retain a limited liability to make up for losses, as a deductible. Insurance companies normally do this in order to limit costs and provide incentives for prudent management (IRMG December 2005).
Alternatively, reserve size could be determined by the results of the risk assessment. This could involve both a standardized or project-specific risk assessment methodology (see 6.1. Issue: Assessing and measuring risk of reversal). A better representation of project risks will help determine a more appropriate reserve level. Both the VCS and CAR have developed risk assessment "tools" that are used to determine the amount of credits to be placed in reserve for each project. The more accurate such a tool is in assessing project risks, the more it will contribute to the economic efficiency and environmental integrity of the scheme. This approach is applicable to a range of projects and builds on best practices to the extent that risk analysis is currently used for forestry projects.

However, this approach may not be so straightforward and could be prone to conflict and possibly litigation. Equity issues could arise in relation to the relative contribution of different projects to the reserve. The operation of the reserve system would involve quite complex issues related to cross-subsidy between generations of projects that entered the scheme at different times and so experienced different loss histories.[26]

CAR protocol developers have acknowledged that the strength of their current proposal rests heavily on the quality of the risk assessment method and could be susceptible to litigation. It is hoped that this will be minimized by creating a living risk assessment method that is refined with time and tailored to specific projects (J. Nickerson, pers. comm.). They also recognize that the choice of not reverting unused reserves to land owners at the end of the project raises cross-subsidy and equity issues (J. Nickerson, pers. comm.). The litigation risk issue is likely much less prominent in the Canadian context, where civil actions of this type are comparatively rare.

Option c: Discount on forest management credits

Protocols can also specify that credits be discounted to reflect risks; the higher this discount the lower the value to the project proponents. This approach can involve a flat discount for all projects or can be tailored to reflect specific project risks. It involves many of the same issues as the insurance and reserve options, but may be easier to manage for the project authority, thereby

[26] This could be due to high incidence and intensity of fires during some years or the occurrence of unforeseen pest attacks.

increasing the administrative effectiveness of the scheme. However, in this case, credits are not matched with reversals, which may complicate mitigation of the cross-subsidy problems identified above.

6.3.2. Evaluation

The preceding three options are presented in Table 6 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 6: EVALUATION OF OPTIONS TO MANAGE RISKS OF REVERSAL

Options	Variations	Pros	Cons
Option a: Insurance	Annual premium	• Allows for premiums to be adjusted as risk is better understood; smaller risks for the insurer lead to lower premiums	• Uncertainty for the liable entity with regard to the premium
	Single premium paid at project start	• Certainty for the liable entity with regard to the premium	• Does not allow premiums to be adjusted; higher premium to cover greater risks for the insurer
Option b: Reserves	"One size fits all" reserve requirement (CCX)	• Promotes administrative effectiveness (transparent and objective)	• Compromises economic efficiency (creates moral hazard)
	Reserve determined by risk assessment (CAR, VCS)	• Increases economic efficiency (reduces moral hazards)	• Compromises administrative effectiveness (subjective and prone to litigation)
Option c: Discount	Credits are discounted from the total stream of credits generated to cover risks	• Promotes administrative effectiveness and reduces transaction costs	• Credits not matched with reversals (complicates dealing with cross-subsidy)

6.3.3. Conclusions

It is important to note that these approaches to insuring against risk are not mutually exclusive and that the optimum strategy may be to combine the various tools available.

CAR has moved towards a mixed approach, using both reserve credits and insurance. It is not in CAR's interest to manage risks in the long term, but it was considered necessary for the project authority to step in to "get things started" (J. Nickerson, pers. comm.).

It is also important to consider transition measures. The best practices of today may not be the best practices of tomorrow; nevertheless, today's best practices are the ones that can be implemented to facilitate a functioning forest management offset initiative. Project authorities can opt to wait for better mechanisms to emerge, such as forest management offset project insurance, but at the cost of viable projects being lost because the offset incentive is missing.

It is also noteworthy that a recent study indicates that with the program authority accepting the same level of risk for fire, project proponents would be better off under the reserve scheme than under project lifetime insurance scheme (IRMG December 2005).

6.4. Issue: Due diligence

In some cases project proponents may not take all the necessary actions to mitigate risks under their control. This may be particularly problematic in cases where project proponents are not the liable entity.

In the event that the program authority assumes liability for reversals, protocols could offer ways to provide the offset system's authority with sufficient guarantees that it will not bear disproportionate risks. These could include setting eligibility requirements to impede the registration of projects deemed too risky; implementation of risk management systems to mitigate risks of project failure or natural disturbances; or the application of a deductible for reversals in order to promote good management.

6.4.1. Options

Option a: Risk management systems and procedures

Protocols may include provisions that require project proponents to put risk management systems in place to mitigate risks of quantification errors, project failure, or natural disturbances. These could, for example, require project proponents to adopt quality control and quality assurance procedures in their monitoring plans to minimize risks. For instance, fire risks can be mitigated with more frequent fire control patrols. Re-emission risks can also be mitigated through project design. Risk mitigation strategies would be different depending on whether a project involves activities at the stand level or the landscape level. The Clean Development Mechanism Board requires that projects adopt such risk management procedures.

Option b: Eligibility requirements

Protocols could set eligibility requirements that require a project to meet certain risk thresholds. A project deemed too risky could then be excluded from the outset. Although this approach might be viewed as arbitrary by some potential project proponents, its acceptance by knowledgeable forestry operations would be a function of the transparency, consistency, and independence of the evaluation process. It is likely to be an administratively efficient and cost-effective way of maintaining the environmental integrity and credibility of a forestry offset initiative. CAR is currently considering setting such eligibility requirements (J. Nickerson, pers. comm.). This option is consistent with the eligibility screening requirements that are built into many programs offered by the Canadian and provincial governments. It has considerable attractiveness as a transitional option within the Canadian context.

Option c: Geographical diversification

Protocols could also require that projects mitigate risk through geographical diversification. This is perhaps the most effective tool for reducing exposure to fires, pests, and extreme weather events (J. Wells, pers. comm.). This option might work well in cases where project proponents manage vast tracts of forests in different regions; however, it could be difficult to manage for project proponents with smaller, location-specific holdings. Geographical dispersion could be required for numerous small projects aggregated into a single project. This might add a burden for project aggregators, but it could also be offset by the economic efficiency gains achieved by pooling risks (i.e., reduced risk leading to reduced discount or reserve requirements).

It is important to note that a geographical dispersion requirement could disadvantage large conservation projects that provide significant adaptation and biodiversity benefits, by increasing the resilience of ecosystems through interconnected webs of forest (i.e., one interconnected area as opposed to geographically dispersed small conservation areas).

6.4.2. Evaluation

The preceding three options are presented in Table 7 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 7: EVALUATION OF OPTIONS FOR DUE DILIGENCE

Options	Pros	Cons
Option a: Risk management systems and procedures	• Reduces program authority exposure to risk	• Extra burden on project proponents and verifiers
Option b: Eligibility requirements	• Environmental integrity sustained • Reduces program authority exposure to risk • Highly cost-effective • Transparent • Administrative economies of scale	• Risk of excluding potentially successful offsets projects
Option c: Geographical diversification	• Reduces program authority exposure to risk	• Disadvantages large conservation projects that could yield important adaptation and biodiversity benefits

6.4.3. Conclusions

Due diligence standards have been included in most GHG protocols, regardless of the sector or activity. The central question regarding this issue is how far such due diligence standards can go to reduce the system's exposure to risk without becoming burdensome and limiting possible successful participation.

6.5. Issue: Addressing permanence at project end

Carbon can be released back into the atmosphere after the end of a forest management offset project. This raises the issue of what is done about the carbon liability after the project ends.

In theory, for offsets to be fully equivalent to emission reductions from regulated facilities, entities should be made liable for forestry offsets in perpetuity, or at least for the approximate time that carbon is believed to remain in the atmosphere, usually estimated as 100 years. Given the challenges involved in making project proponents liable for long periods of time, the choice of a liability period should take into account scientific as well as practical considerations, and should ideally be based on reversal risk after the project lifetime.

This issue could be addressed by establishing legal mechanisms that commit project proponents to permanence, such as long-term liability contracts for reversal, as well as covenants and easements on the use of forested land. The appropriate length of these contracts and the ways through which liable parties could opt out without compromising the environmental integrity of the scheme are addressed below.

6.5.1. Options

Option a: Permanent commitment

Protocols could require that projects commit to legally binding permanent restrictions on land use, such as strict covenants and conservation easements. CAR Forest Protocol 2.1 uses a 100-year conservation easement. This may be a viable option for conservation projects, but it is likely too rigid to be attractive for most other types of activities.

Option b: 100-year contract

The draft CAR Forest Protocol 3.0 replaced the 100-year conservation easement with a 100-year contract (currently called a Project Implementation Agreement).

Option c: Long-term contracts (25-year evergreen agreement)

The longer an entity is liable for credited carbon stocks, the more the permanence risk is reduced.[27] However, placing long-term liability on a project is likely to be difficult from a practical standpoint and may seriously limit participation in the system, as liable entities will be more reluctant to commit for longer periods. This of course depends on the entity that is made liable for reversal after the project's life. Whether forest management is taking place on private land or is carried out by private corporations on Crown land, project proponents will likely be business entities, and businesses generally do not make very long–term commitments. CAR palliates this problem by placing the liability on the forest land.

[27] The risk of reversal is not reduced *per se*; however, the implications of reversal for the environmental integrity of the regime become less important. Carbon dioxide's atmospheric lifetime is variable and cannot be specified with precision, but it is usually accepted to be well over 50 years.

Different offset systems have chosen different lengths of liability periods. CAR asks forest management projects to meet the permanence requirement by ensuring that credited emissions remain sequestered for at least 100 years.[28] The conservation easement required in the first version of the CAR forest protocol has come under considerable criticism by forest industry and forest land owner representatives as a significant barrier to forest management offset project development (Hale 2009). As a consequence, the draft CAR Forest Protocol 3.0 incorporates a 100-year contract requirement rather than a conservation easement.

CCX requires project owners to sign an attestation that the forests involved will be maintained in forest for at least 15 years from enrolment and that forest certification will be maintained for 15 years.

A few of the Canadian interviewees suggested variations on what we would call a "25-year evergreen agreement." This would require project-claimed emission reductions/removals to be valid 25 years after the last credit has been issued, a 25-year agreement and an evergreen clause that provides for an automatic rollover if both parties are willing at each 10-year mark. This approach allows more flexibility than the CAR approach, while providing more assurance of permanence than the CCX approach. It is also a familiar practice in the Canadian forestry industry, as several provinces issue long-term tenures that incorporate evergreen provisions.

Option d: Flexible contracts and opting out

The offset system could allow landowners and project proponents to establish forest carbon contracts of different durations. The system would then have to establish rules for replacing shorter-term credits so that environmental integrity is maintained. This approach could be a way to allow for market flexibility while maintaining the environmental integrity of the system.

The current CAR provisions do not consider variable duration contracts. They only allow land owners to opt out of the agreement at any time, provided that they replace all the offsets that have been issued to them (D. Broekhoff, pers. comm.).

Option e: Temporary credits

To avoid liability issues and mitigate permanence risks, Clean Development Mechanism afforestation and reforestation projects opted for the issuing of temporary credits, which can be

[28] This has been incorrectly interpreted as a land-use commitment rather than a carbon commitment by a number of Canadians interviewed in the process of writing this report. CAR representatives have confirmed that it is indeed a 100-year commitment to carbon stocks, for which verification will be required.

reissued or renewed every five years after an independent verification to confirm that sufficient carbon is still sequestered within the project to account for all credits issued. However, this approach creates barriers to inter-market fungibility and additional administrative requirements. Indeed, the failure of the Clean Development Mechanism to fully integrate forest-based credits within the system is, according to many, due to the mechanism used to deal with permanence (i.e., the creation of non-permanent credits – tCERs and lCERs – for forest carbon projects). This option is further discussed in Chapter 10: Crediting.

6.5.2. Evaluation

The preceding four options are presented in Table 8 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 8: EVALUATION OF OPTIONS FOR ADDRESSING PERMANENCE AT PROJECT END

Options	Pros	Cons
Option a: Permanent commitment (strict covenant or conservation easement)	• Enhances environmental integrity (high permanence guarantee)	• Reduces economic efficiency (inflexible, leading to limited participation)
Option b: 100-year contract	• Viewed by the mainstream forest industry as less inhibiting than a 100-year conservation easement	• The inflexible 100-year commitment
Option c: 25-year evergreen agreement	• Balances environmental integrity with financial interests of potential offset project investors • Familiar concept within Canadian forest industry • Associated permanence risk could also be dealt with through associated assurance mechanisms, such as a small buffer reserve	• Permanence risk is present unless assurance mechanism is used in parallel with the 25-year agreement • Offset market is commodity-based for large investors and other offset project types may still be deemed to be more attractive than a forest management project with a 25-year agreement
Option d: Flexible contract provisions	• Promotes economic efficiency (allows flexibility, leading to greater participation)	• Reduces administrative effectiveness (complex system leads to increased administration costs)
Option e: Temporary crediting	• Guarantees environmental integrity (fully addresses permanence)	• Impedes fungibility

6.5.3. Conclusions

It is difficult to provide recommendations concerning the best option for addressing risks of reversal after the project ends. The experience in carbon trading abroad suggests that temporary credits are not likely to generate much interest, but the 100-year conservation easement requirement in CAR's Forest Protocol 2.1 does not appear to be acceptable to the mainstream forest industry. An evergreen agreement approach allows more flexibility than either a covenant or 100-year contract, while providing more assurance of permanence than does a variable duration contract. It is also a familiar practice in the Canadian forestry industry, as several provinces issue long-term tenures that incorporate evergreen provisions. The ultimate solution will likely involve trade-offs between the different objectives of the scheme. The more risk-averse the program authority, the higher guarantees it will require that these risks are properly assessed and managed.

7. Measurement and Monitoring

Background

Fundamental to a framework for forest management offset protocols is the need to provide guidance on accurately measuring and monitoring changes in carbon stock, including increases or decreases in emissions to the atmosphere. This chapter focuses on issues associated with protocol requirements for accurately and economically measuring carbon stocks and carbon changes in the forest. It draws upon findings from offset protocols and schemes in Canada and the US,[29] World Resources Institute (WRI) technical guidance, Intergovernmental Panel on Climate Change (IPCC) references, and the ISO 14064-2 standard.

The following issues and options for addressing them are included in this chapter:

7.1. Carbon pool selection

- Option a: Only required pools are verified
- Option b: Protocol developer discretion in selecting optional pools for verification
- Option c: All pools required subject to a materiality consideration

7.2. Crediting of carbon storage in harvested wood products

- Option a: Exclude HWP as a carbon pool
- Option b: UNFCCC 100% emission rule
- Option c: Include HWP as a carbon pool

7.3. Requirements for measuring forest carbon

- Option a: Detailed prescription of measurement and monitoring methods
- Option b: Flexibility in choice, but modelling for estimations required
- Option c: Full flexibility in measurement and monitoring options
- Option d: Outcome-based approach

[29] This includes a review of some offset systems and protocols, including draft Alberta Afforestation; BC's *Greenhouse Gas Reductions Targets Act*; the US Department of Energy GFC, Chicago Climate Exchange, Climate Action Reserve, Voluntary Carbon Standard, and Regional Greenhouse Gas Initiative; experiences from interviewees at both the project level and national level and knowledgeable and experienced with forest carbon management and offset systems.

7.1. Issue: Carbon pool selection

A protocol's treatment of the issue of carbon pool selection strongly influences the amount of carbon accumulated by a project (Galik et al. 2008).[30] IPCC guidelines define terrestrial carbon pools as Living Biomass (above-ground biomass and below-ground biomass), Dead Organic Matter (dead wood and litter), and Soils (soil organic matter) (IPCC 2003). In addition, ISO 14064-2 provides broad guidance, indicating that the project should identify SSR that are being controlled by the project proponent, related to the project, or affected by the project (ISO 2006). Harvested wood products (HWP) are a potential carbon pool within the ISO standards and WRI guidance (Greenhaigh et al. 2006).

The WRI developed a decision matrix to assist in the selection of carbon pools (Greenhaigh et al. 2006), which is shown in Table 9. Generally speaking, the largest pool is above-ground live tree biomass. Understorey vegetation is often ignored because it is a relatively small component of this pool and is at least partially balanced by the vegetation prior to the project.

The issue is which carbon pools need to be quantified in forest management protocols in order to maintain environmental integrity in the most economically efficient manner.

[30] Duke University researchers applied several forest protocols in the US, including those from CAR and CCX, to the same longer rotation project in North Carolina and found a wide disparity in cumulative carbon based on the carbon pools that were measured under each protocol.

TABLE 9: DECISION MATRIX TO HELP SELECT FOREST CARBON POOLS (GREENHAIGH ET AL.2006)

TABLE 9 Decision Matrix of the Main Carbon Pools to Estimate or Quantify and Monitor for LULUCF Project Activities

PROJECT TYPE	MAJOR CARBON POOLS						
	Live biomass			Dead biomass			Wood Products
	Trees	Herbaceous	Roots	Fine	Coarse	Soil	
Avoid emissions							
Stop deforestation	Y	M	R	M	Y	R	M
Reduce impact logging	Y	M	R	M	Y	M	N
Improve forest management	Y	M	R	M	Y	M	Y
Sequester carbon							
Plantations/reforestation	Y	N	R	M	M	R	Y
Agroforestry	Y	Y	M	N	N	R	M
Soil carbon management	N	N	M	M	N	Y	N
Carbon substitution							
Short-rotation energy plantations	Y	N	M	N	N	Y	A

Source: Adapted from Brown 1999; Brown, Masera, and Sathaye 2000.

Notes: A = Stores carbon in unburned fossil fuels.
Y = yes and indicates that the change in this pool is likely to be large and should be measured.
R = recommended and indicates that the change in the pool could be significant, but measuring costs to achieve desired levels of precision could be high.
N = no and indicates that the change is likely to be small to none, and thus it is not necessary to measure this pool.
M = maybe and indicates that the change in this pool may need to be measured depending on the forest type and/or management intensity of the project.

7.1.1. Options

Option a: List required pools, and verify only emission reductions from required pools

This is the approach taken under the current Climate Action Reserve (CAR) guidelines. Emission reductions from optional pools cannot be certified. Forest litter, soil, and wood products are optional pools in the CAR forest protocol.

In their comparative study, the Duke University researchers found that inclusion of the HWP pool had a decided influence on accumulated carbon, and the amount of carbon in the HWP pool was tied to the accounting methodology applied to the pool (Galik et al. 2008). A protocol that makes only certain pools eligible to generate reductions that can be certified runs the risk of excluding a pool, such as HWP, which can have a significant impact on total accumulated carbon.

There are two broad concerns that are much more prominent with regard to the HWP pool than to the other pools. The first is the uncertainty levels associated with measuring sequestration and release of carbon in HWP. The second concern is wrapped up in a complex web of associated issues of competing claims to offsets (between consumers, manufacturers, and timber producers), double counting, and management of the chain of custody for carbon accounting purposes.

Option b: List certain required pools and give project proponents the discretion to quantify the optional pools as emission reductions that will be verified

This is the approach used by the Voluntary Carbon Standard (VCS) and the Chicago Climate Exchange (CCX) protocols. CCX has two required pools (live tree and below-ground biomass) and one optional pool (HWP). VCS has only one required pool (live tree) and five optional pools (below-ground biomass, dead tree, forest litter, soil and HWP).

As soon as discretion is handed over to project proponents in the absence of *de minimus* provisions, the environmental integrity of the offsets is called into question. For example, inclusion of wood products can be advantageous under certain accounting provisions. This pool can be less advantageous for inclusion under certain baseline situations.

Prior to selecting the required pools to be listed, the availability and quality of data that would have to be collected and the costs associated with obtaining this information would need to be assessed so as to adapt such requirements to specific conditions and then to avoid technical or economic barriers.

Option c: Require proponents to measure carbon in all carbon pools, subject to a materiality consideration

The Duke University researchers concluded that "the economic feasibility of measuring and monitoring each carbon pool aside, the inclusion of all possible carbon pools has the potential to yield the greatest amount of creditable carbon for a project" (Galik et al. 2008, p. 38). A recently developed scorecard for evaluating offset quality recommended that "…any carbon pool that is expected to decline by at least 5% between reporting periods should be included…" (Beane et al. 2008).

7.1.2. Evaluation

The preceding three options are presented in Table 10 and analyzed according to the evaluation criteria presented in Chapter 4.

TABLE 10: EVALUATION OF CARBON POOL SELECTION OPTIONS

Option	Pros	Cons
Option a: Only required pools are verified	• Gives protocol developers the most discretion to designate pools that would generate emission reductions eligible for certification	• Could be a disincentive for project proponents if an optional pool would have had a significant impact on emission reductions eligible for certification • No financial incentive for the project proponent to measure and monitor the optional pools • Environmental integrity may be perceived as compromised because pools were left optional
Option b: Protocol developer discretion in selecting optional pools for verification	• Allows protocol developers to direct effort to the most important carbon pools in the most efficient manner • Most cost-effective option from the project proponent's perspective	• Environmental integrity of the offsets is left in the hands of the proponent, as incentive exists to leave out pools that are sources • Effort required to address non-quantified emissions, and removals or restrictions to creditable carbon may exceed the cost of having undertaken the estimate
Option c: All pools required subject to a materiality consideration	• Best option from the perspective of environmental integrity • Potential to yield the most carbon for a project	• May add expense to the project • Cost of measurement and monitoring may exceed the value of removals for some pools

7.1.3. Conclusions

All carbon pools should be accounted for, including living biomass (above-ground biomass and below-ground biomass), dead organic matter (dead wood and litter), and soil organic carbon. Protocols should identify whether they are controlled, related to, or affected by the project. Protocol developers should be given the flexibility to exclude elements of pools where they can show them to be immaterial and show how these elements will be accounted for elsewhere, such as under materiality or *de minimus* rules.

Under its 1606(b) registry, the US Department of Energy has a *de minimus* provision for excluding certain emissions. These are emissions that are comparatively small and emissions that are not practicable to assess. Entities may omit reporting up to 3% of total emissions from all sources (estimated in carbon equivalent units) under the *de minimus* provision.[31] The VCS has a *de minimus* limit of 5% per carbon pool for forestry projects (VCS 2007). WRI does not specify a materiality limit, but does state that if secondary effects or carbon pools are omitted because of cost or any other constraint, the plan should explain these exclusions (Greenhaigh et al. 2006). The IPCC does not specify a *de minimus* or materiality limit, but does describe procedures for uncertainty assessments (IPCC 2003). Environment Canada's Pilot Emission Removals, Reductions and Learnings Initiative used a materiality threshold of 5% for each excluded emission or removal and 10% in aggregate. This approach was also proposed for Alberta's afforestation protocol (Graham and Simpson 2008).

7.2. Issue: Crediting of carbon storage in harvested wood products

There are long-standing questions internationally and domestically about whether or not to consider harvested wood products (HWP) as a carbon pool, and how to quantify them. The subject continues to be discussed internationally (UNFCCC Secretariat 2008).

Several approaches to accounting for HWP are under consideration. These include the IPCC default approach, the atmospheric flow approach, the stock change approach, the simple decay approach, and the production approach (Pingoud 2008). There is no official Canadian government position on this matter as yet.

While these approaches would yield the same net carbon exchange with the atmosphere if applied at the global level, they differ on a national level in the way in which they account for the time and place of emissions. All of the approaches other than the IPCC default method track carbon emissions and removals associated with the harvest, manufacturing, and consumption of HWP. Under IPCC default rules, emissions from harvests are treated as though they are released 100% to the atmosphere in the year of harvest. Carbon stored in HWP is recognized[32] under the US

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[31] Richard A. Birdsey, (July 6, 2006) Carbon Accounting Rules and Guidelines for the United States Forest Sector, Published in J Environ Qual 35:1518-1524 (2006), DOI: 10.2134/jeq2005.0193, American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, http://jeq.scijournals.org/cgi/content/full/35/4/1518 (accessed March 20, 2009)

[32] It is common for the US protocols to use the 100-year method for determining the extent of wood in use and in landfills in 100 years.

Department of Energy 1605(b) voluntary reporting program (Pearson et al. 2007; Birdsey 2006). The USDA has devised methods to quantify carbon storage in HWP as a carbon pool (Smith et al. 2005).

7.2.1. Options

Option a: Exclude HWP as a carbon pool

The simplest option is to not allow inclusion of harvested wood products as a carbon pool.

Option b: UNFCCC 100% emission rule

This option assumes that all of the stored carbon in HWP is emitted at the time of harvest, which reflects UNFCCC national inventory reporting rules.

Option c: Include HWP as a carbon pool

The third option is to recognize the storage of carbon in HWP. This would account for the changes in carbon stocks that go into HWP and commodities derived from this wood.

This option would require a methodology for quantifying the carbon storage. The production approach tracks carbon in HWP over time, and it appears to be the favoured approach internationally for national inventory reporting at this time. It follows, then, that an approach used at the project level should reflect an approach used nationally so that the accounting systems complement each other.

7.2.2. Evaluation

The preceding three options are presented in Table 11 and analyzed according to the evaluation criteria presented in Chapter 4.

TABLE 11: EVALUATION OF OPTIONS FOR CREDITING STORED CARBON IN HWP

Option	Pros	Cons
Option a: HWP not included as a carbon pool	• Administratively simple	• Makes some forest management projects less financially attractive

Option b: HWP included as a carbon pool, with 100% of emissions assumed upon timber harvest	• Reflects current UNFCCC/IPCC direction • Easy to administer, and a conservative estimate of carbon emissions • Conservative approach to environmental integrity • More economically efficient than having to quantify HWP emissions	• Disincentive for harvesting • Disincentive for most forest management projects other than conservation projects
Option c: HWP included as a carbon pool, with carbon storage assumed on the basis of the production approach	• More realistic picture of carbon storage and release • Established US protocols (CAR, VCS, and RGGI) have provided for inclusion • Provides an incentive for sustainable forest management	• Much higher uncertainty associated with measurement/estimation of this carbon pool compared to forest carbon pools • Factors need to be derived for the Canadian and possibly provincial situations, to determine the extent and duration of stored carbon in Canadian HWP • No international recognition at the IPCC level for how HWP should be accounted for, so any efforts by protocol developers might end up at odds with eventual international reporting agreement • Additional work required if life cycle or extent to which products are exported need to be estimated, adding to project costs

7.2.3. Conclusions

Because of the ongoing dialogue at the international level about inclusion of and accounting for HWP in national inventories, HWP should not be a mandatory or required pool, and instead the matter should be left to the discretion of the proponent. The Duke University work showed that HWP pool inclusion had an important impact on cumulative carbon, but that the measurement of HWP carbon storage for the baseline and project are determinate in measuring removals (Galik et al. 2008).

The production approach seems to be the favoured way to account for storage in HWP at this time. A wider and accelerated research program in the Canadian Forest Service on selecting a favoured HWP carbon storage accounting approach, better default values for HWP conversion factors and lifetime parameters, and HWP carbon budget computer modelling would greatly facilitate the quality of HWP carbon storage measurement in Canada.

With forest management offset projects directed towards either the compliance-based or voluntary market–based schemes currently moving ahead in Canada, better HWP carbon storage estimation techniques and information directed to the Canadian situation would be helpful in improving measurement quality.

7.3. Issue: Requirements for measuring forest carbon

The most accurate way to estimate carbon stocks is to use direct measurement with a specified sampling procedure (Birdsey 2006). This might include setting up sampling plots in the forest to collect detailed samples that are later analyzed by a laboratory, and could include extensive field work for destructive sampling to cut, dry, and weigh all sources of biomass. These might be suited to a smaller project where data are not available, or where the use of provincial or national forest inventory data is not suited to a small localized project.

A sampling procedure is given in the IPCC Good Practice Guidance (2003, LULUCF, Section 4.3.3.4). Other sampling procedures are available from well-established organizations (Graham and Simpson 2008).

While measurements may be the most accurate, they tend to be more costly than other methods. Lookup tables are the simplest to use, but rely on average conditions and may under- or over-state carbon content. Models are more accurate than look-up tables, as they are able to quantify a broader set of conditions, although they are a much more technically challenging and costly alternative.

Forest inventory data are a key consideration in model-based estimations and the quality of those data has a direct influence on the quality of carbon storage estimations. The quality of inventory data varies widely, however, with some Canadian provinces having inventories that are 25 years out of date (J. Williams, pers. comm.).

In Canada, forest inventory data are typically developed by the Crown and private forest companies for sustainable forest management purposes. Most forest inventories measure timber information such as species, diameter, height, site index, and so on. Some newer inventories in jurisdictions like BC also collect data on shrubs and ground cover, although this is very limited. Carbon stock has generally not been measured in Canada as part of forest inventories, although in Quebec, soil samples are collected for carbon and nutrient evaluation.

Canada’s National Forest Inventory is a consolidation of inventories across the country. While it may offer some overview-level information, it was designed to monitor the progress of sustainable development, meet national and international reporting commitments, and research important national and international concerns, such as climate change.[33] It was not developed for operational-scale forest management projects.

Depending on the size of the area covered, inventory work can be expensive. The amount of effort required will generally increase with the size of the project area. For example, a re-inventory on 600 ha might take less than a month; however, a recent inventory audit to check only the quality of inventory data on a Tree Farm Licence in BC covering 153,000 ha of forest required 450 full measure and count plots to achieve 15% sampling error at a 95% confidence interval (BC Ministry of Forests and Range 2000). A project of this magnitude might require several months to complete.

The main issue is whether a quantification protocol should specify particular methods, emission factors, and models to measure forest carbon at the project planning and monitoring stages. The question of mandating specific approaches or taking a broader approach, as in the Clean Development Mechanism methodologies, stands as an open question.

7.3.1. Options

Option a: Detailed prescription of measurement and monitoring methods

One option is for the protocol to be prescriptive, describing sampling requirements and allowed models, along with uncertainty tolerances. This approach has been implemented in the CAR forest protocol.

Option b: Flexibility in choice, but modelling for estimations required

One step down from the CAR level of prescription is for a protocol to express a preference for direct measurement but to mandate a minimum of plot samples to establish an inventory and modelling, with the choice of growth and yield and carbon budget models left to the project proponent. The verifier would check to see that a suitable model was used.

[33] More information on Canada's National Forest Inventory is available at http://cfs.nrcan.gc.ca/subsite/canfi

Option c: Full flexibility in measurement and monitoring options

A broad prescriptive approach is for a protocol to express a preference for direct measurement but to broaden the estimation approaches to include reference factors, such as biomass expansion factors, and biomass expansion equations, as well as models.

Option d: Outcome-based approach

Rather than taking a prescriptive approach that focuses on measurement methods, an outcome-based approach could be adopted, based on the results of the measurements. The Manomet Center for Conservation Sciences recently recommended this approach in its scorecard method for evaluating project quality (Beane et al. 2008). It recommended that project proponents use measurement methods that result in estimates that are within 10% of the true mean at a 95% confidence level.

7.3.2. Evaluation

The preceding four options are presented in Table 12 and analyzed according to the evaluation criteria presented in Chapter 5.

TABLE 12: EVALUATION OF OPTIONS FOR REQUIREMENTS FOR MEASURING FOREST CARBON

Option	Pros	Cons
Option a: Detailed prescription of sampling and estimation tools	• Uniformity across projects in terms of measurement • Certainty as to measurement quality	• Limits choice by professionals • Must be regularly updated • Creates a single measurement authority • Eliminates creative and possibly less expensive measurement approaches • Difficult to come up with an appropriate one-size-fits-all approach for forest management activities and Canadian regions
Option b: Sampling recommended and use of models for estimations prescribed (but not particular models or sampling requirements)	• Allows professionals to exercise their expertise and knowledge in the measurement area • Models are more rigorous than reference factor techniques	• A less prescriptive approach leaves more discretion to the verifier to determine suitability of measurement techniques • Less costly reference factor techniques are not allowed
Option c: Sampling recommended and use of reference factors as well as models allowed	• Professionals have broad discretion to choose appropriate measurement methods	• Higher parameter uncertainty in estimations unless accuracy targets are specified

Option d: Outcome-based approach, using an uncertainty target	• Similar to option c in broadness, but sole focus on accuracy of measurement outcomes • Professionals have broad discretion to choose appropriate measurement methods	• A less prescriptive approach leaves more discretion to the verifier to determine suitability of measurement techniques

7.3.3. Conclusions

A highly prescriptive option is likely to be met with considerable resistance from within the forest practitioner community.[34] It will limit creativity in measurement and monitoring and impose a regimented approach to measurement and monitoring, with a small cadre of protocol writers deciding on important matters in an area where there is a Canada-wide base of professional and academic expertise in forest resource measurement and monitoring.

The key to high-quality measurement is likely accuracy targets. Estimation uncertainty arises when quantifying emissions and offsets, because there is always some level of uncertainty associated with measurements and sampling, collection of data, calculations, and monitoring activities (WRI/WBCSD November 2005; IPCC 2003). This is particularly true in the dynamic system associated with a forest. Most forest management activities rely on estimates, given the large land base and the cost of producing detailed information. It follows that the trade-off should be to accompany the uncertainty with increased conservatism in the estimate of carbon removals or gains.

Project proponents should be expected to reduce uncertainty to the extent practicable, working within levels of accuracy generally accepted for the measurements and calculations they are responsible for. This can typically be identified for each step of quantification, including data collection, analysis, and monitoring. Protocol developers can declare acceptable levels of uncertainty (or accuracy).[35] For example, if using conventional statistical analysis, the IPCC guidelines (IPCC 1997) recommend calculating a 95% confidence interval to define the range of

[34] Defined broadly as including Registered Professional Foresters (RPF), university and institute forestry researchers, timber supply analysts and modellers who do not hold a RPF designation, and forestry company and ministry managers.

[35] We do not recommend an acceptable level of uncertainty in measurement for any particular measurement activity in the framework. This is a topic unto itself that would benefit from a separate report initiative if this outcome-based approach were of sufficient interest to the CCFM.

uncertainty. This will help determine upper and lower bounds of the calculated removals and provide a basis for creditable removals. The WRI/WBCD has a well-known *Uncertainty Tool for Corporate Inventories*.[36]

[36] Available at www.ghgprotocol.org

8. Leakage

Background

The Intergovernmental Panel on Climate Change (IPCC) *Special Report on Land Use, Land-Use Change, and Forestry* defines land use leakage as "…the indirect impact that a targeted land use, land-use change and forestry activity in a certain place at a certain time has on carbon storage at another place or time" (IPCC 2000, s. 2.3.5.2, p. 71). In another section of the same report leakage is defined as the "unanticipated decrease or increase in GHG benefits outside of the project's accounting boundary…as a result of the project activities" (IPCC 2000, s. 5.3.3, p. 246).

Leakage is not unique to forest management. It can be positive or negative, and sometimes a project can have a positive impact on some SSR while exerting a negative impact on others. Leakage is only an issue if it is negative and/or if the "leaked" (shifted) emissions fall outside the accounting framework (e.g., from a monitored project to an unmonitored activity). Otherwise, it does not undermine net emission reduction/removal. The main issues are therefore how to mitigate leakage and how to account for leakage in the quantification of carbon offsets generated by forest management projects.

In the Clean Development Mechanism (CDM), leakage has been treated essentially as a spatial phenomenon. Afforestation/reforestation CDM methodologies differentiate between emissions occurring inside the project boundary (or in the immediate area outside) and leakage occurring outside the project boundary at the local or broader regional, national, and global level. CDM methodologies typically identify two main types of leakage:[37]

- activity shifting – when previous forest management activities are simply shifted elsewhere, either on the project proponent's land or on a nearby area
- market effects – when emission reductions are countered by emissions created by shifts in supply and demand of the products and services affected by the project.

The ISO 14064 standard deals with leakage by requiring that project proponents consider all

[37] *Super acceptance* is also referred to in the CDM. This occurs when a project creates new economic activities and causes GHG-emitting practices to expand (e.g., a forest conservation project attracting tourists to an area that will result in additional auto traffic, construction and heating of hotels, etc.). Leakage will only be negative if these actors were previously engaged in less GHG-intensive activities.

carbon sources, sinks, and reservoirs (SSR) controlled by, associated with and affected by the project. Rather than adopting a geographically explicit approach, ISO 14064 proposes to deal with leakage through an integrated assessment of all of the project's impacts on SSR. It defines three types of SSR:

- Controlled SSR are those under the control or influence of the project proponent through financial, political, or management means.
- Associated SSR are those related to material or energy inputs and outputs to the project as well as material and energy fluxes internal to the project. The concept of associated SSR attempts to capture the effects of a project through a life-cycle analysis of both upstream and downstream SSRs.
- Affected SSR are those influenced by the project through changes in the supply and demand of forest products or through a shift in the physical location of activities. This is the exact equivalent of market effects. In the ISO 14064 norm, this is the only category of SSR that is explicitly referred to as leakage.

The ISO 14064 norm is expected to serve as the basis for the future Canadian federal offset regime; the ISO standards currently form the quality assurance backbone for BC's GGRTA Offset Initiative and the Alberta Offset System; and the Western Climate Initiative (WCI) proposes to use them as well. In the following sections we build on the ISO 14064 norm definitions and *modus operandi*.

The following issues and options for addressing them are included in this chapter:

8.1. SSR identification

- Option a: Require projects to include all controlled SSR
- Option b: Require projects to monitor and report all controlled SSR
- Option c: Require projects to monitor and report all associated SSR

8.2. Market effects

- Option a: Mitigate market leakage through eligibility criteria
- Option b: Measure and discount market leakage
- Option c: Include HWP as a carbon pool

8.3. Ecological processes

- Option a: Mitigate ecological leakage through eligibility criteria
- Option b: Measure and discount ecological leakage

8.1. Issue: SSR identification

For forest management offset protocols it is essential to clearly define the SSR that need to be accounted for. ISO 14064 distinguishes between SSR under the control or influence of the project proponent (controlled and associated) and beyond the control of project proponent (affected SSR).

Controlled SSR

In the case of forest management, a logging company simply shifting its logging activities to another area under its control is often cited as an important leakage risk.[38] From a conceptual standpoint, the distinction between this type of leakage and market leakage is that these SSR are under the control, or the influence, of project proponents. As a result, options for addressing this kind of leakage may be different from the options best able to deal with market leakage. Protocols will need to address this issue.

Associated SSR

Accounting for associated SSR requires a life-cycle analysis of SSR associated with material and energy fluxes upstream from the project, SSR internal to the project, and SSR associated with outputs downstream from the project. For example, the use of fertilizer is both an emission source upstream (natural gas used in fertilizer production) and an internal source (N_2O released through fertilizer application). In the case of forest management, it is the output of the projects in terms of harvested wood product (HWP) and/or potential biofuel or other biorefining products that is of particular interest because of the large positive effect on SSR associated with these activities downstream. However, quantifying the SSR associated with these outputs remains challenging.

Affected SSR

Project proponents using ISO 14064-2 for measuring the emission reductions linked to their project have to account for affected SSR emissions, which generally fall under the category of external leakage in other offset systems. In the specific context of forest management activities, accounting for the GHG emissions of affected SSR allows for the consideration of shifts in market conditions that result in an indirect increase or decrease of GHG emissions due to the project activity. For instance, in an elastic timber market, a forest conservation activity may create a timber supply shortage that is immediately filled by a competitor, thereby offsetting

[38] This point was made by several of the interviewees.

partly or entirely the climate benefits induced by the forest conservation activity in the first place. Accounting for affected SSR allows project proponents to account for any indirect increase or decrease in GHG emissions that their project may induce.

8.1.1. Options

Option a: Require projects to include all controlled SSR

Eligibility could require that projects include all controlled SSR. On private land this could include local activities by the same company or companies using the same facilities, roads, and sawmill near project boundaries. In the case of Crown land, this would involve the inclusion of entire FMA in offset projects. The rationale behind such an approach is to avoid the creation of perverse incentives for project proponents to register only part of their operations as a carbon project and directly shift their extractive activities elsewhere.

Expanding contracts to include local activity or activities carried out by the same company or companies using the same facilities (roads, sawmill, and so on) near project boundaries could eliminate internal leakage (although it would not eliminate market effects). However, requiring companies to enter their entire managed forest in a GHG offset program might be too burdensome and generate a perverse incentive not to participate. Requiring many companies to design a project and enter into an agreement would present the same problems and could be even more complicated from a legal and administrative standpoint. Nonetheless, this could lead to large-scale projects generating less leakage in proportion to the benefits they provide (Murray et al. 2004).

Option b: Require projects to monitor and report all controlled SSR

Expanding the monitoring footprint would increase the ability to quantify internal leakage (controlled SSR).[39] However, this would not lead to an accounting of all market effects. Measurement at the processing plant sawmill or in the harvested forest area would have an impact on the robustness of these approaches (data integrity, data availability, and the rigour of the data collection method used). It would also have implications for the administrative effectiveness of the system. Measuring internal leakage downstream at the sawmill level may be more cost-effective than requiring area-based leakage quantification. Technically sound, transparent, and objective methods for making this assessment would have to be developed. Sawmills have

[39] Including negative leakage that may result from ecological processes.

information on the amount of timber they process, and other companies also keep records of their extraction volumes. This approach could thus build on existing practices.

Finally, given that harvesting could also be displaced in a number of areas outside the control or influence of the project proponents through market effects, the usefulness of this approach can be questioned, as it could prove to be ineffective as well as burdensome.

Option c: Require projects to monitor and report all associated SSR

ISO 14064 requires that the project proponent identify relevant SSR for surveillance and justify the exclusion of any SSR. The objectivity of this process could be enhanced by setting clear requirements for the measurement of controlled and associated SSR (pools, materials/products and energy fluxes for activities and under certain conditions). This method could be based on the decision trees for the identification of key SSR, similar to what is provided in the IPCC good practice guidance documents (IPCC 2006). For example, in the Climate Action Reserve (CAR) forest protocol, planners must estimate the amount of GHG emissions produced by machinery used in management activities (CAR September 2007). Another example is the Climate Community and Biodiversity Standards, which require the inclusion of non-CO_2 gases if they might be responsible for more than 5% of the net change (CCBA December 2008).

Clear requirements for transparent and objective measurement have been widely used in GHG emission inventories in the past (building on best practices) and this approach is applicable to a relatively large range of activities. However, it may be unable to capture the specific characteristics of a project and/or the region in which it is implemented. Furthermore, SSR measurement requirements are likely to be different for stand-level and landscape-level projects.

8.1.2. Evaluation

The preceding three options are presented in Table 13 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 13: EVALUATION OF SSR IDENTIFICATION OPTIONS

Options	Pros	Cons
Option a: Require projects to include all controlled SSR	Promotes environmental integrity and avoids creation of perverse incentives for project proponents to register only part of their operations	• Increases transaction and administrative costs

Option b: Require projects to monitor and report all controlled SSR	• Promotes environmental integrity of the scheme and avoids creation of perverse incentives for project proponents to register only part of their operations	• Increases transaction and administrative costs • Reduces administrative effectiveness (the definition of controlled SSR can be prone to litigation on private land)
Option c: Require projects to monitor and report all associated SSR	• Promotes environmental integrity (inclusion of upstream emissions and downstream HWP and biofuels)	• Increases transaction costs • Reduces robustness of the approach (accounting difficulties related to HWP and substitution effects)

8.1.3. Conclusions

Most interviewees considered entity-wide reporting at the FMA level as avoiding the creation of perverse incentives. While this approach may be well suited to large-scale timber operations on Crown land, there are difficulties with applying this method to private forests.

8.2. Issue: Market effects

Market leakage refers to the impact on SSR resulting from shifts in supply and demand for wood products caused by a forest management project. An increase in timber extraction in existing managed forests or the development of new timber extraction activities on formerly unmanaged land are examples of negative market leakage that could result from a decrease in supply. Empirical estimates for the US show that leakage ranges from minimal (less than 10%) to enormous (greater than 90%) (Murray et al. 2004). The magnitude of these shifts will depend on the elasticities of supply and demand for HWP and on the relative carbon densities of forest that are substituted for one another.

It is difficult to determine the elasticities of supply and demand for HWP for a particular area. This assessment is further complicated by two "accounting" issues: the scope considered for the leakage calculation and the time horizon over which leakage is assessed.

The scope (regional, national, North American, or global) considered for the assessment will affect the leakage estimate, with greater scope generating greater leakage numbers. For example, Wear and Murray (2003) examine the effects of US federal restrictions on the sale and harvest of old-growth timber from national forests that were implemented in the 1990s in the US Pacific Northwest. Within the region, the leakage factor results indicate that about 45% of the reduction leaked away and was replaced by other regionally induced harvests. The leakage effect increases when we expand the effects in the southern US and Canada. Wear and Murray estimate an additional 300 million board foot harvest response, raising the continental US leakage estimate to 58%. Finally, Wear and Murray estimate a 550 million board foot response in Canada, resulting in a North American continental scale leakage estimate of 84%. This suggests very large leakage effects from reduced timber harvesting. However, Wear and Murray provide results in softwood lumber units, not in carbon.

The time horizon over which leakage is accounted may also have important impacts, as negative leakage in the short term may result in positive leakage in the long term. For example, a forest management scheme may lead to reduced timber supply in the short term (negative market leakage), but increased supply in the long term.

Another matter is relative carbon densities of supplying forests that are substituted for one another. This will have large consequences for the carbon impact of activity shifts. Setting aside old-growth forests, carbon-rich forests on the BC coast, or forest on peatlands could divert harvests to other regions where the forests are typically younger and more uniform. Therefore, the carbon losses from harvests will not be as large as the carbon savings in the old-growth or peatland forests. Conversely, protecting relatively less carbon-dense forests diverts harvests to the more carbon-rich forests, potentially causing large leakage effects (Murray et al. 2004). This presents a significant problem, as it appears very hard to predict where activities will shift and what the final carbon outcome will be.

8.2.1. Options

Option a: Mitigate market leakage through eligibility criteria

To mitigate risks of market leakage, a protocol could set requirements or eligibility criteria promoting activities that are not likely to generate much market leakage.

For example, a project could be required to increase or maintain timber yields. The current Regional Greenhouse Gas Initiative (RGGI) proposes that harvested wood products from the project must meet or exceed the average annual removals in the area (Maine Forest Service et al. 2008). This could be an effective way to provide incentives to improve project design and reduce administration and transaction costs associated with accounting for leakage. However, this approach could also reduce the options for project proponents. Moreover, it could inhibit the participation of forest conservation projects in the program, thus reducing the environmental biodiversity and adaptation co-benefits associated with these projects.

A protocol could set requirements or eligibility criteria promoting activities in project areas where leakage is likely to be minimal due to the carbon intensity of the ecosystem. For example, forest conservation projects could be encouraged to be undertaken in carbon-rich areas, such as old-growth forest and peatlands. However, this could be difficult and prone to litigation, because of the uncertainty as to what the long-term outcome of such measures might be. For example, scientists in Canada are currently debating the possibility that carbon-rich ecosystems such as old-growth forest are at higher risk of disturbances (Kurz 2008).

Option b: Measure and discount market leakage

In a case where leakage cannot be mitigated, measurement would be required. To reduce transaction costs, as a general rule, the protocol could exempt from quantification those projects that can demonstrate positive leakage.

Market leakage could be calculated based on the relative elasticities of supply and demand for the area in which the project is taking place. This would require accurate market data for each project and is a data-intensive, highly sophisticated modelling exercise, which would prove to be a barrier to all but the very largest projects. Furthermore, results can differ widely among models and within the same models because of variation in input data quality, which would make this approach prone to litigation. An alternative would be to have centralized modelling of market leakage. This could be done by the program authority.[40]

Generally speaking, if supply is less elastic than demand, leakage will be smaller than if supply is more elastic than demand. For example, the Duke University *Harnessing Farms and Forests* proposal (Willey and Chameides 2007) suggests that if those elasticities are equal, leakage is computed at 50%. If supply is less elastic than demand, leakage will be less than 50%; for the reverse, leakage will exceed 50%.

[40] Quantifying leakage could be very costly, burdensome, and prone to conflict and possibly litigation, especially for small projects where leakage will be small in absolute terms. However, recent research indicates that leakage will tend to be larger in proportion to the direct project benefits for smaller projects (Murray et al. 2004). Thus, leakage outside the boundaries even of small projects should not be ignored. It is therefore important to explore ways to reduce the costs of accounting for leakage while preserving the environmental integrity of the program.

The scope (regional, national, North American, global) and the time horizon over which leakage is modelled will have a large impact on the results. Typically, models that are largest in scope and that have the longest time horizon will contribute to promoting the environmental integrity of the scheme. However, greater scope and longer time horizons may reduce the robustness of the estimates and increase the associated uncertainty.[41]

Another issue is that market modelling generally produces a high leakage estimate that significantly penalizes forest conservation or reduced-impact logging projects that could yield significant biodiversity and adaptation benefits, especially in the long term.

A standardized approach could be used to quantify leakage in a straightforward manner. This could involve the use of a flat discount rate or an adjusted rate tied to optimal (CAR) or average production in a control area (RGGI) or leakage risks (VCS).

The CAR forest protocol applies an optimal production criterion for market leakage. Project proponents account for market leakage assuming that normal harvests are 2% of total volume. It is assumed that harvest volumes below 2% will cause either increased harvest elsewhere or increased use of substitute materials. Methodologies and worksheets are provided in the protocol to determine the discount to be applied for projects that cause a reduction in annual harvest volumes below 2% (CAR September 2007). This approach could promote sustainable forest management. However, a single criterion may not accurately reflect the different circumstances in which harvesting takes place.

In the RGGI proposal, if harvest is less than the average annual removals in the assessment area (based on US Forest Service Forest Inventory and Analysis Program data), leakage is assumed (Maine Forest Service et al. 2008). Tables for quantifying leakage in the RGGI system are under development. Leakage based on average annual removals in the assessment area is straightforward, transparent, and objective. However, it will generate a premium for those projects taking place on lands of higher productivity and a perverse incentive for projects on lands of lower productivity.

[41] Including data integrity, data availability, and the rigour of the data collection method used to determine elasticity co-efficient and substitution effects.

This may reduce the economic efficiency of the scheme. However, from an environmental standpoint this may not be a problem. It will depend on whether high productivity areas correspond to carbon-rich ecosystems or not within the assessment area used to derive the average removal. For example, peatlands are not generally considered to be productive areas, so assuming leakage based on annual removals in a broad assessment area would not reflect reality and would unduly penalize peatland protection. Conversely, old-growth forests in BC are generally considered to be high-productivity areas, in which case assumed leakage would be smaller. The average annual removal approach thus appears unsuited to accounting for diversity of carbon contents across an ecosystem unless specific physical parameters are taken into account when defining the assessment area. However, in younger and more homogeneous managed forest areas such as those of south central Canada and New Brunswick, this might not be a significant problem.

A standardized approach could also be based on a risk assessment tool that applies a discount rate based on the leakage risks. The VCS protocol applies a similar method by providing a standardized table applying simple criteria for deriving an associated leakage discount. This is a quick and easy method that would contribute to the administrative effectiveness of the program. However, this approach cannot be customized to either a project's characteristics or the conditions in a market region.

8.2.2. Evaluation

The preceding two options and their variations are presented in Table 14 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 14: EVALUATION OF MARKET EFFECTS OPTIONS

Option	Variations	Pros	Cons
Option a: Mitigate market leakage through eligibility criteria	• Requirements to maintain optimal timber yields	• Promotes environmental integrity of the scheme	• Reduces potential for environmental biodiversity and adaptation co-benefits associated with these projects
	• Requirements to minimize carbon density leakage effects	• Promotes environmental integrity of the scheme	• Reduces administrative effectiveness (complex and prone to litigation) • Reduces robustness of the approach (scientific uncertainty)

Option b: Measure and discount market leakage	• Market modelling of market leakage	• Increases robustness of the approach • Reduces administrative effectiveness (uncertainty; subjective and prone to litigation)	• Increases transaction costs (accurate market data is needed) • High leakage estimates reduce the incentives that the mechanism can provide
	• Standardized discount methodology	• Reduces transaction costs (easy to implement) • Applicable to a range of projects	• Compromises robustness of the approach (high uncertainty) • Reduces administrative effectiveness (subjective and prone to litigation)

8.2.3. Conclusions

The literature and interviews did not point to a clear candidate for addressing the issue of market leakage. The application of a simple 2% sustainable timber extraction criterion, proposed by CAR, seems to be the most promising option for dealing with market leakage, but it does disadvantage forest conservation projects.

8.3. Issue: Ecological processes

Neither the ISO 14064 standard nor the CDM methodologies deal explicitly with the possibility that leakage may occur through ecological processes. Ecological processes are complex and difficult to quantify with an acceptable degree of certainty; nonetheless, the carbon implications may be important. For example, preserving old-growth forest may increase the risk of fires and pest infestation (Black et al. 2008); or a forest management project aiming to increase growth through the introduction of exotic species could cause negative leakage by introducing pathogens that could increase mortality in neighbouring forests.

8.3.1. Options

Option a: Mitigate ecological leakage through eligibility criteria

To deal with ecological risks, a protocol could set requirements or eligibility criteria promoting activities that are not likely to generate unforeseen ecological effects. For example, projects could be required to demonstrate that they will not have a negative impact on carbon pools in neighbouring ecosystems. The CAR protocol partly deals with this issue by requiring that forest management use native species, which mitigates the risk of negative ecological effects (CAR September 2007).

Option b: Measure and discount ecological leakage

Projects could also be required to account for negative leakage caused by ecological processes in nearby areas. This could be done through the same means explored above for controlled SSR (i.e., expand monitoring to nearby areas). It is important to note that there are important uncertainties associated with ecological processes. This is particularly important in the case of fire and pest control projects. Further research to enhance the ability to understand and quantify such effects will likely be needed before measurement can be envisaged.

8.3.2. Evaluation

The preceding two options are presented in Table 15 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 15: EVALUATION OF ECOLOGICAL PROCESSES OPTIONS

Options	Pros	Cons
Option a: Mitigate ecological leakage through eligibility criteria	• Promotes environmental integrity and avoids negative environmental co-effects	• Restricts participation in the scheme, thus reducing incentives to participate
Option b: Measure and discount ecological leakage	• Promotes environmental integrity of the scheme and avoids creation of perverse incentives for project proponents to register only part of their operations	• Increases transaction and administrative costs • Reduces robustness of the approach (scientific uncertainty)

8.3.3. Conclusions

Leakage is a complex issue common to all offset systems. It highlights the problems that projects reducing timber yield will create from a GHG accounting standpoint. It may not be feasible or necessary to account for all leakage; however, in order for the offset system to contribute to the achievement of Canada's emission reduction targets, leakage will need to be addressed at the national level.

9. VERIFICATION

Background

Under the Clean Development Mechanism (CDM), the process of verification is defined as the "the periodic independent review and ex-post determination by the designated operational entity (the verifier) of the monitored reductions in anthropogenic emissions by sources of greenhouse gases that have occurred as a result of a registered CDM project activity during the verification period" (UNFCCC 2009). Although other offset systems have come up with their own definition of verification, all tend to define verification more or less the same way, as an independent third-party non-financial audit of a GHG reduction/sequestration project that ensures that the GHG reductions/removals claimed by the project are real. In some cases, a successful verification is followed by the certification of the reductions/removals claimed by the project.

The quality and consistency of verification will necessarily be affected if the verifier is not sufficiently qualified to perform a credible, robust, third-party audit. There seems to be a general concern that some verifiers operating in evolving North American and voluntary offset markets are not sufficiently qualified to do their work (I. Landry, pers. comm.; T. Frank, pers. comm.; S. Carney, pers. comm.). This can be explained by the fact that until recently, there was no formal ISO 14065 accreditation process for would-be verifiers.[42]

Under BC's GGRTA Offset Initiative, validation and verification bodies must be "a body accredited, in accordance with ISO 14065, by a member of the International Accreditation Forum to use ISO 14064-3" as of July 1, 2010.[43] Under the Climate Action Reserve (CAR), verification bodies will soon be required to be ISO 14065–accredited by the American National Standards Institute (ANSI) as of January 1, 2010.

In addition to the conventional ISO-oriented verification duties, verification teams for forestry projects could be used to corroborate the non-permanence risk rating of forestry projects and

[42] Verifiers wishing to obtain accreditation under ISO 14065 have only been able to do so since late 2008 through the American National Standards Institute. In Canada, accreditation under ISO 14065 will be overseen by the Canadian Standards Council; no verifier has received accreditation to date.

[43] The Emission Offsets Regulation is available at http://www.env.gov.bc.ca/epd/codes/ggrta/pdf/offsets-reg.pdf

determine the amount of credits that must be set aside to counter for potential re-emissions (VCS 2008).

The following issues and options for addressing them are included in this chapter:

9.1. Clarity and comprehensiveness of verification guidance

- Option a: Make verification requirements more comprehensive
- Option b: Emphasize professional reliance

9.2. Inclusion of a recognized professional forester on verification teams

- Option a: Require verification teams to include a recognized professional forester
- Option b: Leave decisions about composition of the verification team to the verification body and project proponents

9.3. Verification period

- Option a: Top-down approach for establishment of the verification period
- Option b: Bottom-up approach for establishment of the verification period

9.1. Issue: Clarity and comprehensiveness of verification guidance

Although relevant not only to forest management *per se*, assuring the quality and consistency of verification assessments for forest management offset projects is a key to maintaining the environmental integrity of an offset system. Several types of checks and balances can be put in place to ensure the quality and streamlining of verification, notably by adopting clear, robust quantification and verification guidelines.

The CDM operates with its own verification standards, while a handful of North American offset markets are turning to the ISO 14064-3 standard as their verification backbone. This is the case with the Canadian federal government, BC's GGRTA Offset Initiative, the Alberta Offset System, and CAR. Verification requirements between different offset markets and standards may vary slightly, yet there appears to be a consensus regarding the level of rigour, organizational capacity, and capacity that is generally expected from verifiers to ensure that the audits they perform are in line with international verification procedures (I. Landry, pers. comm.).

It is generally recognized that the rigour and clarity of quantification protocols and reporting methods often vary among different offset systems. Hence, although verifiers may be committed to following international verification procedures as required by their professional affiliation or accreditation body, verifiers often face certain challenges when assessing projects that use imprecise, poorly designed, or unclear protocols, leading them to make judgment calls and adapt their verification procedures to fit a particular context (I. Landry, pers. comm.; T. Frank, pers. comm.).

The ISO 14064-2 standard leaves considerable discretion around the depth of specification that protocol writers incorporate into protocols. For example, clause 5.7 states that "the project proponent shall select or establish criteria, procedures and/or methodologies for quantifying.…" The word "shall" is the trigger in the clause, but very broad scope is provided for specifying what shall be done. It could be to use a specific sampling procedure, model, and so on (rules-based) or to achieve an uncertainty result in sampling (result- or outcome-based).

Offset systems that accept ill-designed protocols or that do not have clear verification guidance force verifiers to assume a greater share of responsibility for ensuring the quality of the verification process. This may ultimately affect the quality and consistency of the verification process, as the judgment, interpretation, and techniques of different verifiers will necessarily vary (S. Carney, pers. comm.). This in turn raises the issue of whether quantification protocols and verification guidelines should be sufficiently detailed to ensure streamlining of verification, or whether the verification process should instead be result-oriented, relying on the professional expertise of the verification team.

9.1.1. Options

Option a: Make verification requirements more comprehensive

The authority of a given offset system could require that protocols have detailed monitoring plans and quality assurance/quality control requirements and procedures, which could facilitate the work of verifiers. In addition, offset systems could establish specific verification guidance for different offset project types. For example, in addition to requiring verifiers to follow ISO 14064-3 verification procedures, CAR has its own forest verification/certification protocol, which provides verifiers with a standardized approach to the independent verification and certification of GHG emissions baselines and emission reductions claims for forest projects (California Climate Action Registry 2007). Overall, it is a carefully crafted protocol that specifies many procedures. The Alberta Offset System has a technical guidance document for verification elements of protocols (Alberta Environment 2008)

Option b: Emphasize professional reliance

While having clear verification guidelines in place could help streamline the verification process, it might also confine verifiers to operating with strict guidelines not necessarily applicable to all forest management situations. For example, some stakeholders interviewed generally agreed that their work should not be too strictly confined, and that it should be their responsibility to determine, for instance, which sampling method is most appropriate for assessing the GHG reduction claim of a given forest management project, or what is the most suitable method for verifying the assumptions used to the determine the baseline of a project (T. Frank, pers. comm.; I. Landry, pers. comm.).

A results-based approach that features "professional reliance" has been used in the BC forest management system since the replacement of the Forest Practices Code with the *Forest and Range Practices Act.*[44] It uses a professional accountability mechanism along with outcomes- or results-based application and planning documents to lessen the regulatory burden while building on the deep body of professional forestry expertise in the province.

9.1.2. Evaluation

The preceding two options are presented in Table 16 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 16: EVALUATION OF CLARITY AND COMPREHENSIVENESS OPTIONS

Options	Pros	Cons
Option a: More comprehensive verification requirements	• May help streamline the verification process and make it more predictable for project proponents • Can help increase consistency and robustness of verification • Helps maintain the environmental integrity of the verification process	• Increases administrative burden for the offset system authority, as protocols become more dense and difficult to evaluate • Increases administrative burden for the offset system authority, as it needs to develop verification guidelines • May provide less flexibility for verifiers to achieve objective • Could increase cost of verification if stringent verification procedures make the process more lengthy and burdensome

[44] See the following presentation for a description of the application of professional reliance within the BC forest regulation system, http://www.abcfp.ca/regulating_the_profession/documents/guideline_FRPA%20OpPlansandDecs(2007).pdf

Option b: Emphasis on professional reliance	• Transfers part of the verification liability from offset system authority to verifiers, giving them an incentive to perform environmentally robust audits • May be less administratively burdensome for the offset system authority if the quality of auditors is partly or fully under check by professional associations or responsibility • Deep body of Registered Professional Foresters expertise and experience with results-based forestry management systems in Canada	• Could lead to looser oversight mechanisms, which may ultimately affect the quality of the verification process • May be difficult to streamline the verification process, which could create more verification-related risks for project proponents

9.1.3. Conclusions

The right balance must be achieved between what the offset system authority can require from verifiers and what they are required or committed to do as professionals who follow international verification standards and rules of conduct. Verification guidelines that apply to groups of similar projects could help streamline the verification process; however, well-designed quantification and monitoring protocols, in combination with an emphasis on "professional reliance," may reduce the need for adopting specific verification guidelines for each project, provided that verification bodies are sufficiently qualified to undertake the work.

9.2. Issue: Inclusion of a recognized professional forester on verification teams

Several elements of forest management offset projects are highly technical, and the expertise required to plan and implement them resides in forestry professionals. Undoubtedly, project proponents will be using forestry professionals to assist in developing and operating their projects.

The question arises as to whether or not at least one member of the verification team should be either a Registered Professional Forester or, alternatively, a forestry professional that has the demonstrated/recognized capability[45] to undertake the work. This consideration could be taken one step further with a requirement that the forestry professional have taken a particular course on verifying forest management offset projects.

[45] This would have to be determined either by competent provincial authorities or by the offset system authority.

9.2.1. Options

Option a: Require verification teams to include a recognized professional forester

To ensure the quality and consistency of third-party audits, verification bodies could also require the verifying agent auditing forest management projects to be a member of a recognized professional order that can be liable for the quality of the work undertaken by its members. For instance, under CAR, only state- and registry-approved forest certifiers (which must include a Registered Professional Forester) are eligible to certify forest biological inventory of entities and projects.

Option b: Leave decisions about the composition of the verification team to the verification body and project proponents

It is likely that project proponents, offset buyers or program authorities, or some combination thereof, will strongly recommend that verification teams for forest management offset projects include at least one recognized professional forester.

BC's GGRTA Offset Initiative simply requires the use of accredited verification bodies (after July 1, 2010) and does not specify the inclusion of a recognized professional forester. However, the regulation setting the framework for the BC offset system has a transition phase for validation and verification body requirements that requires one member of the validation and verification teams to be a "person who is authorized to act as an auditor of a company under section 205 of the *Business Corporations Act*."

9.2.2. Evaluation

The preceding two options are presented in Table 17 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 17: EVALUATION OF INCLUSION OF RPF OPTIONS

Options	Pros	Cons
Option a: Recognized professional forester requirement	• May help ensure the quality and consistency of the verification work • May allow offset system authority to shift part of the verification liability to the market	• May exclude qualified professionals • May limit the number of verifiers, leading to a cost increase
Option b: No recognized professional forester requirement	• Less stringent for verification bodies • Allows market forces to determine who is best qualified to perform audits of forest management offset projects	• May render verification statements less environmentally robust/credible • Gives greater responsibility to the offset system authority for assessing the qualifications of auditors

9.2.3. Conclusions

Requiring that verification be undertaken by qualified recognized professionals – for example, members of a professional association – could help ensure the quality of the verification process. By putting a liability on verifiers and on the professional association with which they are affiliated, such mechanisms could help ensure the quality and consistency of their work and of the verification process in general. Adopting such a mechanism could also allow the offset system authority to pass on to the market part of the liability linked to the verification, which could yield both advantages (less administratively burdensome) and disadvantages (looser quality oversight).

9.3. Issue: Verification period

Most offset markets generally undertake verification of offset projects annually for various reasons. Indeed, many offset project types are able to generate a sufficient amount of credits to justify an annual verification. Other project types might simply want to undergo an annual verification to sell a steady supply of offsets, given that verification is often followed by credit certification and issuance.

The situation is rather different for forestry projects. Indeed, it is generally understood that forest-based carbon sequestration projects (A/R or forest management) do not generally generate a significant amount of emission reductions annually because of the natural limitations of carbon sinks absorbing carbon. Accordingly, many offset systems or standards do not require forestry projects to undergo verification on an annual basis[46] (unless significant natural disturbance or silvicultural intervention has occurred).

Most offset markets and voluntary market standards require that verification of forestry projects occur a minimum of every five years. This is the case under the CDM, although the first verification can be done at the project proponent's convenience. A further requirement is that verification cannot systematically coincide with peaks in carbon stocks (UNFCCC 2006). Under CAR, verification must occur at the beginning and end of every six-year period for which credits are allocated (e.g., years 1 and 6, years 7 and 12). The Voluntary Carbon Standard provides financial incentives to make projects undergo verification at least every five years, by automatically cancelling 50% of the project's buffer if it does not undergo verification (VCS 2007). Other voluntary standards, notably the Plan Vivo[47] and CarbonFix[48] standards, recommend shorter verification intervals, with the possibility of increasing the time between verifications over time (Merger 2008).

Simply put, the length of the interval between two verifications should not significantly affect the accuracy and robustness of reduction claims, as long as the interval is not excessively long and major changes in carbon stocks (e.g., after natural disturbances occur) are properly monitored and reported to the offset's system authority when they occur. Although there are advantages in undertaking verification on a periodic basis, notably because it allows for discerning major changes in the baseline scenario or in project risk factors, the length of the verification period may not be that relevant. What is essential is that major unintentional or dramatic variations in carbon stocks be properly monitored and reported (J. Nickerson, pers. comm.), and that monitoring be undertaken periodically and systematically.

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[46] This logic may not apply to forest management projects that reduce the risk of a carbon release (e.g., fire control projects), as the amount of emission reductions obtained from one year to the other may be sizeable.

[47] The Plan Vivo standard is used for sustainable land-use projects with an emphasis on native or naturalized tree species. These projects mainly benefit small-scale farmers and/or rural communities in developing countries. The Plan Vivo standard may be found at http://www.planvivo.org/content/fx.planvivo/resources/Plan%20Vivo%20Standards%202008.pdf.

[48] The Carbon Fix standard is managed by a non-profit organization. It is focused on sustainable forest management, CO_2 fixation, and permanence. The Carbon Fix standard may be found at http://www.carbonfix.info/CarbonFix_Standard/Summary.html?PHPSESSID=pgqteiqtrl0793glo91rl5fek7.

Requiring that verification be undertaken at short intervals will likely increase transaction costs for project proponents, and may not necessarily bring more robustness to the system. Hence, although the length of the interval between two verification periods will affect the transaction costs faced by project proponents, it may not have a significant impact on the environmental integrity of the system.

9.3.1. Options

Option a: Top-down approach for establishment of the verification period

Opting for a top-down approach for establishing the most appropriate verification interval could give clarity and robustness to the offset system, as it ensures that all projects face similar transaction costs and have to undergo periodic assessments of their baseline scenario and risk rating. This could help identify more rapidly projects that are performing poorly and help adjust permanence risk management requirements when necessary.

Should the offset system authority choose this approach, it would have to settle on the most appropriate verification interval. This decision could be based on the work of other offset systems and rely on international guidance. There seems to be a consensus that this period should be no longer than five or six years and that there should be some flexibility as to when project proponents should undergo their first verification. There appears to be no strong rationale for imposing a shorter interval for verification (e.g., every one or two years). While imposing shorter verification intervals could bring in faster returns for forestry project proponents, it might not necessarily yield more precise results and would likely increase transaction costs for project proponents.

Option b: Bottom-up approach for establishment of the verification period

Imposing fixed verification periods could help identify more rapidly significant, unplanned changes in carbon stocks, but it could also penalize projects that do not generate a significant amount of emission reductions between two verification periods if the mandatory verification interval is short. Allowing project proponents to decide which verification period to use could be more economically efficient, as it would allow project proponents to better weight verification needs over verification costs.

9.3.2. Evaluation

The preceding two options are presented in Table 18 and analyzed against the evaluation criteria presented in Chapter 4.

TABLE 18: EVALUATION OF VERIFICATION PERIOD OPTIONS

Options	Pros	Cons
Option a: Top-down, stringent approach	• Less administrative burden for offset system authority, as it doesn't have to assess the different verification period approaches chosen by developers	• May not necessarily properly account for the specific conditions of different projects
Option b: Bottom-up, flexible approach	• May be more cost-effective, allowing projects to undergo verification when there are sufficient emission reductions to measure	• Could be less environmentally robust if verification interval is chosen to correspond with carbon peaks • Long verification periods could prevent the offset system authority from noticing major changes in carbon stocks

9.3.3. Conclusions

There is a need to strike the right balance to ensure that carbon stock variations are well accounted for and that project proponents face acceptable payback periods and verification costs. As such, there appears to be consistency among different offset markets and standards in the verification interval not exceeding five or six years in order to account for changes in carbon stocks.

There are advantages and disadvantages to both having this interval fixed for all projects and allowing project proponents to decide on the verification period. But allowing for some flexibility might not significantly affect the environmental integrity of the system, and could reduce transaction costs.

Most offset systems and standards are flexible with respect to the first verification (which may also include validation of the baseline and risk rating of the project), allowing project proponents to choose when it occurs. Flexibility with respect to the first verification, combined with a maximum time interval for subsequent verifications, may be both cost-efficient and environmentally robust. On the other hand, allowing project proponents to determine their own verification interval and not imposing maximum verification intervals may create perverse incentives for them not to report significant, unplanned carbon stock changes, ultimately affecting system integrity.

10. CREDITING

Background

Crediting occurs when an offset system's authority issues the amount of offset credits that a given emission reduction/removal project has generated between two verifications. Crediting is generally done after the successful verification and certification of the emission reduction/removal has been achieved by the project. This is called *ex-post* crediting. It assumes that credits correspond to emission reduction/removal above a per–established baseline scenario and that each of these credits corresponds to one tonne of CO_2e permanently removed or avoided.

Given the temporary nature of forest carbon, some have proposed various credit certification mechanisms to reflect the non-permanent nature of forest credits, creating a different carbon commodity that takes into account the risk of non-permanence. This has led to the creation of temporary credits (tCERs) and long-term credits (lCERs), two different types of non-permanent credits issued for forestry projects under the Clean Development Mechanism (CDM).

To address the fact that forest carbon sinks can only absorb a limited amount of carbon per year and therefore only generate a relatively small amount of reductions/removals per year in comparison to other project types, others have proposed mechanisms to issue credits before emission reductions actually occur, namely *ex-ante* crediting. Accordingly, *ex-ante* crediting allows project proponents to obtain credits based on the expected emission reductions of their project and to commercialize these credits at an earlier time, which may help them effect a shorter payback period.

The following issues and options for addressing them are included in this chapter:

10.1. Temporary credits

- Option: Allowing temporary credits

10.2. *Ex-ante* credits

- Option: Allow *ex-ante* credits

10.3. Length of the crediting period and number of renewals allowed

- Option a: Short crediting period
- Option b: Long crediting period

- Option c: Several renewals of the crediting period
- Option d: No renewals of the crediting period

10.4. Ownership

10.1. Issue: Temporary credits

Many interested parties have suggested that the particularities of forest management projects (and of carbon sink projects in general) may raise the need to come up with specific crediting approaches or mechanisms. As explored in chapter 6. Permanence, forestry credits are subject to a number of risks that may compromise the permanence of the removal/reduction generated by forest management projects. This has led some offset systems, notably the CDM, to issue only temporary credits to mitigate the impacts of a re-emission. Others have proposed that forest credits could be made "permanent" by placing a discount on the amount of credits issued to forest management offset projects to account for potential re-releases.

10.1.1. Options

Option: Allowing temporary credits

Temporary crediting is one of the options discussed in Chapter 6. Permanence to reduce the risks and liability involved in a reversal of carbon to the atmosphere. The CDM has allowed for the issuance of temporary credits for forest carbon projects, as it was deemed to be a more environmentally credible approach for taking into account the permanence issue associated with forest carbon. In addition, temporary credits such as tCERs eliminate the need for creating other mechanisms to deal with the non-permanence risk. Because many of these options place a share of the non-permanence on the offset system authority, issuing temporary credits is less risky for the offset system authority.

The disadvantage of temporary crediting is that it creates a new commodity that is not fully commercially fungible with permanent credits. Purchasing a temporary credit allows the buyer to simply delay his or her reduction obligation for the lifetime of the credit, after which the buyer has to replace the temporary credit with another one (usually a permanent credit). Therefore, the price of temporary credits is generally lower (Neeff and Henders 2007). Achieving a reduction objective with temporary credits could be more burdensome for compliance buyers, as they have to track the lifetime of the temporary credits they purchase and replace them upon expiration. This may explain why there is a relatively low demand for temporary credits on global carbon markets (S. Carney, pers. comm.).

10.1.2. Evaluation

The preceding option is presented in Table 19 and analyzed according to the evaluation criteria presented in Chapter 4.

TABLE 19: EVALUATION OF TEMPORARY CREDITS

Option	Pros	Cons
Allowing temporary credits	• May be an efficient strategy to mitigate risks of reversal • Puts less risk on the offset system authority • Provides regulated emitters with an additional, flexible compliance strategy • Helps preserve environmental integrity of the system	• Low demand in global carbon markets because the commodity is not fully fungible with permanent credits • Using temporary credits for compliance is more complex

10.1.3. Conclusions

Issuing temporary credits for forest-based carbon projects helps preserve the environmental integrity of the system because it accounts for the non-permanent nature of forest sinks. This may also be an efficient way to mitigate risks of non-permanence.

10.2. Issue: *Ex-ante* credits

Forest management projects in Canada will take a considerably longer time to generate emission reductions/removals than other types of offset projects. This feature makes it more difficult to finance forest management offset projects, especially if a project requires BAU timber extraction to be delayed.

Given that forestry projects often require high up-front investments and may only yield returns over the long run, some parties who are interested in forest management offset projects have argued for the use of *ex-ante* crediting – that is, the issuance of credits before emission reductions/removals have actually occurred based on anticipated reductions/removals. In effect, it means carbon credits can be generated in advance of the carbon sequestration actually being fully delivered.

Ex-post crediting, which is the norm with respect to crediting, is considered by many to be a more credible, robust approach to credit issuance, helping to preserve the environmental integrity of the offset system. For example, under the Offset Quality Initiative (2008), credits are issued only on an *ex-post* basis, after reductions have been verified, and forward crediting is not allowed.

10.2.1. Options

Option: Allow ex-ante credits

Ex-ante crediting offers the potential to improve the financial viability of forestry offsets, allowing project proponents to reap benefits from selling carbon credits before the reductions attached to them actually occur (S. Carney, pers. comm.; J.-R. Wells, pers. comm.).

Ex-ante crediting also allows regulated emitters to purchase emission reduction credits for reductions that have yet to happen, and use them for compliance. If the market supply of offsets is short, *ex-ante* credits could help keep offset prices low. In addition, because *ex-ante* crediting helps shorten the payback period for projects, such mechanisms could make smaller forestry projects more economically viable.[49]

On the other hand, *ex-ante* crediting would require the offset system authority to assume a much higher risk (S. Carney, pers. comm.). Indeed, because credits would be issued and could be traded before the reductions attached to them actually occur, the program authority would likely be ultimately liable for ensuring that the reduction actually occurs at a set date. The offset system authority could, however, transfer part of that risk back to the market, notably by requiring that project proponents provide insurance that the reductions they get credit for in advance will actually occur, or if not, will be replaced.

Another avenue would see forestry project proponents accepting a much lower price for the *ex-ante* credits, so that the buyer self-insures in the event of some future credits not being realized and having to cover that position in the marketplace. It is likely that a mature offset marketplace will self-correct through lower prices for the risk associated with *ex-ante* credits. However, this type of price-based correction might not bring the type of credit prices that forestry project proponents would like.

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[49] *Ex-ante* crediting has not yet penetrated compliance-based offset schemes, but the CarbonFix and Plan Vivo standards aimed at the voluntary market allow for *ex-ante* crediting of certain forestry projects. These are not widely used standards to date. The VCS allows only *ex-post* crediting.

The question of the liability of the program authority could at least partially be answered by having the *ex-ante* credit buyer sign a legal agreement accepting complete responsibility for replacement of credits not delivered and pay an insurance premium to the program authority to cover the risk of not being there to replace credits when needed to do so. The fundamental problem would likely be in the short term, in the immature offset marketplace situation in which some buyers take a "worry about it tomorrow" approach in response to the lure of a lower-priced offset credit.

However, it could be difficult for project proponents, insurers, or other insurance mechanisms to compensate losses from a project if offset prices have risen significantly since the time of *ex-ante* crediting and sale. Insurers, or the program authority, might be unwilling or unable to accept all these risks and might also find such a system particularly difficult to manage across generations of projects of different sizes and uncertain risk levels. These problems could be aggravated by an unforeseen change in risk factors as a result of climate change (increase in fires and pests). The further in advance credits are awarded, the greater we can expect these problems to be.

Ex-ante crediting that is limited to forestry or soil sequestration projects would place them in a separate category, creating a competitive advantage over offsets from other sectors in the very competitive offset marketplace. If *ex-ante* crediting is allowed for forestry projects, proponents of other project types will request that they too be allowed to claim *ex-ante* credits. In this situation, the prices for non-forestry *ex-ante* credits would likely be higher because of the lower risk associated with them. A proper-functioning offset marketplace will be one where the marketplace is allowed to price the risk associated with an offset credit.

It is important to note that *ex-ante* crediting raises a fundamental environmental question – that is, whether a reduction that occurs today is more important than a reduction that occurs in the future. *Ex-ante* crediting simply takes for granted that future reductions have the same climate impact as reductions that occur today, a claim that some would argue against.

10.2.2. Evaluation

The preceding option is presented in Table 20 and analyzed according to the evaluation criteria presented in Chapter 4.

TABLE 20: EVALUATION OF *EX-ANTE* CREDITS

Option	Pros	Cons
Allow *ex-ante* crediting	• Would make forestry projects more financially viable • Could lower prices of offsets in the short term, as it increases supply • Leverages the power of a properly functioning offset marketplace to factor risks into pricing	• Project proponent would likely have to pay in the marketplace for the risk of future replacement • Affects environmental integrity of the system by creating reductions that are not "real" • Creates a potentially important and hard-to-quantify risk to the program authority and to offset credit buyers • Allowing only *ex-ante* crediting for forestry projects would be inequitable

10.2.3. Conclusions

Ex-ante crediting for forestry projects would help bring more projects to market, as it would allow developers to obtain the carbon benefits of their project before they actually occur. Some mechanisms could potentially be created to insure the risks that these reductions never actually occur, but these mechanisms do not as yet exist. Or buyers could self-insure by offering lower prices for *ex-ante* credits and signing a legal agreement to that effect with the program authority, along with contributing to an insurance fund for replacing credits.

The party that would have to accept the cost of addressing most of this risk is the project proponent; the cost would come in the form of a lower price for *ex-ante* credits. The supply/demand situation would be much like that for temporary credits: extremely weak, because the product would be viewed as unattractive by prospective offset buyers (vis-à-vis more attractive alternatives).

On the other hand, *ex-ante* crediting could harm the environmental integrity of the offset system, as it accounts for reductions/removals that have yet to happen. To date, the attribute of "real" reductions/removals has been a fundamental element in offset systems, but a "futures" market approach could also develop when a large American offset marketplace opens up. It is not known when thinking on an offset futures market will appear, given that many basic offset concepts are still being worked on today.

Advanced payments are possible under offset buying contracts, but the payments are still made on the basis of the project proponent delivering *ex-post* credits. They do not become official credits until the reduction/removal enhancements have occurred and been verified. The advanced payment option is a typical risk issue between contractor and contractee. A basic tenet of offset projects has been the use of verified credits – that is, reductions and removals that have already occurred. The well-established alternative of advanced payment would provide a basis for encouraging worthwhile projects while avoiding the problems of *ex-ante* credits.

Ex-ante crediting is possible within a mature offset marketplace, but very likely only on the basis that the option is available to proponents of and buyers from all types of offset projects.

10.3. Issue: Length of the crediting period and number of renewals allowed

A third issue pertains to the crediting period for which a given project can claim credits. That period also implies that the applicable baseline scenario is valid throughout – that is, the baseline is static (see 6. Baselines and Incrementality). The intent is to provide a stable baseline for a set period of time, so that investments and commercial models can be implemented with a fair degree of certainty. In the Alberta Offset System, the credit duration period is set at 60 years for afforestation projects, or three 20-year cycles of planting/harvests, because of the slow project offset generation cycle times. The American Carbon Registry suggests a crediting period of 35 years for an afforestation project, but 10 years for reduced deforestation and forest degradation projects (WinRock International 2009). The VCS also proposes that baselines be reassessed at least every 10 years (VCS 2007).

The length of the crediting period will have implications for the environmental integrity and economic efficiency of the scheme. Indeed, the length of the crediting period determines how long the baseline scenario is valid for and, consequently, how long a given forest management offset project generates reductions that are incremental.

10.3.1. Options

Option a: Short crediting period

A shorter crediting period could help maintain the environmental integrity of the system but might be an impediment to investment decisions.

Option b: Long crediting period

A longer crediting period would give project proponents more economic certainty, but could end up crediting activities that generate non-incremental reductions if baseline conditions evolve but are not adjusted.

Option c: Several renewals of the crediting period

Allowing for a renewal of the crediting period would offer project proponents the possibility of obtaining a revenue stream for a longer period of time, while allowing for baseline revision at the end of each crediting period. Such an approach could be environmentally robust and economically efficient if forest management activities remained incremental once the baseline scenario was revised. The possibility of renewing the crediting period helps provide project proponents with economic certainty while reducing the need for long crediting periods.

Option d: No renewals of the crediting period

On the other hand, some offset systems allow project proponents to opt for a longer crediting period with no possibility of renewal. While this option gives proponents certainty about their baseline scenario for a longer period, it does not allow them to reap additional economic benefits once the crediting period is over. This option could be advantageous for proponents, who would be able to anticipate that their activity will no longer be judged incremental at the end of the crediting period. It would also reduce the burden of revising the baseline several times.

10.3.2. Evaluation

The preceding four options are presented in Table 21 and analyzed according to the evaluation criteria presented in Chapter 4.

TABLE 21: EVALUATION OF CREDITING PERIOD OPTIONS

Options	Pros	Cons
Option a: Short crediting period	• Baseline more easily adapted to reflect reality, making this approach more environmentally robust	• Reduced economic certainty for project proponents, and more so if renewals are allowed • Less profitable for project proponents as revenues
Option b: Long crediting period	• Project proponents have more economic certainty • Generates more benefits for project proponents	• Reduced environmental robustness, as baseline is subjected to change during the crediting period
Option c: One or several renewals of the crediting period	• More economically attractive to project proponents • May be more environmentally robust because it allows for periodic revisions of the baseline scenario	• Increased administrative burden for offset system authority, as it has to approve revised baselines • Increases costs for project proponents, as it requires baseline revisions
Option d: No renewals of the crediting period	• Administratively simple	• Less economically viable for project proponents

10.3.3. Conclusions

Allowing for long crediting periods would give project proponents more economic certainty and could make their projects more viable. Yet long crediting periods could compromise the environmental integrity of the system if the baseline is susceptible to change during that period. Shorter crediting periods could be more environmentally robust if the baseline scenario is expected to change during the crediting period, but would be less financially attractive to proponents. This dilemma could be solved by allowing for one or several renewals of the crediting period, conditional to a revision of the baseline scenario.

Although asking proponents to revise their baseline scenario prior to renewing the crediting period might be burdensome and costly for them, this could be a good way to balance environmental integrity and economic viability.

10.4. Issue: Ownership

Finally, it is important to consider the issue of ownership of offset credits. A clear, legal claim to reductions/removals generated by a project is required to reduce investment risk and provide the certainty necessary to manage offsets. However, in the case of forest management in Canada, a number of competing claims to title of removals and associated offset credits can arise on private and Crown land. Some Australian states have provided for a "carbon right" that can be registered against the land. In Canada, it is likely that contractual agreements between potential claimants will be needed, at least in the short term, where there is some likelihood of more than one interest.

Analyzing the different ways in which clear ownership can be arrived at is beyond the scope of this project. From a protocol development standpoint, there should be a requirement for "clear ownership." All protocols aimed at compliance-based offset systems require that ownership issues be clearly resolved before a project is undertaken. For example, the *Alberta Offsets Guidance Document* states that "legal ownership of the GHG reductions and removals must be established by contract or other legal agreement in order to qualify under the Alberta system". The document also calls for the verifier to look for "…evidence that the project proponent owns the stated portion, or whole of the emission reduction claim". BC's *Emission Offsets Regulation* requires "an assertion by the proponent that the proponent…has a superior claim of ownership of the reduction to that of any other person".

The ownership of harvested wood products (HWP) is an important, specific issue that has implications for accounting and crediting. In the event that forest owners, timber purchasers, or end consumers are allowed to claim credits for HWP, provisions will be required to avoid double-counting (i.e., to ensure that offsets are unique).

To help ensure that HWP credits are unique, the Chicago Climate Exchange (CCX) aggregators must establish contractual agreements with CCX-enrolled forest land owners that provide that carbon rights from long-lived HWP will be exclusively traded through the respective aggregator. Timber purchasers may acquire these rights from landowners provided that this can be documented according to chain of custody documentation. Long-lived HWP carbon rights cannot be transferred beyond the timber producer at this time (FCSC 2008). Some interviewees felt that allowing both producers and consumers to claim credits for HWP would greatly complicate accounting (K. Plourde, pers. comm.; J. Williams pers. comm). To avoid double-counting, the program authority could take it upon itself to decide on which parties will be allowed to claim HWP credits.

SUMMARY OF ISSUES AND OPTIONS

Issue	Options
5. Baselines and Incrementality	
5.1. Baseline duration	a: Static baseline b: Dynamic baseline
5.2. Baseline establishment	a: Projection b: Historical baseline c: Average carbon stock d: Performance standard e: Adjusted or normalized
6. Permanence	
6.1. Assessing and measuring risk of reversal	a: Macro-level risk assessment b: Micro-level risk assessment c: Quantitative risk assessment d: Qualitative risk assessment
6.2. Liability for reversal	a: Project proponent b: Forest land (owner) c: Buyer d: Aggregator e: Program authority f: Private third party
6.3. Managing risk of reversal	a: Insurance b: Reserves and buffers c: Discount on forest management credits
6.4. Due diligence	a: Risk management systems and procedures b: Eligibility requirements c: Geographical diversification
6.5. Addressing permanence at project end	a: Permanent commitment b: 100-year contract c: Long-term contracts (25-year evergreen agreement) d: Flexible contracts and opting out e: Temporary credits
7. Measurement and Monitoring	
7.1. Carbon pool selection	a: Only required pools are verified b: Protocol developer discretion in selecting optional pools for verification c: All pools required subject to a materiality consideration

7.2. Crediting of carbon storage in harvested wood products	a: Exclude HWP as a carbon pool b: UNFCCC 100% emission rule c: Include HWP as a carbon pool
7.3. Requirements for measuring forest carbon	a: Detailed prescription of measurement and monitoring methods b: Flexibility in choice, but modelling for estimations required c: Full flexibility in measurement and monitoring options d: Outcome-based approach
8. Leakage	
8.1. SSR identification •	a: Require projects to include all controlled SSR b: Require projects to monitor and report all controlled SSR c: Require projects to monitor and report all associated SSR
8.2. Market effects •	a: Mitigate market leakage through eligibility criteria b: Measure and discount market leakage c: Include HWP as a carbon pool
8.3. Ecological processes	a: Mitigate ecological leakage through eligibility criteria b: Measure and discount ecological leakage
9. Verification	
9.1. Clarity and comprehensiveness of verification guidance	a: Make verification requirements more comprehensive b: Emphasize professional reliance
9.2. Inclusion of a recognized professional forester on verification teams	a: Require verification teams to include a recognized professional forester b: Leave decisions about composition of the verification team to the verification body and project proponents
9.3. Verification period	a: Top-down approach for establishment of the verification period b: Bottom-up approach for establishment of the verification period
10. Crediting	
10.1. Temporary credits	Allow temporary credits
10.2. *Ex-ante* credits	Allow *ex-ante* credits
10.3. Length of the crediting period and number of renewals allowed	a: Short crediting period b: Long crediting period c: Several renewals of the crediting period d: No renewals of the crediting period
10.4. Ownership	

LIST OF ABBREVIATIONS USED

BAU – business as usual

CAR – Climate Action Reserve

CCX – Chicago Climate Exchange

CDM – Clean Development Mechanism

CH_4 – methane

ERU – emission reduction units

ETS – emission trading scheme

EU ETS – European Union Emission Trading Scheme

FFMOP – Framework for Forest Management Offset Protocols

FIA – US Forest Service Forest Inventory and Analysis Program

FMA – Forest Management Area

GGRTA – *Greenhouse Gas Reduction Targets Act* (British Columbia)

HWP – harvested wood products

IPCC – Intergovernmental Panel on Climate Change

ISO – International Organization for Standardization

lCERs – long-term credits

LRSY – long run sustainable yield

MAI – mean annual increment

RGGI – Regional Greenhouse Gas Initiative

SSR – sources, sinks, and reservoirs

tCERs – temporary credits

VCS – Voluntary Carbon Standard

WCI – Western Climate Initiative

WRI – World Resources Institute

LITERATURE CITED

Alberta Environment (February 2008) *Offset Credit Project Guidance Document, Version 1.2.*

American Carbon Registry(tm) Forest Carbon Project Standard (March 2009) - v.1

BC Ministry of Forests, Resources Inventory Branch (2000) *TFL19 and TFL 35 Inventory Audit.*

Beane, J. et al. (November 2008) *Forest Carbon Offsets: A Scorecard for Evaluating Project Quality*. Manomet Center for Conservation Sciences

Birdsey, R. (July 2006) *Carbon Accounting Rules and Guidelines for the United States Forest Sector*, J Environ Qual 35:1518-1524 (2006). USDA Forest Service.

Black, T. Andrew, Jassal,S. Rachhpal, and Arthur L. Fredeen (November 2008) *Carbon Sequestration in British Columbia's Forests and Management Options.* Pacific Institute for Climate Solutions, University of Victoria

California Climate Action Registry (2007) Forest Certification Protocols, Entities & Projects, Version 2.0. May 2007. <http://www.climateregistry.org/resources/docs/protocols/industry/forest/forestcertprotocol_may2007.pdf>. Consulted on March 28, 2009.

CCBA (December 2008) Climate, Community & Biodiversity Project Design Standards Second Edition.

Chicago Climate Exchange (March 2009) *CCX Forest Carbon Emission Offsets, Annex 1 CCX Carbon Accumulation Tables for Afforestation Offset Projects*.

Climate Action Reserve (September 2007) *Forest Project Protocol Version 2.1*.

Environment Canada (May 2008) *National Inventory Report 1990—2006: Greenhouse Gas Sources and Sinks in Canada.*

Forest Carbon Standards Committee (2008) *CCX Harvested Wood Products Protocol. American Forest & Paper Association*. Available at http://www.forestcarbonstandards.org/CCX_HarvestedWoodProducts.pdf

Galik, C. et al., (October 2008) *A Critical Comparison and Virtual "Field Test" of Forest Management Carbon Offset Protocols Climate Change Policy Partnership*. Nicholas School of the Environment, Duke University.

Graham, P. (August 2003) *Potential options to increase sequestration through incremental forest management actions: key data and research needs for analysis.* Canadian Forest Service, Natural Resources Canada.

Greenhaigh, S., Daviet, F. and Weninger, E. (October 2006) *The Land Use, Land-Use Change, and Forestry Guidance for GHG Project Accounting*. World Resources Institute.

Guay, B. (2008) *Expanding the coverage of ETS and linking to a broader carbon market.* Annex I Expert Group (AIXG) scoping paper. OECD, Paris, France.

Hale, R. (January 19, 2009) *Comments on the Draft Revised Forest Project Protocol*. American Forest & Paper Association.

IEA (2005) *Act Locally, Trade Globally – Emissions Trading for Climate Policy.* OECD/IEA. American Carbon Registry 2009

Intergovernmental Panel on Climate Change (2006) *Guidelines for National Greenhouse Gas Inventories.*

Intergovernmental Panel on Climate Change (2003) *Good Practice Guidance, for Land Use, Land-Use Change and Forestry.* IPCC National Greenhouse Gas Inventories Programme, Technical Support Unit.

IPCC (1997) *Greenhouse Gas Inventory Reporting Instructions, Vol. 1, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Intergovernmental Panel on Climate Change.*

IPCC, 2000 - Robert T. Watson, Ian R. Noble, Bert Bolin, N. H. Ravindranath, David J. Verardo and David J. Dokken (Eds.)

IRMG (an AON Company) (December 2005) *Report tasks 5-9* (RFP 05-0906). Report prepared for Natural Resources Canada, 39p.

ISO (2006) *Greenhouse gases, Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements*. ISO 14064-2.

Keohane, R. and Raustiala, K. (2008) *Toward a Post-Kyoto Climate Change Architecture: A Political Analysis.* UCLA School of Law, Law-Econ Research Paper No. 08-14.

Kurz, W. et al (2008) *Mountain pine beetle and forest carbon feedback to climate change.* Nature 452: 987-990.

Maine Forest Service, Environment Northeast, Manomet Center for Conservation Sciences and Maine Department of Environmental Protection (2008) *Recommendations to RGGI for Including New Forest Offset Categories: A Summary.*

Merger, E. (November 2008) Forestry Carbon Standards 2008 - A Comparison of the Leading Standards in the Voluntary Carbon Market and the State of Climate Forestation Projects. Carbon Positive.

Murray, B.C., B.A. McCarl, and H. Lee (2004) Estimating Leakage from Forest Carbon Sequestration Programs. In Land Economics 80(1): 109-124.

Murray, B. and Olander, L. (2008) Addressing Impermanence Risk and Liability in Agriculture, land Use Change, and Forest Carbon Projects. Policy Brief NI PB 08-01-C, Nicholas Institute for Environmental Policy Solutions, Duke University.

Neeff, T., von Luepke, H., and Schoene, D. (2006) *Choosing a forest definition for the Clean Development Mechanism.* Prepared for FAO.

Neeff, T. and S. Henders, (February 2007) Guidebook to Markets and Commercialization of Forestry CDM projects. Centro Agronómico Tropical de Investigación y Enseñanza, CATIE.

Offset Quality Initiative (July 2008) *Ensuring Offset Quality, Integrating High Quality Greenhouse Gas Offsets Into North American Cap-and-Trade Policy*. The Climate Trust, Pew Center on Global Climate Change, California Climate Action Registry, Environmental Resources Trust, Greenhouse Gas Management Institute and The Climate Group.

Pearson, T., Brown, S., Birdsey, R. (March 2007) *Measurement Guidelines for the Sequestration of Forest Carbon.* US Department of Agriculture Forest Service Northern Research Station General Technical Report NRS-18

Pingoud, K. (September 2008) *Alternative approaches for accounting for HWP*. Presentation to harvested Wood Products in the Context of Climate Change Policies Conference.

Smith, J., Heath, L.; Skog, K. and Birdsey, R. (December 2005) *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States*. US Department of Agriculture Forest Service, Northeastern Research Station General Technical Report NE-343.

United Nations Framework Convention on Climate Change (2006) *Decision 5/CMP.1 Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol.* FCCC/KP/CMP/2005/8/Add.1.

United Nations Framework Convention on Climate Change (UNFCCC) (March 2009). *Do a: Project Activity.* <http://cdm.unfccc.int/Projects/pac/howto/CDMProjectActivity/index.html>. Consulted on March 23, 2009.

UNFCCC Secretariat (September 2008) *Estimation, reporting and accounting of Harvested Wood Products.*

Voluntary Carbon Standard (VCS) (November 19, 2007) *Guidance for Agriculture, Forestry and Other Land Use Projects*. <http://www.v-c-s.org/docs/Guidance%20for%20AFOLU%20Projects.pdf>. Consulted on March 28, 2009.

Wear, D. and Murray, B. (2003). *Federal Timber Restrictions, Interregional Spillovers, and the Impact on U.S. Softwood Markets*. Working paper, Environmental and Natural Resource Economics Program, RTI International.

Willey, Z., and B. Chameides, editors. 2007. Harnessing Farms and Forests in the Low Carbon Economy. Duke University Press, Durham, NC.

Williams 2009; Jeremy Williams, pers. comm.

WinRock International's Environment Group (March 2009) *The American Carbon Registry Forest Carbon Project Standard*, Version 1.

World Resources Institute and World Business Council for Sustainable Development (November 2005) *GHG Protocol for Project Accounting.*

Additional References

Alberta Climate Change (September 2007) Specified Gas Emitters Regulation. Quantification Protocol for Afforestation Projects Version 1. Alberta Environment.

Boudewyn, P; Song, X; Magnussen, S; and Gillis, M (2007) *Model-based, volume-to-biomass conversion for forested and vegetated land in Canada BC. Information Report – BC-X-411*, Natural Resources Canada Canadian Forest Service Pacific Forestry Centre Victoria.

Boyland, M. (2006) *The economics of using forests to increase carbon storage.* Can. J. For. Res. 36: 2223-2234.

CCX Chicago Climate Exchange (March 2009) *CCX Forest Carbon Emission Offsets, Annex 1 CCX Carbon Accumulation Tables for Afforestation Offset Projects*.

Environment Canada (March 2008) *Turning the Corner, Taking Action to Fight Climate Change.*

Graham, P. and Simpson, B. (August 2008) *Offset System Quantification Protocol for Afforestation Projects, Draft #7*. Natural Resources Canada.

Greig, M. and Bull, G. (January 2009) *Carbon Management in British Columbia's Forests: Opportunities and Challenges*. FORREX Series 24,

http://ec.gc.ca/doc/virage-corner/2008-03/pdf/572_eng.pdf

Moura Costa, P., M. Stuart, M. Pinard and G. Phillips (1999) *Elements of a certification system for forestry-based carbon offset projects*. In: *Mitigation and Adaptation Strategies for Global Change* (2000).

Olander, L. (May 2008) *Designing Offsets Policy for the U.S.* Nicholas Institute for Environmental Policy Solutions, Duke University.

Partridge, C. and Bernath, S. (2008) *Forest Sector Workgroup on Climate Change Mitigation Final Report.* WA Dept. of Natural Resources and WA Dept. of Ecology.

The California Climate Action Registry (March 2009) *Verification Accreditation.* <http://www.climateregistry.org/tools/verification/verification-accreditation.html>. Consulted on March 28, 2009.

United Nations Framework Convention on Climate Change (August 2003) Requirements for CDM Designated Operational Entities. <http://cdm.unfccc.int/Reference/Guidclarif/accr_req.pdf>. Consulted on March 25, 2009.

Vine, E., Sathaye, J., Makundi, W. (1999) *Guidelines for the Monitoring, Evaluation, Reporting, Verification, and Certification of Forestry Projects for Climate Change Mitigation.* Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory.

Voluntary Carbon Standard (VCS) (18 November 2008) Tool for AFOLU methodological issues. <http://www.v-c-s.org/docs/Tool%20for%20AFOLU%20Methodological%20Issues.pdf>. Consulted on March 27, 2009.

APPENDIX: INTERVIEWEES

The following persons were interviewed either singly or in groups for this project. Each provided excellent information and the authors are very appreciative of the time and expertise that they devoted to this project. The opinions in this framework are, however, those of the authors and not of the interviewees.

Name	Organization	Location
Pierre Boileau	Manager, Climate Change, Canadian Standards Association	Ottawa, ON
Jeremy Williams	Consultant	Toronto, ON
Gary Bull	Associate Professor of Forestry, University of British Columbia	Vancouver, BC
Ken Plourde	Director of Forest Strategies, Alberta-Pacific Forest Industries (Alpac)	Boyle, AB
Mark Johnston	Senior Research Scientists, Saskatchewan Research Council	Saskatoon, SK
Thomas White	Manager, Water and Air Monitoring Reporting, BC Ministry of Environment	Victoria, BC
Mark Bettle	Director, Corporate Planning, JD Irving	St. John, NB
Tony Lemprière	Chief, Climate Change Policy, Canadian Forest Service	Vancouver, BC
Peter Graham	Senior Economist, Canadian Forest Service	Vancouver, BC
Todd Frank	Program Manager, GHG Verification Services, Scientific Certification Systems	San Francisco, CA
Isabelle Landry	Responsable des programmes en environnement et en SST Auditrice responsable d'équipe Bureau de normalisation du Québec	Quebec City, QC

Hélène Lahaie	Auditrice Bureau de normalisation du Québec	Quebec City, QC
Jean Roy	Forest auditor Bureau de normalisation du Québec	Quebec City, QC
Rosanne Van Shie	WLFN Economic Development	Temiscaming, QC
Karen Haugen-Kozyra	Acting Director, Policy Development and Offsets Solutions Team, Climate Change Central	Calgary, AB
Tanya Maynes	Program Manager, Climate Change Central	Calgary, AB
Mike Kennedy	Senior Resource Economist, Pembina Institute	Edmonton, AB
Jean-Robert Wells	Chargé de projet Chaire de recherche en Éco-Conseil Université du Québec à Chicoutimi	Chicoutimi, QC
Jean-François Boucher	Chercheur Consortium de recherche sur la forêt Chaire de recherche en Éco-Conseil Université du Québec à Chicoutimi	Chicoutimi, QC
Sean Carney	Cantor Fitzgerald CO_2e	San Francisco, CA
John Nickerson	California Climate Action Registry	Los Angeles, CA
Derik Broekhoff	Policy Director, California Climate Action Registry	Los Angeles, CA
Paul Lansbergen	Association Secretary and Director, Energy, Economics and Climate Change, Forest Product Association of Canada	Ottawa, ON