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ADMINISTRATION AND TRANSACTION COST ESTIMATES FOR A GREENHOUSE GAS OFFSET SYSTEM

-- Final Report --

Submitted to:

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Submitted by:

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In Association with:

PricewaterhouseCoopers
and
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EXECUTIVE SUMMARY

BACKGROUND AND OBJECTIVES

A key part of Canada's Climate Change Plan is to provide Large Final Emitters (LFEs) with the option to meet their emission reduction targets through the purchase of domestic GHG offset credits. A Discussion Paper, outlining core design elements and features of a potential domestic GHG offset system was released in June, 2003.

The objectives of this study were to:

- Identify and estimate potential transaction costs (to proponents) associated with participating in an offset system.
- Identify and estimate potential administration costs (to the government and/or program authority) associated with setting up and operating an offset system.
- Suggest ways that administration and transaction costs may be reduced through design options.

METHODOLOGY

This study examines administration and transaction costs associated with GHG emission reduction or removal projects involving agriculture, forests, landfill gas capture, renewable energy, energy efficiency, and other types, within a potential domestic offset system. The breakdown of potential costs is presented in Table E.1.

Table E.1
Breakdown of Administration Costs and Transaction Costs Elements

Category	Administration Cost Elements	Transaction Cost Elements
One-Time Costs	• Set-Up Program Authority • Develop Legal Framework • Develop Protocols and Guidance • Public Consultation on Protocols • Establish Accreditation Process • Establish Dispute Resolution Process • Establish Project Registry	• Project Evaluation • Project Initiation • Project Proposal • Proposal Validation
Ongoing Costs	• Base Operating Costs • Conduct Oversight/Audit • Operate Registry	• Emission Reductions/ Removals Monitoring and Quantification • Emissions Reductions/ Removals Verification • Required Replacement (if applicable)

The WGO identified a series of design options, which were refined over the course of this study. The options are meant to define alternatives, which are broadly framed as either:

- *Limited* – options involving limited scope and rigorous eligibility requirements - may be expected to increase costs
- *Broad* – options that maximize participation - may be expected to decrease costs
- *Medium* – options that feature aspects of both limited and broad scenarios.

Three scenarios – limited, medium and broad – were established (see Table 3.1 or Appendix C) dealing with the following design options:

- *Scope* – whether to include other sectors, renewable energy and energy efficiency projects
- *Transition* – whether the eligibility of projects types should be phased in
- *Baselines, Boundaries and Quantification (BB&Q)* – the degree of precision and complexity for dealing with these measurements and calculations
- *Verification* – whether to require annual or five-year monitoring and verification
- *Pooling* – whether to allow pooling
- *Surplus* – whether to require that projects demonstrate that emission reductions/removals are surplus to federal climate change measures and regulations only or to those of other governments as well
- *Pre-2008* – whether to allocate potentially discounted credits for reductions/removals during the pre-2008 period for use in the 2008-12 period
- *Non-permanence* – whether to incorporate the concepts of required replacement and/or temporary credits along with risk management
- *Ownership* – whether to specify ownership in legislation or leave ownership to be addressed solely through private contracts.

Through a series of interviews and review of existing references, the project team assembled a range of cost estimates for each element under the different scenarios. We then compiled these estimates into overall estimates of the total costs and per tonne costs for both transaction and administration costs. A statistical sampling methodology was used to determine a likely range of potential costs. Both costs and tonnes were discounted to 2002 values.

TRANSACTION COST RESULTS

Average transaction costs per tonne vary over a wide range with design choices and project types, from as much as $19/tonne for independent agriculture projects in a scenario with a high degree of precision and complexity, to as little as $0.05/tonne for landfill gas projects in a scenario with more simplified approaches to quantification, verification and other elements.

ADMINISTRATION COST RESULTS

Compared to transaction costs, total administration costs vary with design choices across a relatively narrow range. None of the design choices affect estimated total administration costs by more than 5 percent.

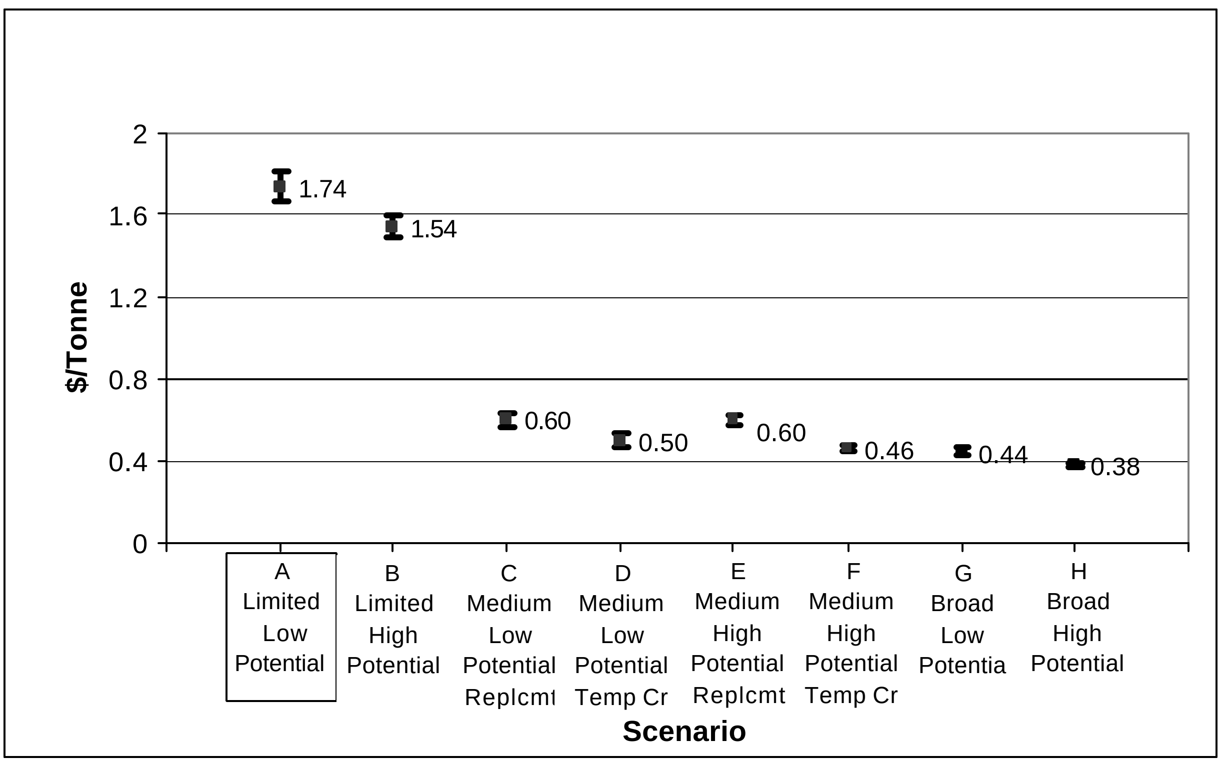
SYSTEM COST RESULTS

Total system costs, the combination of all transaction costs and administration costs, reflect the underlying behaviour of the transaction costs and assumptions concerning the potential for projects. We examined eight cases:

- Two cases based on the limited scenario (low and high potential)
- Four cases based on the medium scenario:
    - Two cases based solely on temporary credits (low and high potential) with a mix of pooling and individual projects
    - Two cases based solely on required replacement (low and high potential) with a mix of pooling and individual projects
- Two cases based on the broad scenario (low and high potential) with a mix of pooling and individual projects.

Results in costs per tonne are presented in Figure E.1

Figure E.1
System Costs (\$/tonne CO_2-e)



IMPLICATIONS FOR THE DESIGN OF THE GHG OFFSET SYSTEM

The analysis suggests that the most significant opportunities to reduce transaction costs are:

- The choice of a broad approach to baselines, boundaries and quantification
- Allow pooling in the forestry and agriculture sectors
- Reducing the frequency of monitoring and verification
- Allowing pre-2008 crediting (although this creates a very large liability to compensate for the increased compliance burden in meeting Canada's Kyoto target).

Although administration costs do not vary significantly between design scenarios, the best opportunities to reduce costs are:

- The choice of a broad approach to baselines, boundaries and quantification
- Allow pooling in the forestry and agriculture sectors.

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1. INTRODUCTION

1.1 BACKGROUND

1.1.1 Canada's Climate Change Plan

Canada's Climate Change Plan includes a range of proposed measures and programs to deliver a reduction of 240 MT in GHG emissions needed to meet our Kyoto target. Included in the Plan is an accounting of GHG offsets associated with emission reductions and removals in agriculture, forestry and landfills.

Another key part of Plan is to seek 55 MT of emission reductions from Large Final Emitters (LFEs) through covenants, with a regulatory or financial backstop. To provide LFEs with flexibility to meet their targets in the most efficient way, it is planned to provide them access to emissions trading, international permits, and domestic offsets.

The remainder of the Plan involves a range of instruments, including targeted measures in transportation, buildings, small and medium-sized enterprises, and renewable energy and cleaner fuels.

1.1.2 The Proposed GHG Offset System

A Discussion Paper, outlining core design and administration elements of a potential domestic GHG offset system was released in June, 2003 and was the subject of consultations with provinces/territories and stakeholders. An interdepartmental Working Group on Offsets (WGO) is considering the results of the consultations and developing an Offsets Design Paper which will be available to provinces/territories and stakeholders for comment.

The Discussion Paper suggests a system that will enhance market liquidity; be as open as practical; contribute to achieving Canada's Kyoto commitment; create an incentive for investment in Canada; and provide appropriate economic signals. While this implies a need to minimize administrative complexity, it also suggests that trade-offs may be required between these objectives.

The Discussion Paper also outlines potential eligibility criteria, including, inter alia, a need for real, measurable and verifiable reductions/removals and a need to demonstrate that reductions/removals are surplus to reductions/removals that might reasonably be expected to be achieved due to regulations and climate change measures. Application of these criteria are among the significant challenges that may influence both administration and transaction costs.

The Paper deals with some of the other important design issues, including definition of baselines, identification of project boundaries, treatment of positive and negative emissions leakage outside project boundaries, and dealing with the non-permanence of removals projects. How the system deals with these issues will also have important implications for administration and transaction costs.

Although the system will be a generic one, it is anticipated that each sector will present its own challenges in implementation. For example, in the case of forest carbon projects, baseline determination is expected to be a major challenge for some types of projects. In the case of agriculture, the option to allow pooling could be an important feature of the market. For renewables and energy efficiency, determination of the baseline fuel to be replaced/reduced will be key. These challenges and the options to deal with them are likely to have the greatest influence on administration and transaction costs for the various project types

The governance of the system could take a variety of forms, including hybrid public-private models. The Discussion Paper identifies four main functions that will be part of the administration of the system, including (1) the initial design and ongoing adjustment of the system; (2) review process; (3) dispute resolution; and (4) offset system registries. Each of these functions will entail effort and costs that together represent the administration costs of the system.

1.2 OBJECTIVES

To make informed decisions, the government requires better information on the nature and extent of administration and transaction costs and the implications of different design options, including their effect on these costs.

The objectives of this study were to:

- Identify and estimate potential transaction costs associated with participating in an offset system.
- Identify and estimate potential administration costs associated with setting up and operating an offset system.
- Suggest ways that administration and transaction costs may be reduced through design options.

1.3 REPORT CONTENT AND ORGANIZATION

The remainder of this report is organized as follows:

- Section 2 describes the methodology used to estimate and compile the costs, including the breakdown of cost elements and definition of the key design options and cost drivers.
- Section 3 documents the estimates of transaction costs
- Section 4 documents the estimates of the administration costs
- Section 5 presents the estimates of overall system costs and conclusions on opportunities to reduce transaction and administration costs.

2. METHODOLOGY

2.1 PROJECT TYPES

This study examines administration and transaction costs associated with GHG emission reduction or removal projects involving agriculture, forests, landfill gas capture, renewable energy, energy efficiency, and other.

The following project typology is used.[1]

Table 2.1
GHG Offset Project Typology

Forests	GHG Removals	Afforestation Reforestation Forest Management
	GHG Reductions	Avoided Deforestation Forest Management[2]
Agriculture	GHG Removals	Cropland Management • Increase No-Till • Decrease Summer Fallow • Increase Permanent Cover • Agro-forestry, Shelterbelts, Plantation Forests Grazing Land Management • Improved Grazing
	GHG Reductions[3]	Crop Nitrogen Management • Crop Nutrient Management Livestock • Feeding Management • Manure Management
Fugitive Emissions	Landfill Gas	Landfill Gas Capture & Flaring
Energy	Energy – Renewables	Small Hydro Wind Biomass Landfill Gas Capture & Use
	Energy Efficiency	Buildings Other DSM
Other	Transportation	Fuel Switching Engine Efficiency Haulage Efficiency Other DSM
	Waste Management	Waste Prevention and Recovery
	Products	Recycling and Reuse

[1] Adapted from World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) GHG Protocol Initiative *Project Typology: Defining Reduction Projects*, Draft December 2002. Projects that would typically be implemented by Large Final Emitters have been omitted and the remainder reorganized to conform to the main project types identified in the Offset System Discussion Paper.
[2] For the purposes of this study, forestry management projects for emission avoidance are not considered.
[3] Because it is anticipated that emission removal projects will constitute over 85% of agriculture projects, the focus of this study is on transaction costs for these project types. Discussions with experts also suggested that transaction costs for pooled agriculture reduction projects would probably not differ significantly from those for pooled removal projects.

2.2 COST ELEMENTS AND GENERAL ASSUMPTIONS

In order to identify and assess the costs, it is necessary to break down the administration and transaction costs into their key components. This breakdown is based on the initial set of cost examples provided by the WGO but has been refined through a number of iterations based on the results of interviews, the development of additional assumptions (in concert with the WGO) and the development of a better understanding of the significance of each category of cost. The resulting breakdown is presented in Table 2.2.

Table 2.2
Breakdown of Administration Costs and Transaction Costs Elements

Category	Administration Cost Elements	Transaction Cost Elements
One-Time Costs	• Set-Up Program Authority • Develop Legal Framework • Develop Protocols and Guidance • Public Consultation on Protocols • Establish Accreditation Process • Establish Dispute Resolution Process • Establish Project Registry	• Project Evaluation • Project Initiation • Project Proposal • Proposal Validation
Ongoing Costs	• Base Operating Costs • Conduct Oversight/Audit • Operate Registry	• Emission Reductions/ Removals Monitoring and Quantification • Emissions Reductions/ Removals Verification • Management of Non-Permanence

A number of definitions and general assumptions are embedded in this breakdown, including:

- *Transaction.* Transaction refers to the process of taking a project from its inception through to the certification of GHG Offset Credits. It does not refer to the trading of those credits.

- *Transaction Costs.* These are costs, other than project costs, that are borne by the project proponent in completing a transaction.[4]

- *Administration Costs.* These are costs that are borne by the government or Program Authority (PA).

- *Distribution of Costs.* A number of assumptions have been made about the distribution of costs between the PA and the proponents. In principle, these assumptions could be

[4] Project costs are the inherent costs associated with the planning, design and implementation of a project in the absence of a GHG offset system.

changed and the associated costs would move accordingly from one party to the other. For example:

It is assumed that the PA will be responsible for the development of protocols and guidance. Proponents may be encouraged to develop methodologies, however, if those methods are approved, the associated intellectual property would be purchased by the PA. Thus methodology and protocol development is included in administration costs and not transaction costs.

It is assumed that the PA will undertake the validation of project proposals but that the cost of this validation will be fully recovered from the proponents. Thus validation is included in transaction costs and not administration costs.

It is assumed that verification of emission reductions/removals will be done by accredited third parties (managed by the Program Authority), that the cost of operating the accreditation process will be charged to those third parties and that the cost of the verification (including profits and the cost of accreditation of third parties) will be passed on to the proponents. Thus the set-up costs of the accreditation process are included in administration costs, however, the costs of accreditation itself are embedded in the costs of verification, which are included in transaction costs.

2.3 DESIGN OPTIONS AND COST DRIVERS

The WGO identified a series of design options, which were refined over the course of this study. For each option, alternative scenarios were defined, broadly framed as either:

- *Limited* – options involving limited scope and rigorous eligibility requirements - may be expected to increase costs
- *Broad* – options that maximize participation - may be expected to decrease costs
- *Medium* – options that feature aspects of both limited and broad scenarios.

Three scenarios – limited, medium and broad – were established (see Table 3.1 or Appendix C) dealing with the following design options:

- *Scope* – whether to include other sectors, renewable energy and energy efficiency projects
- *Transition* – whether the eligibility of projects types should be phased in
- *Baselines, Boundaries and Quantification (BB&Q)* – the degree of precision and complexity for dealing with these measurements and calculations
- *Verification* – whether to require annual or five-year monitoring and verification
- *Pooling* – whether to allow pooling
- *Surplus* – whether to require that projects demonstrate that emission reductions/removals are surplus to federal climate change measures and regulations only or to those of other governments as well
- *Pre-2008* – whether to allocate potentially discounted credits for reductions/removals during the pre-2008 period for use in the 2008-12 period
- *Non-permanence* – whether to incorporate the concepts of required replacement and/or temporary credits along with risk management

- *Ownership* – whether to specify ownership in legislation or leave ownership to be addressed solely through private contracts.

In order to investigate the effect of these options on transaction and administration costs, we conducted a preliminary screening to identify which options had the most significant impact on each of the cost elements. The results of the screening are shown in Tables 2.3 and 2.4., where an X indicates an impact, either positive or negative.

Table 2.3
Key Administration Cost Drivers

Design Options	Start-Up Costs (except Guidance)	Guidance Documents (and Consultation)	Base Operations	Oversight/ Audit	Operate Registry
Scope		X		X	X
Transition		X			
B,B & Q		X		X	X
Verification				X	
Pooling		X		X	X
Surplus		X			
Pre-2008 Period				X	X
Non-Permanence		X			
Ownership					

Table 2.4
Key Transaction Cost Drivers

Design Options	Initial Project Evaluation	Project Initiation	Proposal and Monitoring Plan	Project Validation	Monitoring & Quantification	Verification	Required Replacement
Scope							
Transition	X			X			
B,B & Q	X		X	X	X	X	
Verification					X	X	
Pooling	X	X	X	X	X	X	
Surplus			X	X			
Pre-2008 Period					X	X	
Non-Permanence	X		X	X	X	X	X
Ownership		X					

The anticipated impact of each option in qualitative terms is as follows:

- *Scope* – Will determine whether or not certain categories of projects are included and therefore will affect overall volume of projects and the need for guidance, and in turn will affect oversight and registry.

- *Transition* – In theory, will affect the availability of information and the ability to apply lessons learned. In practice, the phase-in period would likely have to be limited to no more than 2 years since any longer delay would have a significant negative impact on offset revenues. This time is too short to allow for much effective acquisition, dissemination and application of new information and experience. Nevertheless, the PA might be expected to gain a small average cost saving in project validation, which would be reflected in the transaction costs, as well as a small savings in guidance preparation costs. Similarly, there may be some learnings available to proponents through the transition phase that could reduce initial project evaluation costs slightly.

- *BB&Q* – The varying level of effort associated with the limited or broad approach has a significant impact on a wide range of both administration and transaction cost elements.

- *Verification* – These options affect the frequency, and therefore the total cost, of both monitoring and verification activities (which are assumed to coincide). With design options of five-years or annual, the impact is significant.

- *Pooling* – The policy option would provide an opportunity for producers to join a formal entity ("offsets pool"). The pool would be an organized group who adhere to a specified set of Beneficial Management Practices (BMPs) to produce credits in aggregate.[5] The pooling alternative affects the volume of projects thereby affecting the oversight and registry, and adds a small increment to both the administration cost of developing guidance, as well as most transaction costs. However, by increasing the size of projects, pooling has a very important impact on costs per tonne, particularly in reducing the costs associated with BB&Q. Conversely, many of the costs associated with proponent interactions with the Program Authority would be reflected in internal pool costs, including project initiation costs, such as pool set-up.

- *Surplus* – In any scenario, proponents will have to prove that reductions/removals are surplus to federal climate change measures. Adding the requirement to show surplus to provincial or municipal climate change programs and compliance with provincial or municipal regulations will have a very significant impact on project viability, however, the implications for transaction costs are relatively minor, involving a need to demonstrate surplus in project proposals and validation.[6] Our assumption is that most of the burden of establishing the tests for surplus and identifying the programs and regulations of concern will be borne by this PA in preparing guidance rather than the proponents.
- Consequently, there will be an incremental cost to develop Guidance for demonstrating surplus.

- *Pre-2008 Period* – Allocation of pre-2008 credits increases the transaction costs for quantification and monitoring, and verification by adding additional years. Similarly, it

[5] See "Offset System Discussion Paper" for additional information on pooling.
[6] Requiring that reductions/removals be surplus to climate change measures and regulations/operating certificates of all levels of government could also reduce the number of tonnes eligible and therefore the per tonne transaction costs. This effect has not been modelled.

requires the project registry to accommodate those additional years and implies additional oversight. Most importantly, it decreases the overall transaction costs per tonne. *Note: for the purposes of this study, no discounting has been applied to pre-2008 tonnes.*

- *Ownership* – The existence of default rules of ownership is expected to simplify the process of project initiation. Without default rules, more complex contracts involving more potential players will be required to ensure that ownership is clearly established.

- *Non-Permanence* – The potential non-permanence of carbon removals is a fundamental characteristic of forest or agriculture carbon projects (see the discussion in Section 4.C of the *Offset System Discussion Paper*). The cost of addressing non-permanence (addressing both the risk of a loss of carbon, and any actual losses or "reversal" in carbon) is a project cost as opposed to a transaction cost. Nevertheless, the way in which non-permanence is addressed has an impact on transaction costs. Risk management plans are required under all three design option scenarios in this study. If risk management is the only approach used for addressing non-permanence then this suggests that offset rules might place greater emphasis on this activity, with additional costs for the project proposal, monitoring and verification. Two additional modalities for addressing non-permanence are 'temporary crediting' and 'required replacement':

  - With temporary crediting, credits are issued only for a short period and after that time there is an implicit assumption that there has been a complete, 100%, reversal of emissions offsets. No further monitoring or verification is required unless there is a desire to issue new credits for the carbon removal.
  - Under a system of 'required replacement' the credits are valid indefinitely (or a specified long period) and monitoring and verification must continue to be done to show that the carbon remains sequestered. In the event of a reversal only the portion of credits equal to the amount of reversal must be replaced. The replacement liability could be fulfilled through purchase of replacement credits when replacement is required, thereby incurring brokerage fees. Alternatively the potential liability could be fulfilled in advance by obtaining insurance, thereby incurring insurance costs.

  Offset credits issued under a required replacement approach can be fully fungible with credits from emissions reductions in the non-sink sectors, but temporary credits are a different commodity and will have a different (lower) market value (see for example Subak, 2003). Thus while required replacement would have higher transaction costs than temporary credits due to more requirements for monitoring and verification and the transaction costs associated with the replacement if required, the value of the credits would also be higher.

2.4 SOURCES OF COST INFORMATION

2.4.1 GHG Emissions Trading – International Experience and Domestic Pilots

The main international project-based trading initiatives are the Clean Development Mechanism (CDM) and Joint Implementation (JI). JI is less developed than CDM and information on JI project costs are limited at best. The CDM is only in its initial stages of operation and so provides limited information from actual operation. However, there has been considerable effort devoted to the design of the CDM, much of it focused on administration elements.

There are also a number of emission trading or offset pilots and programs, in Canada, the U.S. and other countries, from which to draw information and experience. While these pilots/programs vary considerably in design, collectively they provide a potentially significant source of information on the transaction and administration cost implications of different offset system designs.

Unfortunately much of the available information has limited applicability to a potential Domestic Offset System because of differences in important design features and/or differences in the context in which the system would operate. In particular, the applicability of CDM/JI experience is limited because no projects have gone through the entire UNFCCC-defined project cycle, and the transactions that have taken place have involved a speculative component, which has greatly increased the transaction costs of projects. For example projects funded through the World Bank Prototype Carbon Fund (PCF) or the Dutch Emission Reduction Unit Procurement Tender – Certified Emission Reduction Unit Procurement Tender (ERUPT/CERUPT) have encountered relatively high transaction costs because of the uncertainties associated with the methodology approval process, host country approval, and the immaturity of the international market – in the range of US$150-400K ($210-560K), or US$1.00 ($1.40) per tonne for projects in the order of 100kt/year. In this context, however, it should be noted that these programs began before the carbon market developed and the international rules were finalized, thus they may represent higher than normal costs relative to those expected for future projects.[7] In addition, the costs associated with these programs have decreased over the years with experience and lessons learned.

Similar caveats must also be applied to cost information from the Canadian pilots, GERT and PERT. These pilots were multistakeholder exercises that used the project review process (analogous to the validation phase) as a mechanism for developing quantification and monitoring protocols and other elements of a possible offset system. The nature of the process had a significant impact on the costs of the validation phase, and it was not unusual for total project review costs to exceed $50,000. The lack of standard approaches to baselines and quantification, and uncertainty about a range of issues, including ownership and the surplus requirement also tended to increase costs significantly.

Assuming that the rules are established and that they are relatively clear, it is expected that the transaction costs for projects under an established Canadian GHG Offset System will be significantly lower. Similarly, administration costs should be lower, in particular, because of the opportunity to draw knowledge and lessons learned from the international experience and domestic pilots.

In order to be complete, each sub-section of the Report provides all of the available international and domestic cost information first. Then we draw on this information, commenting on its applicability when necessary, in order to develop the cost estimates we actually use.

[7] All currencies in Canadian dollars unless otherwise noted, in which case Canadian dollar conversion is provided in brackets.

2.4.2 Reference Documents and Interviews

Recognizing the limitations of the international experience and domestic pilots, we nonetheless sought information on the nature and range of transaction and administration costs from a variety of sources.

From the literature, we examined reports and studies dealing with transaction costs, as well as studies on the characteristics of carbon removal projects that would affect those costs. We also examined guides that would illustrate typical project proposal, validation and verification approaches, as well as a standardized project types for emission reduction and removals projects. The list of reference documents is provided in Appendix A.

Because of the limited applicability of published reports on administration and transaction costs, we sought to assemble a more representative information base by drawing on the views of a series of knowledgeable experts in various aspects of the set-up and operation of an Offset System. Because the system is not in place, the views we sought were necessarily speculative, however we provided context and assumptions (including the broad, medium and limited scenarios) that should reflect reasonably well the situation that is likely to exist in the context of a Canadian domestic GHG offset system. The list of interviewees is provided in Appendix B.

2.5 COMPILATION AND CONFIDENCE LEVELS

Because of the uncertainty associated with the anticipated costs and the speculative nature of the exercise, we identified a range of possible costs for each element (*low* and *high*), along with the most likely cost (*mode*).

Unless otherwise specified, our confidence in the range is good, based on a minimum of 3 to 5 sources, who were themselves confident in the selected range and were reasonably consistent. In other cases (noted as *limited confidence*), the sources expressed a relative lack of confidence or there was insufficient information to permit assignment of a "good" confidence level. Nevertheless, a guesstimate of the most likely cost and a representative range has been developed.

The ranges of potential costs are used in the compilation of both transaction costs and administration costs. A Monte-Carlo sampling approach is used to develop a mid-point estimate of the total costs, together with a range, representing a 95% confidence level (this is a theoretical confidence level which is, in reality, compromised somewhat by the uncertain confidence attached to some of our individual element cost estimates). Additional details on the compilation and sampling approach are provided in Appendix D.

3. TRANSACTION COSTS

3.1 INTRODUCTION

Transaction costs are the expenses, which the proponent must incur to complete the project cycle from evaluation to certification of the credits, but do not include costs associated with assessing technical feasibility, project design costs or implementation costs. Most of these are one-time costs and are fixed. Monitoring and verification costs are the exception: these elements can vary according to project size and can be expected to re-occur on a defined schedule.

We examine these costs from the perspective of the various project types listed in Section 2.1, while assuming a generic and representative project for each. We also associate a specific project size for each project type. This illustrative size is based on some very preliminary research conducted by the WGO and the Project Team, with knowledgeable experts in each category. Different project size assumptions are made for individual projects and for pooled projects.

The illustrative project types and sizes are as follows:

- Forests GHG Removal
  - Individual: 1333 Hectares, or approximately 20kt/year of removals
  - Pooling: 120kt/year
- Agriculture GHG Removal
  - Individual: 1400 Hectares, or approximately 1.4 kt/year of removals
  - Pooling: 246kt/year
- Landfill Gas Capture and Flaring: 125kt/year
- Renewable Energy: 100kt/year
- Energy Efficiency: 10kt/year
- Other: 10kt/year.

Together with the WGO, three scenarios – limited, medium and broad – were established by specifying the design options discussed in Section 2.3. The three scenarios are summarized in Table 3.1 (below), and more detail can be found in Appendix C.

Table 3.1
Description of Transaction Cost Scenarios

Option/Scenario	Limited	Medium	Broad
Scope	Agriculture, Forestry and Landfill Gas only	All sectors, except renewables and energy efficiency	All sectors
Transition	Phase-in period	All projects eligible from launch	All projects eligible from launch
BB&Q	More precise approach, with higher cost	Less precise approach, with lower cost	Less precise approach, with lower cost
Verification	Reductions: • Non-expiring credits – annual Removals: • Non-expiring credits – annual	Reductions: • Non-expiring credits – annual Removals: • Non-expiring credits – annual • Temporary credits – 5 years	Reductions: • Non-expiring credits – annual Removals: • Non-expiring credits – 5 years
Pooling	Independent only	Choice of independent or pooling	Choice of independent or pooling
Surplus	Surplus to federal and other government regulations and climate change measures	Surplus to federal regulations and climate change measures	Surplus to federal regulations and climate change measures
Pre-2008 Crediting	No pre-2008 crediting	No pre-2008 crediting	Pre-2008 crediting[8]
Non-Permanence	Risk management and required replacement	Risk management and choice of required replacement or temporary credits	Risk management only
Ownership	Stipulated in legislation	Stipulated in legislation	Determined by private contract

Because the pooling and non-permanence options include choices, there are a potential maximum number of seven different possible cases for forestry and agriculture removal projects (one limited, four medium and two broad) and as few as one scenario for the renewables and energy efficiency projects (that qualify only under the broad option for scope). The full list of illustrative scenarios (with associated project sizes in kt CO_2-e/year) is provided in Table 3.2.[9]

[8] With respect to forest removals, carbon removal prior to 2008 would be expected to be lower. However, for convenience, our estimates assume the project size is constant over the entire period.

[9] While the project size estimates and Mts potential estimates in this report represent the best estimate of government experts, there is still considerable uncertainty around these numbers.

Table 3.2
List of Illustrative Transaction Scenarios Cost Cases

Project Type	Scenario	Project Size (kt/year)	Pooling?	Option for Non-Permanence
Forests	Limited	20	No	Req. Replacement
	Medium	20	No	Req. Replacement
				Temp credits
		120	Yes	Req. Replacement
				Temp credits
	Broad	20	No	Risk Management
		120	Yes	Risk Management
Agriculture	Limited	1.4	No	Req. Replacement
	Medium	1.4	No	Req. Replacement
				Temp credits
		246	Yes	Req. Replacement
				Temp credits
	Broad	1.4	No	Risk Management
		246	Yes	Risk Management
Landfill Gas	Limited	125	No	N/A
	Medium	125	No	N/A
	Broad	125	No	N/A
Renewables	Broad	100	No	N/A
Energy Efficiency	Broad	10	No	N/A
Other	Medium	10	No	N/A
	Broad	10	No	N/A

3.2 PROJECT EVALUATION

Project evaluation refers to the assessment of the business case for the project based on the revenues from GHG offsets. The estimated project evaluation costs could range from as low as $500. to as high as $10K, depending on the project type and choice of design option. The specific costs under each of the scenarios are shown in Table 3.3.

Table 3.3
Project Evaluation Costs ($000)

Scenario	Range	Agriculture	Forestry	Landfill Gas	Renewables	Energy Efficiency	Other
Limited	Low	2	6	1	N/A	N/A	N/A
	Mode	3	8	3			
	High	4	10	5			
Medium - without Pooling – Req. Replacement	Low	1.5	4	0.5			2.5
	Mode	2	6	1			5
	High	3	8	3			10
Medium - without Pooling – Temporary Credits	Low	0.5	3	N/A			N/A
	Mode	1	5				
	High	2	7				
Medium - Pooling – Req. Replacement	Low	2.5	6				
	Mode	5	8				
	High	10	10				
Medium - Pooling – Temporary Credits	Low	2	5				
	Mode	4	7				
	High	8	9				
Broad - without Pooling	Low	1.5	4	0.5	1	1	2.5
	Mode	2	6	1	2	2	5
	High	3	8	3	5	5	10
Broad - Pooling	Low	2.5	5	N/A	N/A	N/A	N/A
	Mode	5	8				
	High	10	10				

Project evaluation costs are one-time, and are largely independent of project size. Project evaluation costs in this context refer only to the assessment of the likely net offset revenues associated with the project; not costs associated with assessment of the technical feasibility of the project. The estimates assume that there are guidance documents, standardized approaches and other information available to assist proponents with project evaluation.

The experience to date with project evaluation has generally been in a speculative environment in which the methodologies for large-scale projects are not standardized and carbon markets are still in a developmental stage. As a consequence, the project evaluation phase has needed to reflect considerable uncertainty in key parameters, and the analysis has had to consider a broader range of possible outcomes. Typical CDM project evaluation costs for the PCF have varied from US$25-40K ($35-55K). In Canada, domestic project evaluation costs associated with the pilot systems have varied from $2-5K for very simple projects to $20K for more complex projects (e.g., forest projects).

In a fully operational offset system with guidance documents and other resources, and simplified approaches to baselines, boundaries and quantification, the project evaluation phase is expected to be relatively low cost. Consequently the range of costs used in the scenarios is close to the costs experienced through the Canadian pilots with simple domestic projects. Project evaluation costs for renewable electricity and energy efficiency projects that use standard emission factors, landfill gas projects, and many agriculture projects are expected to be no more than $2-4K. Project evaluation costs for more complex forest projects and some other (e.g., transportation) projects are expected to be higher and may range from $6-10K.

3.3 PROJECT INITIATION

The two main elements of project initiation costs are associated with:

- Establishing ownership and/or negotiating ownership contracts, and
- Implementing a pooling arrangement for forest and agriculture projects.

The estimated project initiation costs could range from as low as zero to as high as $70K, depending on the project type and choice of design option. The cost ranges for each of the scenarios are shown in Table 3.4.

Table 3.4
Project Initiation Costs ($000)

Scenario	Range	Agriculture	Forestry	Landfill Gas	Renewables	Energy Efficiency	Other
Limited	Low	0	0	0	N/A	N/A	N/A
	Mode	1	2.5	1			
	High	4	5	2			
Medium - without Pooling – Req. Replacement	Low	0	0	0			0
	Mode	1	2.5	1			1
	High	4	5	2			2
Medium - without Pooling – Temporary Credits	Low	0	0	N/A			N/A
	Mode	1	2.5				
	High	4	5				
Medium - Pooling – Req. Replacement	Low	15	10				
	Mode	25	20				
	High	50	40				
Medium - Pooling – Temporary Credits	Low	15	10				
	Mode	25	20				
	High	50	40				
Broad - without Pooling	Low	0	1	2	5	5	5
	Mode	1	5	4	15	15	15
	High	4	25	10	25	25	25
Broad – Pooling	Low	15	10	N/A	N/A	N/A	N/A
	Mode	30	25				
	High	70	65				

The experience to date with establishing ownership has almost exclusively involved private contractual arrangements (broad scenario), often between several parties, rather than the use of default ownership rules specified by legislation/regulation (medium and limited scenarios). Typical legal costs for PCF CDM projects have been in the US$100K ($140K) range. Three Canadian sources were consulted and provided estimates of $20-$50K for legal costs for domestic projects in the current environment. These costs are expected to decrease significantly over time, as standard contracts (such as the ones developed by IETA) come into wider use.[10]

The costs of establishing ownership, in the absence of default rules, are expected to be highest for projects where there may be a number of possible ownership claims – energy efficiency

[10] *Principles for the Canadian Carbon Market*. Government of Canada and International Emissions Trading Association (IETA) Canadian Working Group on the Carbon Market (CWGCM). October 23, 2003.

projects, renewable energy, transportation (other), and some forest projects. The development of standard contracts, broader experience with offset trading, and competition for legal services are expected to reduce legal costs for these projects from the levels seen to date in the international market and in the domestic pilots to between $5K and $15K. Costs for establishing ownership for agriculture projects are expected to be quite low, even in the absence of default rules. Where default rules are in place, the cost of ownership will decrease, depending on how much the rules can reduce the possibility of legal disputes. The impact of default rules for ownership on initiation costs varies by project type. For renewable energy, energy efficiency and other (e.g. transportation) projects, the absence of default rules could add between $5K and $25K. Additional costs would be incurred by entities when contracts are used to redistribute shares. For forestry projects, the difference could be $1-20K, depending on the number of players (governments, lease holders, other companies) and the need to negotiate sharing contracts in pooling scenarios. In the agriculture sector ownership is expected to be straightforward for individual projects, but in pooling scenarios additional costs ($5-20K) would be incurred for contracts used to redistribute shares.

There has been very little experience to date with pooling of activities for the purposes of generating emission offset credits, and little information on which to base estimates of the cost of establishing offset credit pools. Based on interviews with three sources, the costs of establishing pools that were used in the scenarios range between $10K and $65K, and to be generally larger for agriculture pools because of the larger number of entities involved.

3.4 PROJECT PROPOSAL

Development of the project proposal entails describing the project; establishing eligibility, baselines, boundaries, and leakage; quantifying the GHG reduction removals; and developing a monitoring plan and risk management plan (if applicable). The estimated transaction costs for this element could range from as low as $1000 to as high as $100K, depending on the project type and choice of design option. The specific costs under each of the scenarios are shown in Table 3.5

Table 3.5
Project Proposal Costs ($000)

Scenario	Range	Agriculture	Forestry	Landfill Gas	Renewables	Energy Efficiency	Other
Limited	Low	10	25	5	N/A	N/A	N/A
	Mode	15	50	10			
	High	20	100	25			
Medium - without Pooling – Req. Replacement	Low	2.5	10	1			10
	Mode	5	12.5	3			25
	High	10	25	10			50
Medium - without Pooling – Temporary Credits	Low	1.5	5	N/A			N/A
	Mode	3	7.5				
	High	7	15				
Medium - Pooling – Req. Replacement	Low	10	15				
	Mode	15	20				
	High	20	35				
Medium - Pooling – Temporary Credits	Low	7.5	10				
	Mode	12.5	17.5				
	High	17.5	25				
Broad - without Pooling	Low	4.5	10	1	2.5	2.5	10
	Mode	7	12.5	3	5	5	25
	High	12	25	10	10	10	50
Broad - Pooling	Low	12.5	15	N/A	N/A	N/A	N/A
	Mode	17.5	20				
	High	22.5	35				

These are one-time costs, which are largely independent of project size. These estimates assume that project methodology, in the form of guidance documents or protocols are available and, in the case of the medium and broad scenarios, that the guidance specifies the parameters to be used in specifying baselines, boundaries and quantification, and (in the case of forestry) that proponents choose to use the specified parameters. The effect of adopting a broad surplus requirement is incorporated into the cost effect of reduced complexity and precision for BB&Q.

The international experience (PCF, CDM, etc.) suggests costs for this element in the range of US$20K ($28K) (for very simple projects) to US$50K ($70K) (for more complex projects) with a typical cost of approximately US$40K ($55K).[11,12]

Four Canadian sources (involved in pilot programs) provided estimates in the range of $25-50K in a mature system but closer to $50-75K in the early stages, depending on the quality of the guidance provided. Although not specified, these estimates are interpreted as reflecting an "average" level of precision and complexity for BB&Q.

[11] It should be noted that most of the international experience relates to emission reductions rather than removals. Under the CDM rules, simplified methodologies have been developed for a variety of projects under 15 MW (electricity generation), 15GWh/year (energy efficiency), and 15kt (other project types), however no methodologies have yet been developed for emission removal projects.

[12] Unless otherwise noted, all estimates from the international experience are based on: Fichtner et al, Michaelowa et al, Stronzik, Sathaye and PricewaterhouseCoopers (see references – Appendix A).

There is a clear distinction between removals projects, that involve potentially complex calculations and field measurement, and reduction projects, that involve relatively straightforward calculations with standard parameters and minimal measurements.

Agriculture

Four sources were consulted, who quoted cost estimates based on experience to date with project proposal development that ranged from $5K for the simplest projects/approaches to between $50K and $100K for large projects with precise and complex approaches to baselines, boundaries and quantification. Project proposal costs in a fully operational offset system with guidance documents and standardized approaches are expected to be at the lower end of this range of costs.

For the medium scenario used in the analysis, with a simplified approach to baselines, boundaries and quantification and independent projects, the cost range for developing a project proposal was estimated to be in the $2.5-10K range. Pooling is expected to increase costs by $10-20K. Costs for projects involving temporary credits were decreased by $2-3K (to account for reduced requirements for risk management plan and monitoring plan) and costs for the broad option (risk management plan only) are increased by $2-3K (to account for the added reliance on this plan).

Forests

A total of five sources were consulted. For an “average” level of precision and complexity, the estimates range from $15-50K, depending on whether or not accounting of soil emissions is required. For the most rigorous approach, these costs could reach $50-150K and might increase slightly with project size. Using a less precise and complex approach with standard parameters could reduce costs to as little as $5-10K. Projects involving pooling are expected to incur costs that are 10-20% higher in per project terms (but much lower costs per tonne).

The ranges of costs chosen for the various scenarios reflect the ranges provided by the sources minus one outlier at the low end ($5K) and one at the high end ($150K). Costs involving pooling are increased by $5-10K, whereas costs involving temporary credits are decreased by $5-10K (to account for reduced requirements for risk management plan and monitoring plan) and costs for the broad option (risk management plan only) are increased by $5-10K (to account for the added reliance on this plan).

Landfill Gas

A total of three sources were consulted. There was a strong consensus that costs were not likely to exceed $5-10K unless an excessive level of detail was required to estimate the baseline (involving site specific values for the methane generation rate and potential, and detailed modelling) and for the monitoring plan.

A representative range of $1-10K was selected for the broad scenario, weighted to the lower end of the range. Similarly, for the limited scenario, a range of $5-25K was selected with the peak probability at $10K.

Renewables and Energy Efficiency[13]

Four sources were consulted. The consensus was that, for both renewables and energy efficiency, costs were likely to be in the $5K range, unless a precise estimate of the marginal impact of projects on emissions from electricity generation is required.

Since only the broad scenario applies to the renewables and energy efficiency categories, only this lower cost is used ($2.5-10K). It is also worth noting that limited BB&Q could increase these costs substantially (e.g., to $15-25K).

Other Sectors

Three sources were consulted. Because of the many types of possible projects (see Table 2.1), the range of estimates is broad. Furthermore, it is anticipated that most of these projects will require substantial effort in establishing baselines and in dealing with boundaries and leakage issues, even in the broad scenario.

A representative range of $10-50K has been selected but there is only limited confidence in this estimate.

3.5 PROJECT VALIDATION

Project validation entails a review of the Project Proposal by the PA to confirm eligibility, and confirm the accuracy, completeness, and credibility of the Proposal.

The estimated transaction costs for project validation could range from as low as $1000, to as high as $50K, depending on the project type and choice of design option. The specific costs under each of the scenarios are shown in Table 3.6.

[13] Note: Throughout this report, per project transaction costs for renewables and energy efficiency projects are considered to be the same. This reflects the considerable range of project types for each category and the lack of systematic information (as opposed to anecdotal) concerning potential cost differences.

Table 3.6
Project Validation Costs ($000)

Scenario	Range	Agriculture	Forestry	Landfill Gas	Renewables	Energy Efficiency	Other
Limited	Low	7.5	10	2.5	N/A	N/A	N/A
	Mode	10	15	5			
	High	15	50	10			
Medium - without Pooling – Req. Replacement	Low	2	5	1			5
	Mode	4	7.5	2			12.5
	High	6	12.5	5			25
Medium - without Pooling – Temporary Credits	Low	1	2.5	N/A			N/A
	Mode	3	5				
	High	5	12.5				
Medium - Pooling – Req. Replacement	Low	5	7.5				
	Mode	10	10				
	High	15	20				
Medium - Pooling – Temporary Credits	Low	2.5	5				
	Mode	7.5	7.5				
	High	12.5	15				
Broad - without Pooling	Low	3	5	1	1	1	5
	Mode	5	7.5	2	2	2	12.5
	High	7	12.5	5	5	5	25
Broad - Pooling	Low	7.5	7.5	N/A	N/A	N/A	N/A
	Mode	12.5	10				
	High	20	15				

These are one-time costs, which are largely independent of project size. These estimates assume that the validation is undertaken by the Program Authority and charged to the proponent. The limited scenario costs incorporate a small reduction in average costs (5%) to reflect the learning acquired through phased eligibility (however, this reduction is masked by the cost increase due to more precise and complex BB&Q). The effect of adopting a broad surplus requirement is incorporated into the cost effect of reduced complexity and precision for BB&Q.

The international experience (e.g., PCF) for pre-validation suggests costs for this element in the range of US$15K ($21K) (for very simple projects) to US$60K ($85K) (for more complex projects) with a typical cost of approximately US$30K ($42K). These costs assume third-party validation.[14]

Three Canadian sources (involved in pilot programs) provided estimates for the Canadian context in the range of $25-50K in a mature system but closer to $50-75K in the early stages, depending on the quality of the guidance provided. At the time of the interviews, the limited and broad scenarios had not been defined and, therefore, these estimates reflect an "average" level of precision and complexity for BB&Q.

There is a clear distinction between removals projects, that involve potentially complex calculations and field measurement to check, and reduction projects, that involve relatively straightforward calculations with standard parameters and minimal measurements.

[14] These costs reflect the literature quoted previously as well as additional sources in Australia, Netherlands and Canada.

Agriculture

Four sources were consulted. There is relatively little actual experience with validation of agriculture projects. The estimates of agriculture project validation costs provided by the sources ranged from $10-50K, for an “average” level of precision and complexity. However, sources indicated that using a less complex approach with standard parameters could reduce costs to as little as $5-10K. Pooling was expected to increase validation costs by about 25% in total (but be lower in cost per tonne terms).

The ranges of costs chosen for the various scenarios are at the lower end of the observed range, and in some cases are even lower than the estimates provided by sources. This reflects an expectation that eligibility criteria and quantification methods for agricultural removal projects can be highly simplified and that it will therefore be very straightforward to confirm eligibility and to confirm the accuracy, completeness, and credibility of the project proposal. Costs to validate projects involving pooling are expected to be increased by $1.5-9K, because of the need to consider a significant number of farm operations. Costs are expected to increase much less than proportionately with the number of farms, and be considerably lower in per tonne terms than in the independent project scenario. Costs involving temporary credits are decreased by $1-2.5K since there is no requirement to review risk management and monitoring plans). Validation costs for the broad scenario which involves reliance only on a risk management and monitoring plan are expected to be $1-5K higher due to the need for more detailed review of these plans.

Forests

A total of five sources were consulted. For an “average” level of precision and complexity, the estimates range from $10-25K. For the most rigorous approach, these costs could reach $50-75K. Using a less complex and precise approach with standard parameters could reduce costs to as little as $5-10K. Projects involving pooling are expected to incur costs that are approximately 10% higher in per project terms (but much lower costs per tonne).

The ranges of costs chosen for the various scenarios reflect the ranges provided by the sources minus one outlier at the high end ($75K), leaving a range of $10-50K. The range for the limited scenario is influenced by the costs reported from the international experience and Canadian pilots, however the range for the medium and broad scenarios is substantially lower.[15] Costs involving pooling are increased by $2.5-5K in per project terms because there will more information to review/check, whereas costs involving temporary credits are decreased by a similar amount because there is no need to review a monitoring and risk management plan, and costs involving a risk management plan only for non permanence are increased by $2.5K because of the cost of reviewing a more detailed plan.

Landfill Gas

A total of three sources were consulted. There was a strong consensus that costs were not likely to exceed $5K.

[15] It should be noted that pilots may have been designed with objectives other than offset trading – e.g., learning.

Nevertheless a representative range of $2.5-10K was selected for the limited scenario, reflecting the international experience and Canadian pilots. For the broad scenario, a range of $1-5K was selected, more in line with the expectations of sector experts.

Renewables and Energy Efficiency

Four sources were consulted. The consensus was that, for both renewables and energy efficiency, costs were likely to be less than $5K. Limited BB&Q would likely increase these costs somewhat (e.g., to $5-15K).

Other Sectors

Three sources were consulted. Because of the many types of possible projects, the range of estimates is once again broad. It is anticipated that most of these projects will require substantial effort in reviewing baselines and in dealing with boundaries and leakage issues, even in the broad scenario.

A representative range of $5-25K has been selected but there is only limited confidence in this estimate.

3.6 MONITORING AND QUANTIFICATION

Monitoring and Quantification entails activities by the proponent to measure (directly or indirectly) the GHG reductions/removals and to quantify the resulting credits using the approach specified in the validated project proposal. This may involve metering (e.g., for energy efficiency, renewables, landfills), field measurements (e.g., for individual agriculture or forest projects), remote sensing (e.g., for large forest areas), the use of standard coefficients applied to activity measures (e.g., hectares using low-till), or top-down statistical estimation (e.g., for agriculture pooling).

The estimated transaction costs for this element could range from as low as $500. per year to as high as $50K per year depending on the project type, choice of design option and whether or not this is the first year of measurement. The specific costs under each of the scenarios are shown in Table 3.7.

Table 3.7
Monitoring and Quantification Costs ($000)[16]

Scenario	Range	Agriculture		Forestry		Landfill Gas		Renewables		Energy Efficiency		Other	
		1	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Limited	Low	10	7.5	10	5	2.5	1.5	N/A		N/A		N/A	
	Mode	15	12.5	15	7.5	5	2.5						
	High	30	25	50	25	7.5	5						
Medium - without Pooling – Req. Replacement	Low	2	2.5	5	2.5	1	1					5	2.5
	Mode	3	5	7.5	5	2	1.5					15	7.5
	High	7	7.5	10	7.5	5	2					25	15
Medium - without Pooling – Temporary Credits	Low	1	1	2.5	1	N/A							
	Mode	2	2.5	5	2.5								
	High	6	5	7.5	5								
Medium - Pooling – Req. Replacement	Low	10	5	7.5	2.5								
	Mode	10	10	10	5								
	High	15	15	12.5	7.5								
Medium - Pooling – Temporary Credits	Low	3	5	5	2								
	Mode	8	7.5	7.5	3								
	High	12	10	10	5								
Broad - without Pooling	Low	3	2.5	7.5	2.5	1	1	1	1	1	1	5	2.5
	Mode	5	5	10	5	2	1.5	2	1.5	2	1.5	15	7.5
	High	9	7.5	12.5	7.5	5	2	5	2	5	2	25	15
Broad - Pooling	Low	7	7.5	10	5	N/A		N/A		N/A		N/A	
	Mode	12	12.5	12.5	7.5								
	High	18	15	15	10								

These are recurring costs, which, in theory, depend on project size. However the timing will depend on what is mandated/allowed by the offset program design and the size dependence may not apply if top-down estimation is used instead of field measurements. In particular, a top-down approach is more likely to be applicable in some pooling scenarios.

When costs do recur, it is anticipated that they will be substantially lower after the initial measurement (this is reflected in the two columns for each project type). Most experts believe there will be a substantial cost reduction in year 2 and beyond due to the legacy of measurement infrastructure and procedures, and lessons learned from year 1. 50% was considered a reasonable reduction.

PwC has developed estimates of the potential annual costs for this element in the range of US$3-5K ($4-21K), however this reflects GHG reduction projects, as opposed to GHG removals projects.[17]

[16] Column 1 presents first year of monitoring and quantification; column 2 presents second and subsequent years.
[17] PricewaterhouseCoopers. *A Business View on Key Issues Relating to the Kyoto Mechanisms*. October 2000.

Three Canadian sources (involved in pilot programs) provided estimates in the range of $10-20K for the Canadian context, with lower costs for renewables and higher costs for agriculture and forestry, where fieldwork may be necessary.

Agriculture

A total of four sources were consulted. In a limited scenario with high precision and complex approaches to quantification of independent projects, including a requirement for direct measurement of soil carbon, sources indicated that monitoring and quantification costs could be in the $10-30K range for the first year, but would be expected to decline by as much as half in subsequent years. A simplified approach to quantification based on the use of standard coeffiecients applied to the amount of land employing best management practices was expected to be much less costly – in the range of $2-7K.

In a medium scenario, without pooling and with required replacement, a cost range of $2-7K was used for the first year of quantification.. Costs for scenarios involving temporary credits were reduced by $2.5K since there are no costs for monitoring an d reporting on a risk management plan. Costs for the broad option (risk management plan only) were increased by $2.5K to reflect the additional costs of monitoring a more comprehensive and detailed plan. Cost ranges used for scenarios involving pooling were considerably higher in absolute (per project) terms – in the $13-38K range – to reflect the need to gather information from a large number of farms. However, costs are much lower on a per tonne basis. In all scenarios, costs ranges for subsequent years were reduced by 50%

Forests

A total of five sources were consulted. For a high level of precision and complexity, the estimates range from $10-50K, for the first year for 1000-1500 hectares, based on the requirement for field sampling (more, in a few cases, if soil carbon needs to be accounted for). Using standard parameters or remote sensing could reduce costs to as little as $5-10K.[18] Projects involving pooling are expected to incur additional costs of approximately $2.5K in per project terms (but much lower costs per tonne). Costs for subsequent years are expected to be in the order of 50% of first year costs.

The ranges of costs chosen for the various scenarios reflect the ranges provided by the sources. Costs involving pooling are increased by $2.5-5K in per project terms because there will more information to collect, whereas costs involving temporary credits are decreased by a similar amount because there is no need for risk management, and costs involving a risk management plan only for non permanence are increased by $2.5K because of the cost of additional monitoring.

Landfill Gas

A total of three sources were consulted. There was a strong consensus that costs were not likely to exceed $5-10K in the first year, even in the most rigorous scenario, and the costs were likely to be much lower.

[18] One reference reports a cost of $6K for satellite data covering a minimum of 5,000 hectares (but potentially more) plus $4K of analysis time.

Thus, a representative range of $2.5-7.5K was selected for the limited scenario. For the broad scenario, a range of $1-5K was selected. Once again, costs for subsequent years were specified to be approximately 50% of first year costs.

Renewables and Energy Efficiency

Four sources were consulted. The consensus was that, for both renewables and energy efficiency, costs were likely to be less than $5K for the first year ($1-2K in subsequent years) in the broad scenario. Limited BB&Q would likely increase these costs somewhat (e.g., to $5-15K).

Other Sectors

Three sources were consulted. Because of the many types of possible projects, the range of estimates is once again wide. It is anticipated that most of these projects will require substantial effort in conducting surveys, etc to quantify the incremental results.

A representative range of $5-25k for the first year ($2.5-15k in subsequent years) has been selected but there is only limited confidence in this estimate.

3.7 VERIFICATION

Verification entails a third party review of quantification reports to confirm the materiality, accuracy and quality of the evidence supporting the credits being claimed and the appropriateness of the monitoring and risk management activities.

The estimated transaction costs for this element could range from as low as $500. per year to as high as $50K per year depending on the project type, choice of design option and whether or not this is the first year of verification. The specific costs under each of the scenarios are shown in Table 3.8.

Table 3.8
Verification Costs ($000)[19]

Scenario	Range	Agriculture		Forestry		Landfill Gas		Renewables		Energy Efficiency		Other	
		1	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Limited	Low	5	2.5	10	5	2	1	N/A		N/A		N/A	
	Mode	7.5	3.8	15	7.5	3.5	2						
	High	15	12.5	50	20	7.5	5						
Medium - without Pooling – Req. Replacement	Low	1	0.5	5	2.5	2	1					5	2.5
	Mode	2	1	7.5	4	2.5	2					10	5
	High	5	2.5	10	5	5	3.5					25	12.5
Medium - without Pooling – Temporary Credits	Low	0.5	0.8	2.5	1.5	N/A							
	Mode	1.5	0.8	5	2.5								
	High	4	2	7.5	3.5								
Medium - Pooling – Req. Replacement	Low	5	2.5	7.5	3.5								
	Mode	7.5	3.8	10	5								
	High	10	5	12.5	7.5								
Medium - Pooling – Temporary Credits	Low	3	1.5	5	3								
	Mode	5.5	2.8	7.5	4								
	High	8	4	10	5								
Broad - without Pooling	Low	2	1	3.5	1.5	2	1	2	1	2	1	5	2.5
	Mode	3	1.5	5	2.5	2.5	2	2.5	2	2.5	2	10	5
	High	6	3	7.5	3.5	5	3.5	5	3.5	5	3.5	25	12.5
Broad - Pooling	Low	5	2.5	5	3	N/A		N/A		N/A		N/A	
	Mode	7.5	3.8	7.5	4								
	High	10	5	10	5								

As with the monitoring and quantification costs, these are recurring costs, which, in theory, depend on project size. Similarly, the timing will depend on what is mandated or allowed by the offset program design and the size dependence may not apply if top-down estimation is used instead of field measurements. The costs reflect third-party verification by accredited entities. Most experts believe there will be a substantial cost reduction in year 2 and beyond due to the legacy of experience and previously approved monitoring and quantification procedures. 50% was considered a reasonable reduction.

The international experience (PCF, CDM, etc.) suggests annual costs for this element in the range of US$10-25K ($14-35K) for the first year. These costs reflect third-party verification and the fairly detailed protocols described in the proposed *Validation and Verification Manual.*[20] Reflecting a less rigorous process, Australia's *Greenhouse Friendly Program* reports much lower costs (less than $5K).

Five Canadian sources (involved in pilot programs) provided estimates in the range of $5-60K for the Canadian context, depending on the requirement for fieldwork and the level of

[19] Column 1 presents first year of verification; column 2 presents second and subsequent years.
[20] CDM/JI. *Validation and Verification Manual, Version 2.0*. Prepared by Det Norske Veritas (DNV) Certification. June 2003.

competition between accredited verifiers. The higher amount reflects the cost for early projects but is expected to decrease as the system matures.

Agriculture

Four sources were consulted. Estimates of verification costs ranged from $5-15K for a limited scenario with a reasonably high level of precision and complexity, and field verification of soil carbon measurements. Verification of removals where quantification is based on farm management practices was expected to be much less costly, in the range of $1-5K. Verification of pooled projects was expected to increase costs by about $5K, assuming that a relatively small number of farms would be sampled. In general, costs were expected to decline by approximately 50% in subsequent years.

Cost ranges used in the scenario analyses reflect the estimates provided by sources. Costs for pooling scenarios are increased by $5K. Costs for scenarios involving temporary credits are reduced by $0.5-2K. Costs in the broad option - risk management plan only - are increased by $1K.

Forests

A total of five sources were consulted. For a medium level of precision and complexity, the estimates range from $10-30K, for the first year for 1500 hectares, increasing slightly with project size. A requirement for field verification would increase this cost to $25-50K. Using standard parameters or remote sensing data could reduce costs to $5-10K. Projects involving pooling are expected to incur additional costs of approximately $2.5K in per project terms (but much lower costs per tonne). Costs for subsequent years are expected to be in the order of 50% of first year costs.

The ranges of costs chosen for the various scenarios reflect the ranges provided by the sources. Costs involving pooling are increased by $2.5-5K in per project terms because there will more information to review/check, whereas costs involving temporary credits are decreased by a similar amount because there is no need to review risk management, and costs involving a risk management plan only for non permanence are increased by $2.5K because of the cost of reviewing additional risk management information.

Landfill Gas

A total of three sources were consulted. There was a strong consensus that costs were unlikely to exceed $7.5K in the first year, even in the most rigorous scenario, and the costs were likely to be much lower.

Thus, a representative range of $2.5-7.5K was selected for the limited scenario. For the broad scenario, a range of $2-5K was selected. Once again, costs for subsequent years were specified to be approximately 50% of first year costs.

Renewables and Energy Efficiency

Four sources were consulted. The consensus was that, for both renewables and energy efficiency, costs were likely to be less than $5K for the first year ($1-3.5K in subsequent years) in the broad scenario. Limited BB&Q would likely increase these costs somewhat (e.g., to $5-10K).

Other Sectors

Three sources were consulted. Because of the many types of possible projects, the range of estimates is once again wide. It is anticipated that most of these projects will require substantial effort in reviewing data, etc to verify the incremental results (i.e., to verify the baseline and the quantification of the reduction).

A representative range of $5-25K for the first year ($2.5-15K in subsequent years) has been selected but there is only limited confidence in this estimate.

3.8 REQUIRED REPLACEMENT TRANSACTION COSTS

Required replacement entails the purchase of replacement credits or insurance and involves brokerage fees for the transaction. The estimated transaction costs for this element could range from as low as 3% to as high as 5% under all scenarios, as shown in Table 3.9.

Table 3.9
Non-Permanence Costs (% of Replacement/Insurance Costs)

<table>
<tr><th>Scenario</th><th>Range</th><th>Agriculture</th><th>Forestry</th><th>Landfill Gas</th><th>Renewables</th><th>Energy Efficiency</th><th>Other</th></tr>
<tr><td rowspan="3">Limited</td><td>Low</td><td>3</td><td>3</td><td rowspan="21" colspan="4">N/A</td></tr>
<tr><td>Mode</td><td>4</td><td>4</td></tr>
<tr><td>High</td><td>5</td><td>5</td></tr>
<tr><td rowspan="3">Medium - without Pooling – Req. Replacement</td><td>Low</td><td>3</td><td>3</td></tr>
<tr><td>Mode</td><td>4</td><td>4</td></tr>
<tr><td>High</td><td>5</td><td>5</td></tr>
<tr><td rowspan="3">Medium - without Pooling – Temporary Credits</td><td>Low</td><td rowspan="3" colspan="2">N/A</td></tr>
<tr><td>Mode</td></tr>
<tr><td>High</td></tr>
<tr><td rowspan="3">Medium - Pooling – Req. Replacement</td><td>Low</td><td>3</td><td>3</td></tr>
<tr><td>Mode</td><td>4</td><td>4</td></tr>
<tr><td>High</td><td>5</td><td>5</td></tr>
<tr><td rowspan="3">Medium - Pooling – Temporary Credits</td><td>Low</td><td rowspan="9" colspan="2">N/A</td></tr>
<tr><td>Mode</td></tr>
<tr><td>High</td></tr>
<tr><td rowspan="3">Broad - without Pooling</td><td>Low</td></tr>
<tr><td>Mode</td></tr>
<tr><td>High</td></tr>
<tr><td rowspan="3">Broad - Pooling</td><td>Low</td></tr>
<tr><td>Mode</td></tr>
<tr><td>High</td></tr>
</table>

Aside from the costs of monitoring and verification of non-permanence (covered previously), required replacement introduces additional transaction costs. Although the cost of the insurance or replacement is considered a project cost, the brokerage fees are considered transaction costs.

Estimates of these fees range from 1-7%, however most sources indicate that in a relatively mature market, they should be in the range of 3-5%. Thus, the transaction cost for required replacement in a market where GHG tonnes sell for $10, would be 30-50 cents per tonne.

For our purposes, it is assumed that, on average, each year from 2012 onward, some portion of credits experience a reversal so that the required replacement provision comes into force for those credits.

Furthermore, for illustrative purposes, we assume a portion of 2% of the amount of credits existing in any given year undergo a reversal (e.g., given 100 credits, 2 of 100 are replaced in 2012, 1.96 of 98 are replaced in 2013, etc.). We assume a constant (current year) replacement cost of $10/tonne.

3.9 TOTAL TRANSACTION COSTS

In order to compile the transaction costs for each of the scenarios, we make the following assumptions concerning timing:

- Project evaluation, initiation, proposal and validation take place in 2006
- Crediting takes place from 2008-2012 in the limited and medium scenario
- Crediting (without discounting) takes place from 2005-2012 in the broad scenario
- Monitoring, quantification and verification take place:
  - Reductions – annual in all scenarios
  - Removals
    - Limited
      - Non-expiring credits – annual
    - Medium
      - Non- expiring credits – annual
      - Temporary credits – 5 years (2012 only)
    - Broad
      - Non- expiring credits – 5 years (for convenience we assume 2008 and 2012)

The results are presented in Table 3.10. These represent total costs and costs per tonne in 2002 dollars, with both dollars and tonnes discounted at a rate of 10% per year. The cost per tonne is obtained by dividing the total cost by the discounted total tonnes (5 or 8 years, depending on the case).[21]

[21] As noted in Section 3.1, the project size assumptions are primarily for illustrative purposes.

Table 3.10
Transaction Costs

Project Type	Scenario	Project Size (kt/year)	Pooling	Non-Permanence	Total Cost ($000)			Cost /Tonne		
					L	M	H	L	M	H
Forests	Limited	20	No	Replace	84	108	133	1.80	2.30	2.81
	Medium	20	No	Replace	42	49	56	0.90	1.05	1.19
				Temp.	15	20	24	0.32	0.42	0.52
		120	Yes	Replace	80	93	105	0.28	0.33	0.37
				Temp.	34	45	55	0.12	0.16	0.19
	Broad	20	No	Risk Mgmt	31	40	49	0.35	0.46	0.56
		120	Yes	Risk Mgmt	51	68	85	0.10	0.13	0.16
Agriculture	Limited	1.4	No	Replace	51	61	72	15.23	18.56	21.88
	Medium	1.4	No	Replace	15	19	23	4.64	5.84	7.05
				Temp.	6	9	11	1.87	2.63	3.38
		246	Yes	Replace	112	125	137	0.19	0.22	0.24
				Temp.	37	48	59	0.06	0.08	0.10
	Broad	1.4	No	Risk Mgmt	16	19	22	2.54	3.08	3.63
		246	Yes	Risk Mgmt	61	78	94	0.06	0.07	0.09
Landfill Gas	Limited	125	No	N/A	23	31	39	0.08	0.11	0.13
	Medium	125	No	N/A	13	17	20	0.04	0.06	0.07
	Broad	125	No	N/A	22	27	33	0.04	0.05	0.06
Renewables	Broad	100	No	N/A	28	36	43	0.06	0.08	0.10
Efficiency	Broad	10	No	N/A	28	36	43	0.63	0.81	0.98
Other	Medium	10	No	N/A	58	77	95	2.43	3.25	4.07
	Broad	10	No	N/A	90	119	149	2.05	2.71	3.36

Costs per tonne for the different scenarios for each type are contrasted in Figures 3.1 to 3.6.

3.9.1 Forest Projects – Non Expiring Credits

The key transaction cost elements for non-expiring credits arising from forests projects are project initiation, proposal preparation; monitoring and quantification; and (when applicable) required replacement. Among the options, the key cost drivers are:

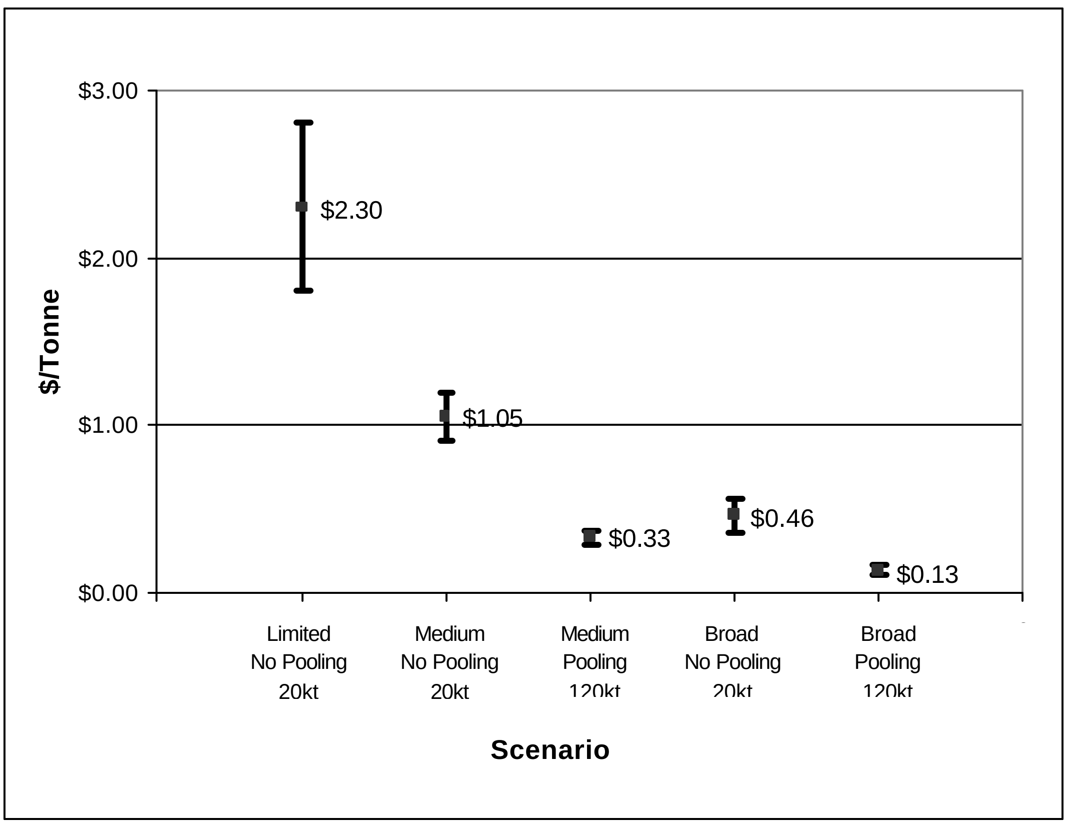
- BB&Q, which in the medium and broad scenarios without pooling, reduces proposal preparation by a factor of six, and reduces monitoring costs by one half
- Pooling, which tends to raise per project costs by 75-100% (primarily by raising project initiation costs), while increasing the credits generated by a factor of six, thereby decreasing the costs per tonne by a factor of three
- Verification, which reduces the frequency of monitoring and quantification, and verification in theory by a factor of up to five – in practice, by a factor of three (due to discounting and the higher costs for the first year)
- Pre-2008 crediting, which increases the costs of monitoring and quantification, and verification by less than 25% (because this option coincides with reduced verification), while almost doubling the credits generated (because the pre-2008

credits occur earlier, they suffer less discounting), thereby decreasing costs per tonne almost by half.
- Non permanence, which costs approximately $0.06 per tonne in the limited and medium scenarios for required replacement

The reduced costs associated with the medium and broad scenarios reflect the savings to be gained from the less precise and complex BB&Q, which is the key costs driver (see Figure 3.1.). In the medium scenario, the costs remain relatively high compared to the broad scenario because of the estimated brokerage fees associated with required replacement (approx. $0.06/tonne). Costs for the broad scenario also incorporate substantial savings from having five-year, as opposed to annual, monitoring and verification requirements and also reap the rewards of three extra years of pre-2008 crediting.

Given that most of the transaction costs are relatively fixed, the advantages of pooling are clear and this is reflected in the per tonne costs.

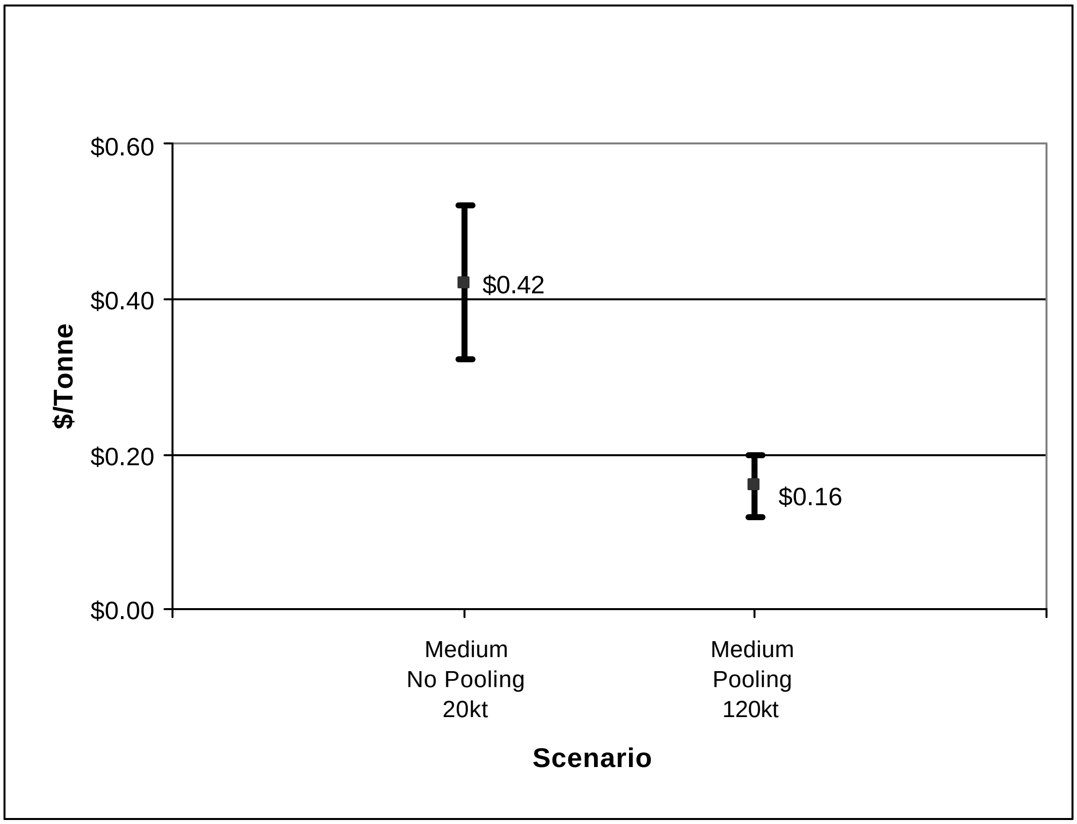
Figure 3.1
Forests Projects – Non-Expiring Credits
Transaction Costs ($/t CO_2-e)



3.9.2 Forest Projects – Temporary Credits

The key transaction cost elements for temporary credits arising from forests projects are project initiation and proposal preparation. Because of their temporary nature, these credits require comparatively less effort in monitoring, quantification and verification, and there is no cost for required replacement. As with non-expiring credits, pooling is an important cost driver, which tends to raise per project costs by 75-100% (primarily by raising project initiation costs), while increasing the credits generated by a factor of six, thereby decreasing the costs per tonne by a factor of three. See Figure 3.2.

Figure 3.2
Forests Projects - Temporary Credits
Transaction Costs ($/t CO_2-e)



3.9.3 Agriculture Projects – Non-Expiring Credits

The key transaction cost elements for non-expiring credits arising from agriculture projects are project initiation, proposal preparation; monitoring and quantification; and (when applicable) required replacement. Among the options, the key cost drivers are:

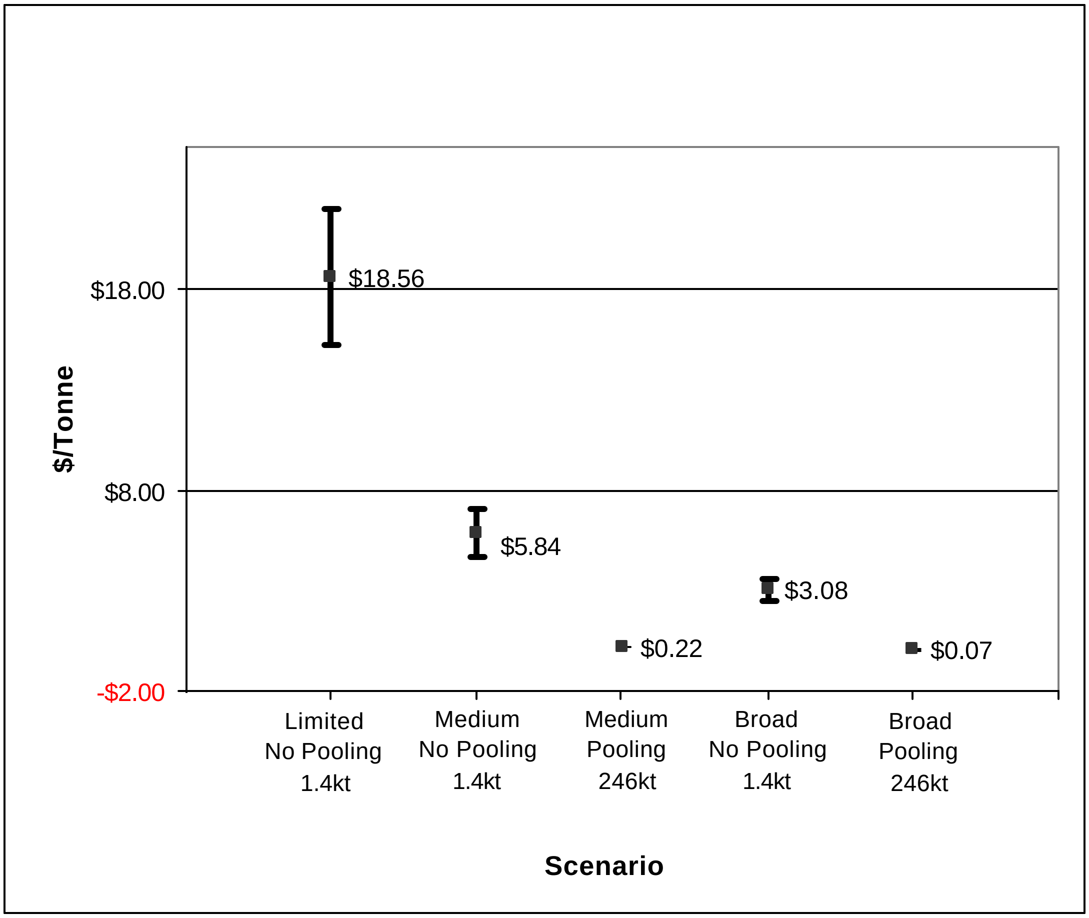
- BB&Q, which in the medium and broad scenarios without pooling, reduces proposal preparation by a factor of two to three, and reduces monitoring costs by a factor of five.

- Pooling, which tends to raise per project costs by a factor of 5-6 (primarily by raising project initiation costs and monitoring costs), while increasing the credits generated by a factor of 175, thereby decreasing the costs per tonne by a factor of approximately 30-40.
- Verification, which reduces the frequency of monitoring and quantification, and verification in theory by a factor of up to five – in practice, by a factor of two (due to discounting and the higher costs for the first year)
- Pre-2008 crediting, which increases the costs of monitoring and quantification, and verification by less than 25% (because this option coincides with reduced verification), while almost doubling the credits generated (because the pre-2008 credits occur earlier, they suffer less discounting), thereby decreasing costs per tonne by almost half
- Non permanence, which costs approximately $0.06 per tonne in the limited and medium scenarios for required replacement

The reduced costs associated with the medium and broad scenarios reflect the savings to be gained from the less precise and complex BB&Q, which is the key costs driver (see Figure 3.3.). In the medium scenario, the costs remain relatively high compared to the broad scenario because of the estimated brokerage fees associated with required replacement (approx. $0.06/tonne). Costs for the broad scenario also incorporate substantial savings from having five-year, as opposed to annual, monitoring and verification requirements and also reap the rewards of three extra years of pre-2008 crediting.

Given that most of the transaction costs are relatively fixed, the advantages of pooling are clear and this is reflected in the per tonne costs. Independent projects that are 1.4 kt in size are clearly not viable, but somewhat larger projects (e.g., more than 10kt) could be viable.

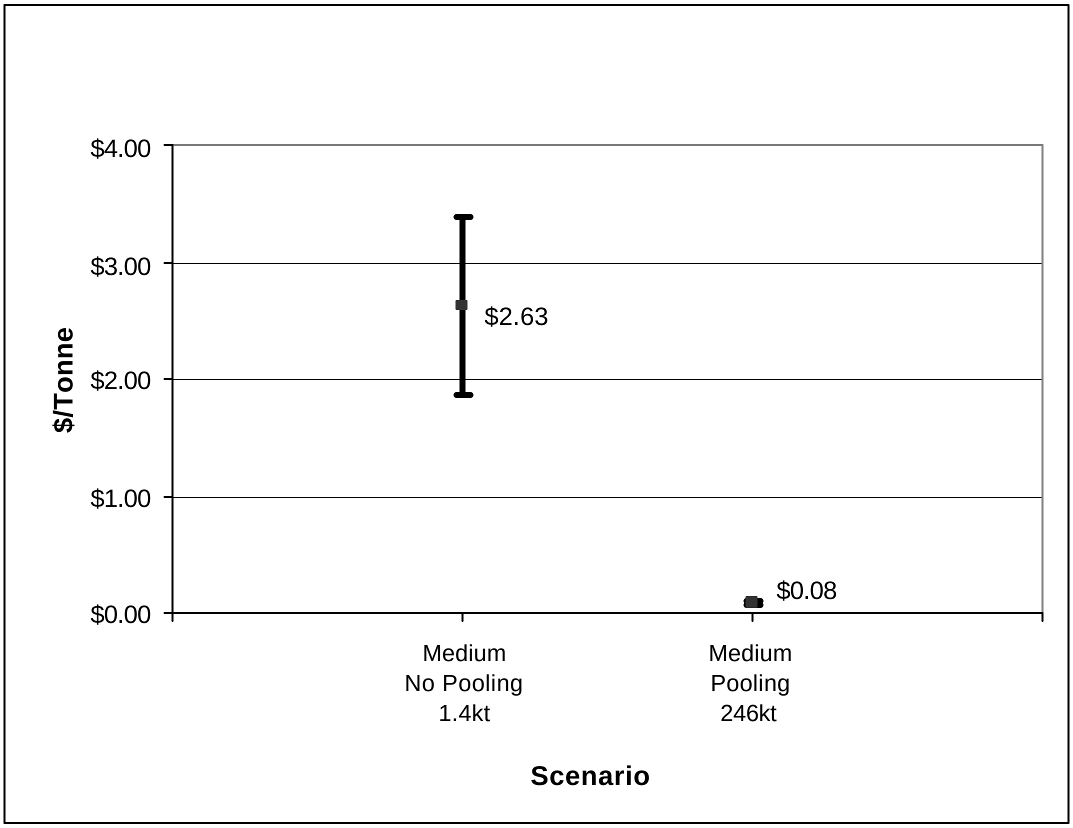
Figure 3.3
Agriculture Projects – Non-Expiring Credits
Transaction Costs ($/t CO_2-e)



3.9.4 Agriculture Projects – Temporary Credits

The key transaction cost elements for temporary credits arising from agriculture projects are project initiation and proposal preparation. Because of their temporary nature, these credits require comparatively less effort in monitoring, quantification and verification, and there is no cost for required replacement. As with non-expiring credits, pooling is an important cost driver, which tends to raise per project costs by a factor of five (primarily by raising project initiation costs), while increasing the credits generated by a factor of 175, thereby decreasing the costs per tonne by a factor of 35. See Figure 3.4.

Figure 3.4
Agriculture Projects - Temporary Credits
Transaction Costs ($/t CO_2-e)

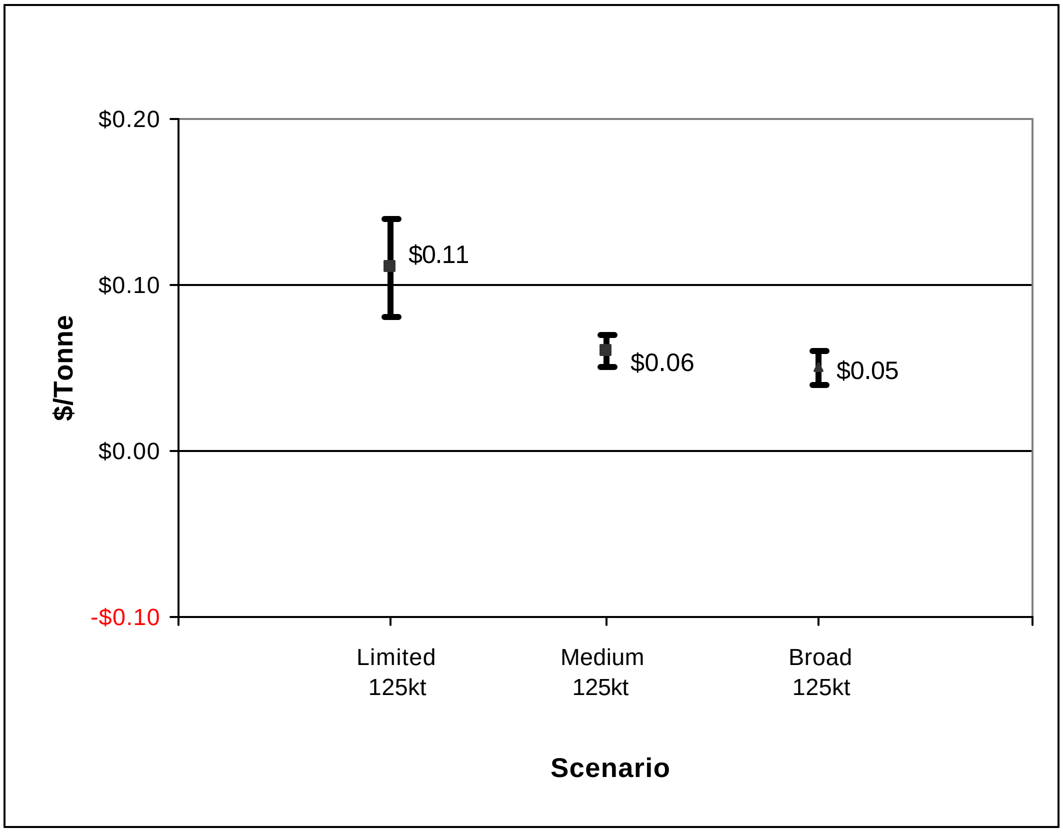


3.9.5 Landfill Gas Projects

When compared to other project types (esp. carbon removal projects), the transaction costs for landfill gas projects are much lower, due to the simplicity of specifying BB&Q, the permanent nature of the credits, and the relatively large project sizes (see Figure 3.5). The key transaction cost elements for credits arising from landfill gas capture and flaring projects are project initiation, proposal preparation; monitoring and quantification; and verification. Among the options, the key cost drivers are:

- BB&Q, which in the medium and broad scenarios, reduces proposal preparation by a factor of three, and reduces monitoring costs by a factor of two
- Pre-2008 crediting, which raises costs by about two thirds, while increasing the credits generated by about three quarters (because the pre-2008 credits occur earlier, they suffer less discounting), thereby decreasing costs per tonne slightly.
- Ownership, which, when not stipulated in legislation, increases project initiation costs by approximately 0.5 cents per tonne.

Figure 3.5
Landfill Gas Projects
Transaction Costs ($/t CO_2-e)



3.9.6 Other Projects

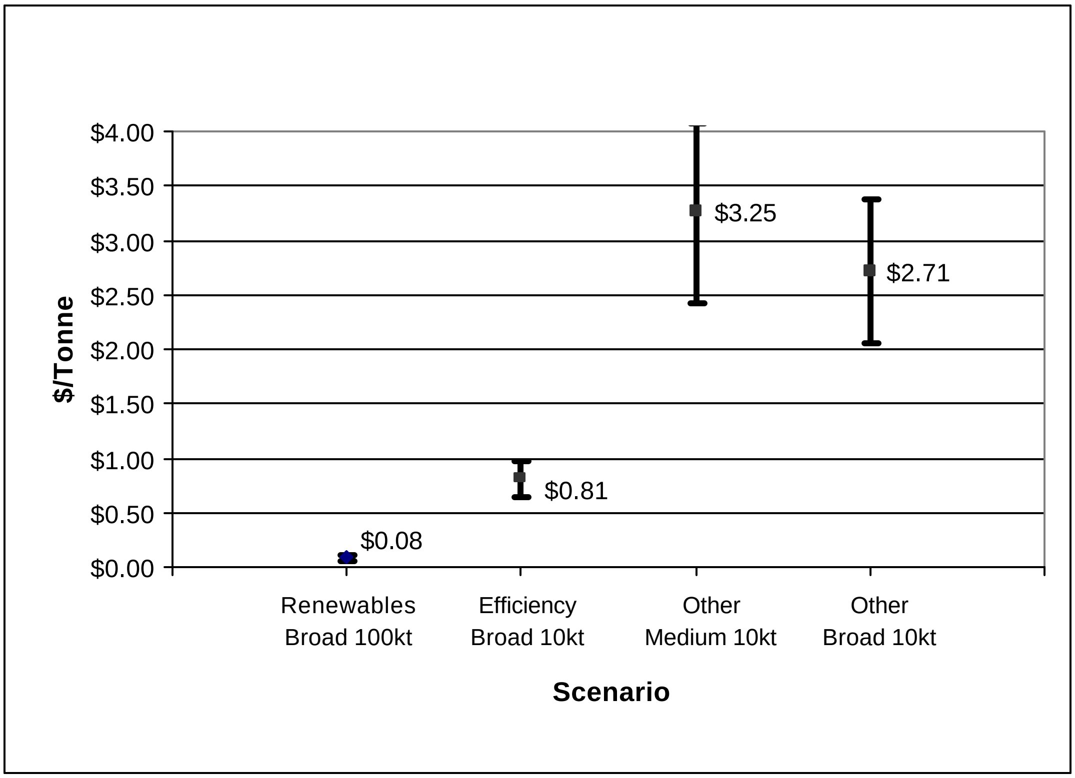
Given the broad approach to BB&Q and pre-2008 crediting, it is estimated that per project costs for both renewables and energy efficiency projects in the broad scenario will be relatively low and very similar (see Figure 3.6). This is due to the relatively straightforward and similar measurements and calculations involving the GHG emission reductions associated with reduced fossil fuel generation from reduced consumption or alternative generation. However, in the case of renewables, the projects are anticipated to be significantly larger and therefore the per tonne costs will be much lower. Transaction costs per tonne for other sectors can vary widely (see error bar in Figure 3.6): many of these projects are expected to require extensive work to meet even the less complex and precise requirements for BB&Q.

The key transaction cost elements for both renewables and energy efficiency projects are project initiation; monitoring and quantification; and verification.

For other projects, the key cost elements are project initiation; proposal preparation; monitoring and quantification; and verification. The key drivers in reducing costs from the medium to broad scenarios are:

- Pre-2008 crediting, which raises costs by about half, while increasing the credits generated by about nine tenths (because the pre-2008 credits occur earlier, they suffer less discounting), thereby decreasing costs by about 40 percent.
- Ownership, which, when not stipulated in legislation, increases project initiation costs by approximately 25 cents per tonne.

Figure 3.6
Other Sector Projects
Transaction Costs ($/t CO_2-e)



4. ADMINISTRATION COSTS

4.1 INTRODUCTION

Administration costs are the expenses, the program authority (PA) will incur to set-up and operate the GHG offset system. Most of these are fixed and many are one-time set-up costs. Oversight and project registry costs are the exception: these elements can vary according to the number of projects and can be expected to re-occur on a defined schedule. In addition, the PA can be expected to require a budget for ongoing base operating costs, which may be relatively independent of activity levels.

We examine these costs from the perspective of two estimates of potential tonnes, the project sizes defined in Section 3, and the corresponding number of projects. The estimated number of tonnes/projects is based on some very preliminary research conducted by the WGO and the project team, with knowledgeable experts in each category.[22] Different project size and number assumptions are made for individual projects and for pooled projects.

The project types and volumes that were assumed are as follows:

Forests GHG Removal

- Limited Scenario
  - 100-200 individual projects of 20kt/year = 2.0-4.0Mt/year[23]
- Medium Scenario
  - 75-150 individual projects of 20kt/year = 1.5-3.0Mt/year; and
  - 13-25 pooled projects of 120kt/year = 1.5-3.0Mt/year
- Broad Scenario
  - 100-200 individual projects of 20kt/year = 2.0-4.0Mt/year; and
  - 17-33 pooled projects of 120kt/year = 2.0-4.0Mt/year

Agriculture GHG Removal

- Limited Scenario
  - 214-429 individual projects of 1.4kt/year = 0.3-0.6Mt/year
- Medium Scenario
  - 214-429 individual projects of 1.4kt/year = 0.3-0.6Mt/year; and
  - 22-50 pooled projects of 246kt/year = 5.3-12.3Mt/year
- Broad Scenario
  - 214-429 individual projects of 1.4kt/year = 0.3-0.6Mt/year; and
  - 22-50 pooled projects of 246kt/year = 5.3-12.3Mt/year

Landfill Gas Capture and Flaring

- Limited Scenario
  - 48-64 individual projects of 125kt/year = 6.0-8.0Mt/year
- Medium Scenario
  - 64-80 individual projects of 125kt/year = 8.0-10.0Mt/year
- Broad Scenario
  - 80-96 individual projects of 125kt/year = 10.0-12.0Mt/year

[22] In the case of forests projects, these are assumptions rather than estimates.
[23] All tonnes are t CO_2-e.

Renewable Energy

- Broad Scenario
  - 5-30 individual projects of 100kt/year = 0.5-3.0Mt/year

Energy Efficiency

- Broad Scenario
  - 50-200 individual projects of 10kt/year = 0.5-2.0Mt/year

Other

- Medium Scenario
  - 100-200 individual projects of 10kt/year = 1.0-2.0Mt/year
- Broad Scenario
  - 200-300 individual projects of 10kt/year = 2.0-3.0Mt/year

Total

- Limited Scenario
  - 362-693 individual projects = 8.3-12.6Mt/year
- Medium Scenario
  - 453-859 individual projects = 10.8-15.6Mt/year
  - 35-75 pooled projects = 6.8-15.3Mt/year
  - Total = 488-934 projects = 17.6-30.9Mt/year
- Broad Scenario
  - 649-1255 individual projects =15.3-24.6Mt/year
  - 39-83 pooled projects = 7.3-16.3Mt/year
  - Total = 688-1338 projects = 22.6-40.9Mt/year

Section 3 describes a series of up to seven transaction cases for each project type, involving different option scenarios and different proponent choices concerning pooling and non-permanence. To examine administration costs, we define a total of eight system cases:[24]

- Two cases based on the limited scenario (low and high potential)
- Four cases based on the medium scenario:
  - Two cases based solely on temporary credits (low and high potential) – in each of the two cases, the following assumptions are made concerning pooling:
    - Agriculture Mt are split 95-5 between pooling and individual projects
    - Forests Mt are split 50-50 between pooling and individual projects
  - Two cases based solely on required replacement (low and high potential) – in each of the two cases, the following assumptions are made concerning pooling:
    - Agriculture Mt are split 95-5 between pooling and individual projects
    - Forests Mt are split 50-50 between pooling and individual projects
- Two cases based on the broad scenario (low and high potential).

Table 4.1 summarizes the number of projects in each case.

[24] Although the medium design option for non-permanence offers a choice of temporary credits or required replacement, cases are defined as 100% temporary credits or 100% required replacement in order to avoid providing misleading results (because of the different value of temporary credits vs. non-expiring credits).

Table 4.1
Description of System Cases (# of Projects)

System Case	Forests	Agriculture	Landfill Gas	Renewables	Energy Efficiency	Other
A Limited Scenario Low Potential	100 ind.	214 ind.	48	N/A	N/A	N/A
B Limited Scenario High Potential	200 ind.	429 ind.	64	N/A	N/A	N/A
C Medium Scenario Low Potential Replacement Only	75 ind. replace 13 pools replace Total = 88	214 ind. replace 22 pools replace Total = 236	64	N/A	N/A	100
D Medium Scenario Low Potential Temp. Credits Only	75 ind t.credits 13 pools t.credits Total = 88	214 ind. t.credits 22 pools t.credits Total = 236	64	N/A	N/A	100
E Medium Scenario High Potential Replacement Only	150 ind. replace 25 pools replace Total = 175	429 ind. replace 50 pools replace Total = 479	80	N/A	N/A	200
F Medium Scenario High Potential Temp. Credits Only	150 ind. t.credits 25 pools t.credits Total = 175	429 ind. t.credits 50 pools t.credits Total = 479	80	N/A	N/A	200
G Broad Scenario Low Potential	100 ind. 17 pools Total = 117	214 ind. 22 pools Total = 236	80	5	50	200
H Broad Scenario High Potential	200 ind. 33 pools Total = 233	429 ind. 50 pools Total = 479	96	30	200	300

4.2 SET-UP PROGRAM AUTHORITY AND LEGAL FRAMEWORK

These cost elements include policy, legal and clerical staff time to support the policy and legislative process, develop accountability frameworks, acquire budgets, human resources, office accommodation, etc., and develop generic policies, guidance and operational procedures, including a dispute resolution process. The ongoing base operating costs include personnel (including ongoing policy, legal and administrative support), and O&M costs, including accommodation, but not those costs associated with development of protocols and guidance, operation of the registry, and operation of the validation, verification and oversight functions.

The estimated costs for these elements do not vary by scenario and they cover all projects. Most of these are one-time costs, except for ongoing base operating costs. These estimates assume that the GHG Offset system design will already be complete and that the Program Authority will be established as a federal body created by statute.

The estimated administration costs for these elements are shown in Table 4.2.

Table 4.2
Program Authority Set-Up Costs ($000)

Cost Element	Low	Mode	High
One-Time General Set-Up	300	450	600
One-Time Legal Support for Set-Up	500	850	1600
One-Time Set-Up Dispute Resolution Process	25	50	75
Ongoing Base Annual Operating	800	1100	1500

There is no documented research on these costs, however, a number of sources provided information on similar costs for other international and Canadian Programs.

Comparable international initiatives, including Dutch and Australian Programs and the World Bank's PCF have incurred set-up costs ranging from $500K to several million dollars and ongoing costs of $500K to $1.5M. These costs include costs for operation of project registries as well as validation, verification and oversight; however, they all deal with a relatively low volume of transactions, reflective of immature markets without a regulatory incentive.

Comparable Canadian experience, including Ontario's SO2 and NOX trading system, VCR Inc., and PERRL have annual administration costs ranging from $300-500K, and similar levels of one-time set-up costs. Based on very preliminary internal estimates, legal support for the Large Final Emitters (LFE) System is anticipated to cost $2.5-5.0M over four years.

Although useful as benchmarks, the above reported costs reflect circumstances that are significantly different from what is anticipated for the Canadian GHG Offset System.

Using the advice of various sources, the estimates were prepared on the basis of the following assumptions:

- Set-up will require 3-4 people 12-18 months @ average $100K/FTE = $300-600K
- Set-up legal support will involve 1-2 people for 1-2 years for legislation; another 1-2 people for 1-2 years for development of regulations, guidelines and protocols (legal support only – see Section 4.3 for development); and another 1-2 people for 1 year to legally establish the Program Authority @ average $160K/FTE = $500-1600K
- Set-up of the dispute resolution process will involve 1-2 people for a total of 0.25-0.75 FTE @ average $100K/FTE = $25-75K
- Base operations will require 1 Director, 2-4 program officers, and 2-4 support staff @ average $100K/FTE plus $75-100K for accommodation, $150-250K for ongoing legal support, and $100-300K for other O&M = $800-1500K/year

Set-up costs are anticipated to occur in the period 2004-2005, with ongoing costs beginning in 2006. Because of the many factors that could affect these costs, the level of confidence in these estimates is limited. It may also be possible to reduce costs by combining some of these tasks and functions with other programs, such as the LFE system.

4.3 PROTOCOLS AND GUIDANCE

The development of protocols and guidance involves the preparation, publication and dissemination of documents to assist proponents in determining project eligibility, and provide proponents with approved methods for determining boundaries and baselines, and quantifying emission reductions. Guidance will also deal with monitoring and verification requirements as well as risk management (as appropriate).

The estimated administration costs for the preparation of protocols and guidance could range from as low as $5K to as high as $200K per protocol, depending on project type and choice of design option. The total costs (for all protocols) are shown in Table 4.3, along with the associated public and stakeholder consultation costs.

Table 4.3
Protocol and Guidance Development Costs ($000)

Scenario	Range	Forests	Agriculture	Landfill	Renewables	Efficiency	Other	Consultations	Total
Limited	Low	300	600	5	0	0	0	65	970
	Mode	400	800	15	0	0	0	195	1410
	High	600	1200	30	0	0	0	390	2220
Medium	Low	120	400	5	0	0	100	125	750
	Mode	240	800	10	0	0	200	375	1625
	High	320	1200	20	0	0	300	750	2590
Broad	Low	160	320	5	40	20	100	155	800
	Mode	280	720	10	80	40	200	465	1795
	High	360	1120	20	160	80	300	930	2970

These estimates assume that the cost of protocol preparation will be borne by the Program Authority even if the proponents do the actual work. The number of protocols and amount of guidance is based on the assumption that each project type requires a separate protocol and the types are defined by the project typology described in Table 2.1. In addition, it is assumed that pooled agriculture projects involve different BB&Q methods and therefore require separate protocols from those used for independent projects. The *Greenhouse Gas Protocol: Project Quantification Standard* (see Appendix A) provides a useful benchmark for defining the level of complexity and precision associated with the limited option, whereas the *Simplified Baseline and Monitoring Methodologies for Selected Small-Scale CDM Project Activity Categories* provides a useful benchmark for defining the level of complexity and precision associated with the broad option (in fact, in the broad option, it is assumed that even this "simplified" process is further simplified by the use of specified default parameters).

Generic costs for the development of Project protocols, including costs from the US Regional Clean Air Incentives Market (RECLAIM) system, Canada's VCR program, Ontario's SO2 and NOX program, range from $50-200K

Consultation costs are based on the assumption that comments will be provided in writing (possibly through a website) and that no public meetings will be held (this is consistent with the approach used in the CDM process). The estimate for consultations is based on a range of $5-

30K per protocol, for a total of 13, 25, or 31 protocols in each of the limited, medium or broad scenarios. This includes the cost of preparing consultation documents, reviewing comments, and providing appropriate responses, including detailed responses if necessary. The cost of website development and upkeep is included in set-up and base operating costs.

Agriculture

A total of six sources were consulted. The agriculture sector requires the largest number of protocols to be developed, as there are eight project types (five for removals, three for reductions) and separate protocols will be required for pooling. Consequently eight protocols are required in the limited scenario and sixteen are needed in the medium and broad scenarios.

Sources quoted relatively high costs for the development of sequestration protocols – ranging from $100K to $200K for fairly rigorous protocols, with most indicating costs would exceed $150K. The level of rigor was not expected to affect costs greatly, as a considerable amount of work would be still be needed to develop standard factors that could provide reliable results where proponents are using simplified quantification methods. While for each project a separate, second protocol would be required for pooling, the development cost of the second protocol was expected to be considerably less – in the range of 50% of the initial cost. Costs for emission reduction protocols were similar to those quoted for other emission reduction project types for an "average" level of precision and complexity – from $20-50K. A less complex and precise approach to these protocols was expected to reduce costs to $10-30K.

The range of costs selected for the scenarios reflects the estimates provided by sources. For the limited approach, a range of $100-$200K was used for sinks project protocols, and $20-$50K for emission reduction protocols. In the medium and broad scenarios, the cost of developing protocols was reduced by one-third relative to the limited scenario, since although the protocols themselves would be relatively simple, they would require much of the same development effort as more complex protocols. Costs were reduced by one-half for the development of a second protocol for each project type for the pooling case. The level of confidence in these estimates is moderate

Forests

A total of eight sources were consulted. For an "average" level of precision and complexity, the estimates range from $25-50K. For the most rigorous approach, these costs could reach $30-150K for an afforestation or reforestation protocol, depending on the need to deal with soil carbon, and with most sources at the higher end of the range (current CFS work on an afforestation protocol is expected to cost $100-150K). Using a less complex and precise approach could reduce costs to $15-60K.

The ranges of costs chosen for the various scenarios reflect the ranges provided by the sources minus a few outliers. For the limited approach, we use a range of $75-150K. The use of standard parameters would significantly reduce costs for proponents but would require significant work in protocol development to select the parameters. For this reason we use somewhat higher costs than recommended by the sources for the broad BB&Q approach, in the range of $30-80K, which also includes a small premium to document requirements for pooled projects. For the broad scenario, which relies only on risk management for non-permanence, we add another $10K to our range to reflect the need for the protocol to address it. A total of four protocols are needed in all scenarios.

Landfill Gas

A total of three sources were consulted. The range of estimated costs for protocol development is $10-30K, however the general view is that a good Protocol in the Canadian context is already available and that adapting it would cost as little as $1-15K.

A representative range of $5-30K was selected for the limited scenario, reflecting a detailed Protocol, with expanded discussion and guidance concerning emission baseline modelling and parameter selection. For the medium and broad scenarios, a range of $5-20K was determined reflecting a simple measurement of methane as it enters the combustor. Only one protocol is needed under all scenarios.

Renewables and Energy Efficiency

Four sources were consulted. The general view is that several different protocols exist already and that they could be adapted for $10-30K. Otherwise development of a relatively less complex and precise protocol would cost $20-40K

Since only the broad scenario applies to the renewables and energy efficiency categories, only one cost range is required. We use a range of $10-40K to reflect the possibility that new protocols might be needed. A total of six protocols are required.

Other Sectors

Three sources were consulted. Because of the many types of possible projects (see Table 2.1), the range of estimates is again wide. Furthermore, it is anticipated that these protocols will need to deal with a number of complex boundary and leakage issues, even in the broad scenario.

A representative range of $25-75K has been selected but there is only limited confidence in this estimate. As many as four protocols may be needed.

4.4 VALIDATION AND OVERSIGHT

Although the PA will undertake the validation, the costs will be recovered from the proponent and therefore these are included in the transaction costs. Similarly, because accredited third parties will undertake verification of reductions and removals, these costs are also included in the transaction costs. Furthermore, if the costs of accreditation are recovered from the third parties, these costs will then be passed on to the proponents and can also be assumed to have been included in the transaction costs. This leaves only two categories of costs to be borne by the Program Authority: establishment of the accreditation system (distinct from its operation); and periodic audit or oversight of the verification process.

The administration costs for the one-time set-up of the accreditation system do not vary by scenario. These costs are estimated to be:

- Low: $50K
- Mode: $100K
- High: $400K.

These estimates reflect the experience in accreditation of the Canadian Environmental Auditing Association and the opinion of PwC consultants who have been involved with accreditation processes.

The cost of oversight/audit depends on the frequency/sampling approach and the complexity of the verifications being audited. For the purposes of this estimate, we assume that 10% of all verifications are audited and that the cost is 50% of the corresponding verification cost. Table 4.4 lists the resulting costs in 2002 dollars (note: these are costs for the entire system, i.e., for all projects).

Table 4.4
Oversight/Audit Costs ($000)

System Case	Forestry	Agriculture	Landfill	Renewables	Energy	Other	Total
A	102	143	17	0	0	0	263
B	205	287	23	0	0	0	514
C	51	53	18	0	0	118	240
D	9	12	18	0	0	118	157
E	102	111	23	0	0	235	471
F	18	25	41	0	0	235	319
G	28	36	41	3	26	416	549
H	55	74	49	15	103	624	921

4.5 OFFSET REGISTRY

The offset registry is assumed to be a public project registry containing information on validated projects. Project-specific documents available to the public would include:

- Project design document (project proposal)
- Validator's report
- Emission reduction/removal reports (prepared by proponent)
- Verification reports
- Information on offset credits issued (volume, serial numbers).

The registry is also assumed to include a searchable database of information on projects (in addition to project-specific documents), with the ability to generate reports. The registry would be comprised of a single database, with different levels of access for public and the PA (and other authorized users), and with PA-only capability to do more sophisticated queries and generate customized reports. The project registry is assumed to be separate and distinct from the national registry which would track ownership of domestic and international compliance units.

Three Canadian sources were consulted. The main start-up costs involve the design and development of the database and the various interfaces (public, internal). Start-up costs are estimated to be in the range of $100-300K. The annual operation of the registry is expected to involve between 2-4 technical/admin staff (depending on the volume of projects) and limited management time.

Table 4.5
Program Registry Costs ($000)

Cost Element	Low	Mode	High
Registry set-up (one-time)	100	200	300
Ongoing Registry Operating	175	250	315

Set-up costs are anticipated to occur in the period 2004-2005, with ongoing costs beginning in 2006.

4.6 TOTAL ADMINISTRATION COSTS

In order to compile the administration costs for each of the cases, we make the following assumptions concerning timing:

- Set-up takes place in 2005
- The PA operates from 2006-2012
- The Registry operates from 2006-2012
- Audits take place from 2005-2012 (coinciding with verifications).

The results are presented in Table 4.6. These represent total costs and costs per tonne in 2002 dollars, with both dollars and tonnes discounted at a rate of 10% per year.

Table 4.6
Administration Costs

System Case	Set-Up Costs ($millions)			Operating Costs ($millions)			Total Administration ($millions)			Admin Costs/tonne ($)		
	L	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**
A Limited Scenario Low Potential	2.05	2.55	3.05	4.61	5.90	7.19	7.08	8.45	9.83	0.36	0.43	0.50
B Limited Scenario High Potential	2.05	2.55	3.05	5.14	6.43	7.71	7.62	8.98	10.34	0.26	0.30	0.35
C Medium Scenario Low Potential Replacement Only	2.08	2.65	3.22	4.59	5.88	7.17	7.13	8.52	9.91	0.17	0.21	0.24
D Medium Scenario Low Potential Temp. Credits Only	2.08	2.65	3.22	4.51	5.79	7.07	7.07	8.44	9.81	0.17	0.20	0.24
E Medium Scenario High Potential Replacement Only	2.08	2.65	3.22	5.09	6.38	7.68	7.62	9.03	10.44	0.10	0.12	0.14
F Medium Scenario High Potential Temp. Credits Only	2.08	2.65	3.22	4.94	6.23	7.52	7.48	8.88	10.27	0.10	0.12	0.14
G Broad Scenario Low Potential	2.18	2.80	3.42	5.16	6.46	7.76	7.81	9.26	10.71	0.08	0.09	0.11
H Broad Scenario High Potential	2.18	2.80	3.42	5.77	7.11	8.44	8.43	9.90	11.38	0.05	0.05	0.06

Total administration costs and costs per tonne for the different scenarios are contrasted in Figures 4.1 and 4.2.

The key administration cost elements are startup and ongoing base operations. Because most of the variable costs (e.g. project validation) are assumed to be recovered as transaction costs, total administration costs are relatively fixed and there is relatively little variation between scenarios. The costs that do vary include:

- Start-up Costs – Develop guidance and undertake public consultations – approximately $1.4-1.8M, depending on the option
- Ongoing Costs – Operate registry and conduct oversight/audit of verifications – approximately $250-600K per year, depending on the option

Together, these variable costs amount to approximately one third of the administration costs, however, the scope for variation is much less. Taking into account opposing effects, the total scope for variation is only about plus or minus 10 percent, with the average being approximately $9.0M.

To the extent that administration costs do vary, the key cost drivers are:

- Scope, which introduces 1-3 additional project types as well as a need for 4-10 additional protocols
- BB&Q, which in the medium and broad scenarios reduces protocol preparation costs by a third to a half and decreases the effort involved in auditing verifications by a half
- Verification, which decreases the requirements for verification, and therefore oversight, by a factor of two
- Pooling, which tends to raises the cost of guidance preparation slightly and introduces a need for some new protocols, raising overall guidance preparation costs by approximately a third
- Pre-2008 crediting, which increases the costs of verification, and therefore oversight by approximately 50 percent.

In addition, these factors and others will have an impact on the overall volume of projects, which is reflected in the low and high potential assumptions. However, given the relatively small share of ongoing costs that are variable (less than 10%), the overall effect on administration costs is relatively minor (in the order of $500K difference). See Figure 4.1.

Given relatively fixed administration costs, the variation in volume of projects and total tonnes implied by the low and high potential cases will have a predictable effect on per tonne administration costs (i.e. inversely proportional). In the broad scenario, the effect of the increased volume is accentuated by the pre-2008 crediting of additional tonnes (see Figure 4.2). It should be noted that administration costs for temporary credits vs. non-expiring credits are virtually identical despite the significantly lower value of the latter.

Figure 4.1
Administration Costs ($ millions)

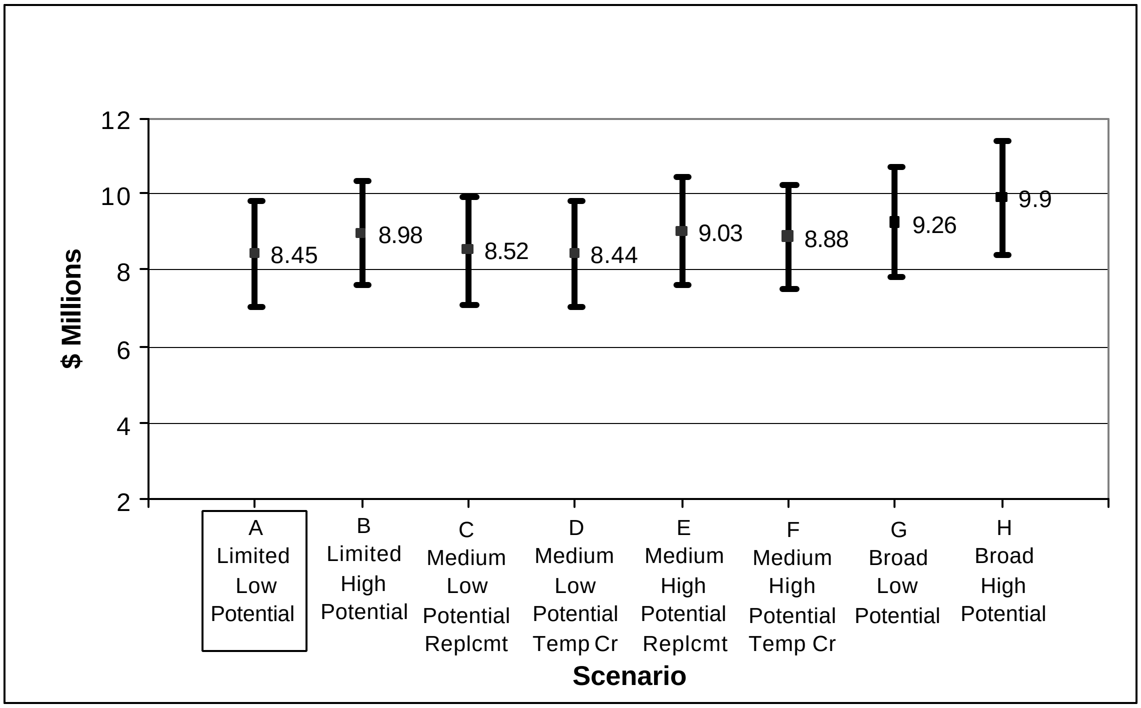
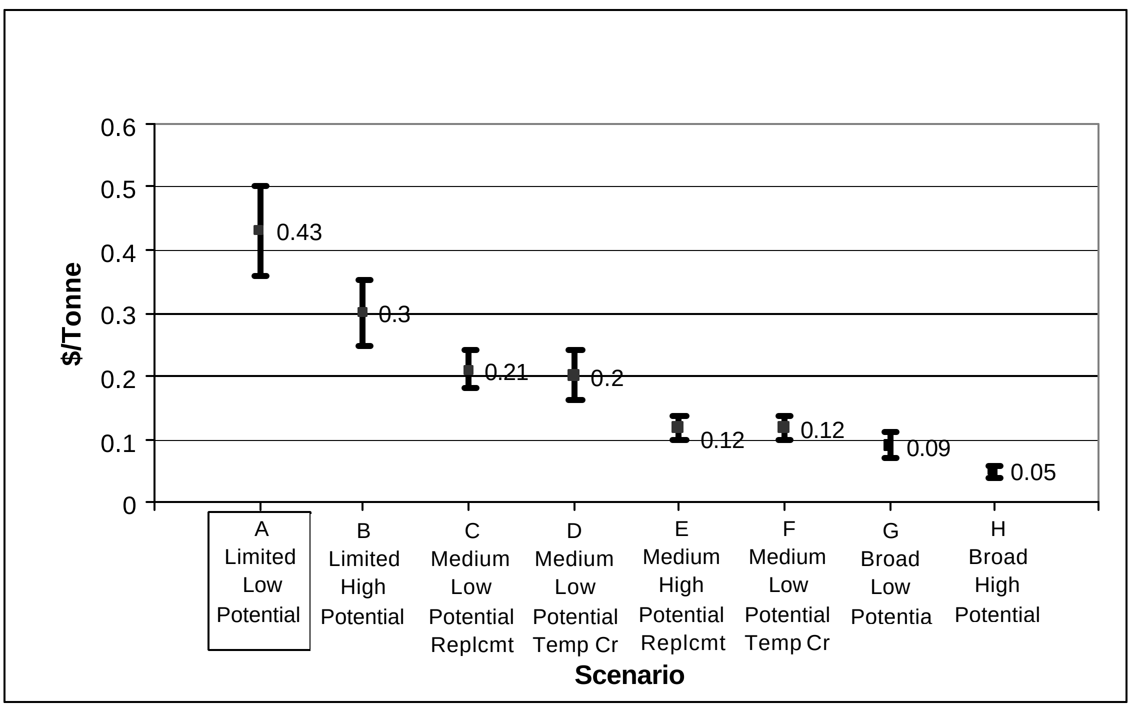


Figure 4.2
Administration Costs ($/t CO_2-e)



5. CONCLUSIONS

5.1 SYSTEM COSTS

System costs are the total costs to all project proponents and the PA to deliver the tonnes of removals and reductions defined under each case. To calculate the system costs, we add the total administration costs (calculated in section 4) to the total transaction costs obtained by multiplying each of the transaction case project costs by the corresponding number of projects (defined in section 4.1). Table 5.1 summarizes the result in 2002 dollars. To obtain the per tonne costs, the total costs are divided by the total number of tonnes generated.

Table 5.1
Offset System Costs ($ millions)

System Case	Total Transaction ($millions)			Administration ($millions)			Total System ($millions)			Total Tonnes (MT)	$/Tonne		
	L	M	H	L	M	H	L	M	H		L	M	H
A Limited Scenario Low Potential	22.1	25.4	28.8	7.1	8.5	9.8	30.3	33.9	37.5	19.5	1.56	1.74	1.92
B Limited Scenario High Potential	31.6	36.8	42.0	7.6	9.0	10.4	40.3	45.8	51.2	29.7	1.36	1.54	1.72
C Medium Scenario Low Potential Replacement Only	15.4	16.3	17.2	7.1	8.5	9.9	23.1	24.8	26.5	41.4	0.56	0.60	0.64
D Medium Scenario Low Potential Temp. Credits Only	11.6	12.2	12.8	7.0	8.4	9.8	19.1	20.6	22.1	41.4	0.46	0.50	0.53
E Medium Scenario High Potential Replacement Only	33.0	34.9	36.8	7.6	9.0	10.4	41.5	43.9	46.3	72.7	0.57	0.60	0.64
F Medium Scenario High Potential Temp. Credits Only	23.6	24.8	26.0	7.5	8.9	10.3	31.8	33.7	35.5	72.7	0.44	0.46	0.49
G Broad Scenario Low Potential	34.0	34.9	35.7	7.8	9.3	10.7	42.5	44.1	45.8	99.7[25]	0.43	0.44	0.46
H Broad Scenario High Potential	57.0	58.6	60.2	8.4	9.9	11.4	66.3	68.5	70.6	180.4[25]	0.37	0.38	0.39

[25] These estimates of total tonnes generated include 46.5-84.1 Mt of pre-2008 credits. These credits imply an associated cost of $465-841 million to compensate for the increased compliance burden in meeting Canada's Kyoto target.

Transaction costs make up between 60 and 85 percent of total system costs and therefore system costs reflect primarily the different impact of the design options on transaction costs. Thus, costs per tonne decrease substantially in moving from the limited to the broad scenario. Similarly, cases that involve temporary credits rather than required replacement produce lower per tonne costs, albeit with credits of lesser value. The higher potential cases generally produce lower per tonne costs, as the relatively fixed administration costs are amortized over a larger number of tonnes, however this can be offset by changes in the relative importance of different project types in moving from low potential conditions to high potential conditions.

5.2 IMPLICATIONS FOR THE DESIGN OF THE GHG OFFSET SYSTEM

The analysis of transaction and administration costs suggests that the impacts of design choices on transaction and administration costs vary considerably. The table below summarizes the main impacts of design choices.

Table 5.2
Impacts of Design Choices on Costs

Design Choice	Cost Implications		
	Transaction Costs	**Administration Costs**	**Total System**
Scope	No impact on transaction costs within project types.	Most significant driver for variations in per tonne administration costs because of the impact on the number of projects (less than 5% impact on total costs)	Significant impact on total system costs
Transition	Minor impacts	Minor impacts	Minor impacts
Baselines, Boundaries and Quantification	Very significant impacts on project proposal development costs and quantification/ monitoring costs.	Reduced complexity and precision decreases costs of developing protocols & guidance by one-third to one-half. Decreases verification audit costs by one-half. Total impact is less than $0.5 million (5% of total admin costs)	Significant
Verification & Quantification timing	Significant impact	5-year quantification/verification for removals reduces total verification audit costs by one-half (less than $100K or 1% of total admin costs)	Significant
Pooling	Very significant impact on unit costs. Some impact on total costs	Pooling increases overall guidance prep costs by approximately one-third (less than $0.5 million or 5% of total admin costs)	Significant
Surplus	Captured in analysis of BB&Q	Minor impact on guidance preparation (captured in analysis of BB&Q)	Captured in BB&Q

Design Choice	Cost Implications		
	Transaction Costs	**Administration Costs**	**Total System**
Pre-2008 Credits	Significant impact – generally reduced unit costs by 50%	Allowing pre-2008 credits increases verification oversight costs by 50% (1% of total admin costs)	Significant
Non-Permanence	Impact is significant but produces different commodities	Significant impact	Not compared
Ownership	Relatively modest impacts.	No significant impact	Minor impact

5.2.1 Transaction Costs

Average transaction costs per tonne vary over a wide range with design choices and project types, from as much as $19/tonne for independent agriculture projects in a scenario with a high degree of precision and complexity, to as little as $0.05/tonne for landfill gas projects in a scenario with more simplified approaches to quantification, verification and other elements.

Because of the interactions between design choices, and the need to define scenarios that group design choices together, it is not possible to completely isolate the impact of different design choices on transaction costs. However, it is clear that some design choices may have significantly more impact than others on transaction costs. The main drivers for transaction costs are:

1) Baselines, boundaries and quantification

The level of precision and complexity required in baselines, boundaries and quantification has a significant impact on project proposal development costs and quantification/monitoring costs. In the limited scenario, proposal development costs were increased by as much as $2/tonne for independent agriculture projects, $0.50/tonne for independent forestry projects and by less than $0.05 for landfill gas projects. Increased precision and complexity increased monitoring and quantification costs by as much as $5/tonne for independent agriculture projects, $0.20/tonne for independent forestry projects and by less than 1.5 cents/tonne for landfill gas projects. The main reason for the difference across project types is project size.

2) Pooling in the forestry and agriculture sectors

A pooling approach has significant implications for both agriculture and forestry, because so many transaction costs are fixed and do not vary with project size. Unit transaction costs for forestry projects were generally reduced by a factor of three in a pooling scenario. Agriculture project transaction costs were reduced by a factor of between 30 and 45, due to the 175-fold increase in project size resulting from pooling.

3) The frequency of monitoring and verification

Monitoring and verification costs, because they are recurring rather than one-time, have a large impact on transaction costs. Allowing monitoring and verification of removal projects to be done every five years rather than annually reduced these costs by approximately half. For independent agriculture projects this represented a reduction of approximately $0.60/tonne; for independent forestry projects this resulted in a reduction of approximately $0.15/tonne.

4) Pre-2008 crediting

Allowing credits for pre-2008 reductions and removals generally doubled the size of the project (after discounting) with little impact on project transaction costs, and consequently reduced unit transaction costs by approximately 50%.

5) Ownership

When ownership is not stipulated in legislation, the legal costs associated with establishing ownership were estimated to range between $2K and $20K. Although not insignificant, these costs represented a relatively small proportion of transaction costs, except for small projects or projects with low overall transaction costs (e.g. landfill gas).

The analysis suggests that these design choices offer the greatest potential for reducing transaction costs, especially on a unit (per tonne) basis.

5.2.2 Administration Costs

Compared to transaction costs, total administration costs vary with design choices across a relatively narrow range. None of the design choices affect estimated total administration costs by more than 5 percent, and in total the estimated administration costs varied by only about 10 percent across the scenarios. The design choices with the largest impact on total administration costs are:

1) Baselines, boundaries and quantification

Scenarios with reduced requirements for complexity and precision resulted in lower costs for protocol and guidance development costs and reduced costs for audits of verifications. However, the total impact of reduced complexity and precision was less than $500K, or about 5% of total administration costs.

2) Pooling

The option to allow pooling requires the development of additional protocols and guidance documents, raising administration costs by less than 5%.

3) Scope

Broader system scope requires the development of additional protocols and guidance documents. The number of projects also increases, which affects requirements for oversight/audit of verification as well as operation of the registry. The impact on total administration costs of changing system scope is estimated to be less than 5%.

Administration costs per tonne are sensitive to design choices that affect the number of projects and/or tonnes, such as scope, pooling and pre-2008 crediting. [26] These design choices offer the most potential for reducing administration costs per tonne or per project.

[26] Some caution should be used in interpreting per tonne administration costs. The analysis was based on assumptions about the number of projects in each scenario, assumptions that were made in the absence of estimates of transaction costs. In the time available it was not possible to reassess these assumptions to consider the impact that the estimated transaction costs would have on project economics in each scenario.

APPENDIX A
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APPENDIX B
List of Interviews

List of Interviews

Name	Organization	Subject
Penny Baalman	Forestry New South Wales, Australia	Forests Projects
Ed Banfield	Canadian Forest Service	Forests Projects
John Bennett	Saskatchewan Soil Conservation Association	Agriculture
Kevin Boehmer	Canadian Standards Association	Accreditation
Pierre Boileau	Environment Canada, Greenhouse Gas Verification Centre	Protocol Development and General
Michael Burnett	The Climate Trust	General
Robyn Camp	California Climate Action Registy	Registries
Alain David	Environment Canada	Landfill Gas
Simon Dawes	DNV Certification Pty Ltd., Australia	Verification Project
Aldyen Donnely	GEMCo (Greenhouse Emissions Management Consortium)	Project Initiate and Evaluate and Proposal
Len Eddy	AgCert Canada	Agriculture Projects
Ted Ferguson	BC Hydro	Project Initiate and Evaluate and Proposal
Mauritz Henkemans	ERUPC/CERUPT Program, Netherlands	General
John Hutchison	Ontario Ministry of the Environment	Protocol Development Registry
Robin James	Environment Canada, PERRL (Pilot Emission Removals, Reductions and Learnings) Program	Protocol Development Registry
Mark Johnson .	Saskatchewan Research Council	Forests Projects
Joanne Kellerman	Natural Resources Canada, LFE Group	Legal Framework
Sudhir Khanna	Ontario Ministry of the Environment	Protocol Development and Registry
Tony Lemprière	Canadian Forest Service	Forests
Tim Lesiuk	BC Hydro	Project Proposals
Paul McArdle	United States Department of Energy, Voluntary Programs Office, United States	Registry
Brian McConkey	Agriculture and Agri-Food Canada	Agriculture Projects
Lisa Minotti	Ontario Ministry of the Environment	Protocol Development and Registry
Carlos Monreal	Agriculture and Agri-Food Canada	Agriculture Projects
Richard Patterson	Marbek Resource Consultants	Energy Efficiency
Ken Plourde	Alberta Pacific Forest Products	Forest Projects
Ray Rivers	Clean Air Canada Inc.	Protocol Development and Registry
Stéphane Roberge	Environment Canada, Legal Counsel	Legal Framework
Leslie-Anne Robertson	Clean Development Mechanisms/Joint Implementation Office	General
Paul Robillard	Marbek Resource Consultants	Energy Efficiency
Doug Russell	Global Change Strategies International/Natsource	Brokerage

Name	Organization	Subject
Jan Schuh	TerraRemote	Monitoring
Laurent Segalen	PwC Paris, France	General
Matt Spanagle	Australian Greenhouse Office, Australia	Offset Systems Setup and Operation
Don Wharton	TransAlta	General
Sean Whittaker	Marbek Resource Consultants	Renewables
Ian Wishart	Keystone Agricultural Producers Association	Agriculture Projects

APPENDIX C
Key Cost Drivers

TRANSACTION AND ADMINISTRATION COST CONTRACT
DESIGN OPTIONS FOR SOME KEY COST DRIVERS

This piece has been written to tailor the work of the transaction and administration cost contract only - no policy decisions have been made as to the eventual design of an offset system. In that context, this piece provides design options for some key cost drivers on which the final report should convey findings. Findings on other major issues noted in the Discussion Paper should also be conveyed.

For the key cost drivers below, limited and broad access options are presented. Definitions are as follows:

- *Limited Access* – design options involving limited scope and rigorous eligibility requirements - may be expected to increase costs
- *Broad Access* – design options that maximize participation - may be expected to decrease costs.

A medium access option is also presented, which is meant to incorporate aspects from the both the limited and broad access options.

Scenarios

	Limited Access	Medium Access	Broad Access
Scope	Agriculture, forestry and landfill gas	Agriculture, forestry, landfill gas and other sectors, excluding renewable energy and energy efficiency	Agriculture, forestry, landfill gas and other sectors, including renewable energy and energy efficiency
Transition	Scope of system phased in to allow for learning by doing.	Same as broad access	All projects are eligible from the launch of program.
Baselines, Boundaries and Quantification	*Baseline estimation approach*: The Program Authority specifies a precise baseline estimation approach – e.g., data rich modeling approach to estimate a BAU scenario. *Quantification approach:* The Program Authority specifies a medium number of parameters in the quantification approach. *Accuracy:* The Program Authority requires very accurate estimation of the baseline and quantification – e.g., a very high confidence level. *Leakage:* The Program Authority requires precise leakage accounting in the baseline and in measurement and monitoring – e.g., proponent must justify boundaries for leakage assessment to Project Authority on a project-by-project basis.	Same as broad access	*Baseline estimation approach*: The Program Authority allows a less precise approach to easily estimate the baseline – e.g., historical emissions/ removals over a base period are used as the baseline scenario. *Quantification approach:* Where it is the lowest cost option, the Program Authority specifies as few parameters as possible in the quantification approach. Where it is the lowest cost option, Program Authority specifies as many parameters as possible. *Accuracy*: The Program Authority requires accuracy but at a lower level than with limited access option. *Leakage:* The Program Authority requires less precise leakage accounting – e.g., set geographical limits are used for all projects of a given project type.

Verification & Quantification timing	• Reductions
	  • Permanent credits – annual
	• Removals
	  • Permanent credits – annual
		• Reductions
		  • Permanent credits – annual
		• Removals
		  • Permanent credits – annual
		  • Temporary credits – 5 years
			• Reductions
			  • Permanent credits – annual
			• Removals
			  • Permanent credits – 5 years

Pooling	Independent project/producer approach only.	Same as broad access	Both independent project/producer and pooling approach available at the same time.

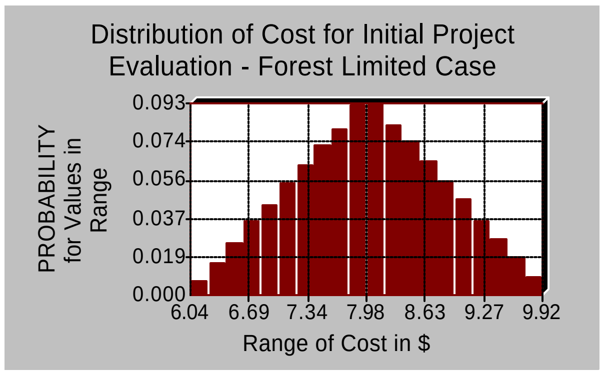
	Limited Access	Medium Access	Broad Access
Surplus	The reduction /removal, or the activity that causes it, exceeds the level that might reasonably be expected will be achieved due to another government climate change measure. The reduction /removal, or the activity that causes it, is not required by federal/ provincial/ local regulation or operating certificate existing at the time of credit creation. Reductions/ removals under a voluntary agreement may not be eligible if the agreement is comparable to a regulatory requirement.	Same as broad access	The reduction /removal, or the activity that causes it, exceeds the level that might reasonably be expected will be achieved due a federal government climate change measure. The reduction /removal, or the activity that causes it, is not required by federal regulation or operating certificate existing at the time of credit creation.
Pre-2008 Credits	Do not allocate credits for reductions /removals during the pre-2008 period.	Same as limited access	Allocate potentially discounted credits for reductions/removals during the pre-2008 period for use in the 2008-12 period.
Non-Permanence	Risk management plan and required replacement.	Risk management plan and proponent can choose to use the requirement replacement approach or the temporary offsets approach.	Only a risk-management plan is required.
Ownership	Ownership rule stipulated in advance in legislation and supplemented by private contracts addressing special circumstances.	Same as limited access	Ownership determined by private contracts only

APPENDIX D
Explanation of Modeling Approach

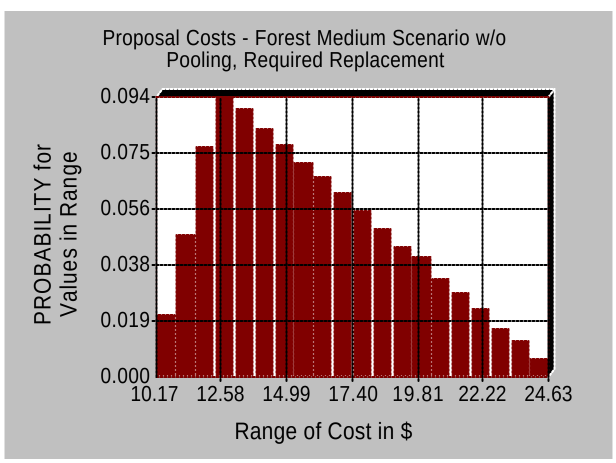
EXPLANATION OF MODELING APPROACH

A number of steps were followed for the administrative, transaction and system cost compilations. These steps are described below.

1. Start-up and yearly costs and uncertainty ranges by cost element and case were first estimated. The ranges reflect the probability density function (PDF) based on low, central and high estimates. In the chart below, a cost range specified as 5, 10 and 15 is presented as a PDF for the Initial Project Evaluation costs for forests limited case. This distribution of costs simply states that the most likely estimate for the cost falls in the center of the range but may also be found in decreasing probability in the outer ends of the range.



Similarly, for forests medium case without pooling, the range of Development of Project Proposal Costs is between 10 and 25 with a central value of 12.5. This weighting skews the sampling distribution to the left, where the majority of the probability can be found. However, to be conservative, the sampling also is conducted at the upper end of the range, but less frequently.



These ranges are then used in a Monte Carlo sampling framework for the cost compilation. Monte Carlo sampling uses the PDF for each input variable to estimate a PDF of outcomes. For example, in case 1, the PDF above along with PDFs for all of the other cost elements for case 1 is used to estimate a range of possible costs (or outcome

PDF) for the case. This outcome PDF then provides a solid understanding on how the costs for each case vary based on our uncertainty in the actual input value (i.e., cost element).

2. The costs were then attributed to the year in which they are expected to occur between 2005 and 2012. In the example below, the Initial Project Evaluation cost for case 1 is expected to occur in 2006. The cost is then discounted to 2002 dollars using the Treasury Board recommended rate of 10%. Similarly, applicable operating costs were identified as a steam of on-going yearly costs over a period and then discounted back to 2002 dollars.

Cost Element	Scenario		NPV in 000s $2002	Year									
				2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Initial Project Evaluation	#1	Limited	$6.83	0	0	0	$10.00	-	-	-	-	-	-

3. Tonnes were also discounted back to the year 2002 using the 10% discount rate. For example, a stream of 20 kt annually from 2008 to 2002 (i.e., limited or medium scenario) would be equivalent to 47 kt in 2002. The discounted tonnes were then used to estimate complied costs in terms of $ per tonne.

4. Total administration, transaction and system costs were then compiled and uncertainties estimated. Uncertainties are estimated using the output from the Monte Carlo sampling. Since a PDF is estimated for each output, we are able to identify the mean value (or central) as well as a standard deviation which characterizes the "spread" around the mean. We then use 2 times the standard deviation to identify 95% of the PDF in which the actual administration, transaction and system cost estimate can be expected to be found. That is, the uncertainty range we specify around the central value captures 95% of the probability of where the actual cost can be expected to be found.

The adjacent chart presents the $/tonne results for forests limited case without pooling. The central value for this scenario is $2.6/tonne, with low and high values of $1.91 and $3.33/tonne. However, to exclude outliers (extreme deviations from the mean) we take two standards deviations from the central value (which is +/- $0.51/tonne) and estimate a new low value of $2.1/tonne and a high of $3.1/tonne (second vertical dotted lines on the graph are 2 standard deviations from the mean). This range is reported in the compilation results above and captures the majority of the probable cost outcomes for each scenario (i.e., the outliers beyond 2 standard deviations are excluded).