

ECOSYSTEM SERVICES ROADMAP

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“A Pathway to Innovation and Competitiveness”

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“Ecosystem Services Roadmap: A Pathway to Innovation and Competitiveness”

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Ecosystem Services Roadmap:

A PATHWAY TO INNOVATION AND COMPETITIVENESS

1. EXECUTIVE SUMMARY

“Ecosystem services” refers to the benefits that society enjoys from a range of resources and processes supplied by nature. Everything from maintaining biodiversity to the production of ecosystem goods, such as seafood, wild game, forage, timber, biomass fuels, natural fibres, many pharmaceuticals, and industrial products. Ecosystem services are integrated in nature and provide recognition of the system, connections and choices (or tradeoffs) to be made around the environment, economy, and society. An ecosystem services approach ensures that we consider the nature and magnitude of the service, how it would change if the ecosystem changed, who makes use of the service (in what way and for what purpose), what alternatives they have, and what trade-offs there might be between the different kinds of services that an ecosystem might provide (e.g., carbon sequestration versus biodiversity, agricultural production versus water quality, current water use versus future water needs).

Management decisions might focus on the immediate provision of an ecosystem service, at the expense of this same ecosystem service or other services in the future. Identifying tradeoffs allows there to be an understanding of the long-term effects of choosing one ecosystem service over another and the consequences of focusing only on the present provision of a service rather than its future. Focusing on ecosystem services results in an integrated approach to land and resource management. It requires coordination and collaboration across sectors and disciplines and relies on transparent and credible science-based information about the state of ecosystem services.

The Roadmap provides the strategic direction for areas requiring innovation relating to the enhancement of ecosystem services and the application of market-based approaches to strengthen the competitiveness of resource-based sectors through environmental excellence.

Markets for some of nature's benefits are already well developed, such as the provision of forest products and agricultural crops. However, markets for most ecosystem services are less well established, even though those services provide important benefits such as climate moderation, water regulation, pest control, and wildlife habitat, to name a few.

Various organizations, government departments, agencies and councils in Alberta have been evaluating market-based instruments for applications related to environmental issues faced by specific regions of the province. These include:

1. Water Quantity—pricing and trading
2. Water Quality—trading and effluent management schemes
3. Air Quality—emissions trading system for NO_x and SO_x
4. Land Use—transfer of development rights, conservation easements, and tax increment financing
5. Biodiversity Conservation—tradable land use rights, conservation easements, biodiversity banking, and conservation offsets
6. Wetlands Preservation and Restoration—mitigation banking and offsets

Well-functioning markets need transparent and consistent information sharing and knowledge availability. There is currently a lack of access to data and information on ecosystem services, processes and variables that influence ecosystem well-being. There is also a need to better understand the dynamics between ecosystem processes and human and natural disturbance variables.

To assist with addressing these gaps, on-the-ground applied proofs of concept will be carried out to enhance ecosystem services through conservation offsets, a type of market-based instrument. Knowledge gained on the inner workings of this tool will be used to inform the development of other types of market-based instruments.

Building on the integrative nature of the Millennium Ecosystem Assessment (the international standard for the emerging concept of ecosystem services), the RUBICODE Project, and the former Institute for Agriculture, Forestry and the Environment, the applied proofs of concept projects, initially targeted to the Lower Athabasca and South Saskatchewan planning regions, will address identified gaps in a multidisciplinary, multi-stakeholder manner across sector boundaries. Because it is extremely important to involve and engage a very broad range of disciplines to create a new type of knowledge base oriented around socio-ecological systems (cumulative effects management), a systems approach is required. This approach focuses a wide array of disciplines on common, very complex problems that require integration and collaboration of research and management, with the varied stakeholder interests.

A key requirement is the ability to quantify the tradeoffs between different ecosystem services (i.e., carbon versus biodiversity). Integrating research on tradeoffs between ecosystem services with applied proofs of concept requires involvement from community stakeholders and decision makers. For example, quantifying ecosystem services and mapping them spatially across a planning region to identify scarcities and priorities may highlight areas where conflicts or unintended consequences associated with the provision of differing ecosystem services are likely to occur. Engaging stakeholders in the process to evaluate and prioritize ecosystem services builds community understanding of what ecosystem services are and why they are so valuable.

Work on developing key components such as the data and information management system, and the ecosystem services assessment, have been started to support implementation of the proofs of concept over the next five years. The Roadmap outlines the work that will take place in the proofs of concept with and through a network of experts and specialists, community stakeholders, and policy advisors in a creative environment. Stemming from the Millennium Ecosystem Assessment, the next action identified for the implementation of an ecosystem services approach is to step away from discipline-bound research and focus on a multidisciplinary approach to build knowledge about socio-ecological systems¹. This approach is founded on better integration, multidisciplinary perspective, and advancing existing and active market approaches and tools. It will be nimble and responsive, and will advance knowledge and understanding by building on and bringing together work being done by many organizations in the province.

The Roadmap outlines:

1. The background and context for market-based approaches to enhance ecosystem services in Alberta.
2. An overview of the current state of knowledge regarding ecosystem services, technology and systems to enhance the application of market-based instruments, and the key players engaged in this work (networks).
3. Knowledge, information and capacity gaps.
4. The key actions needed to fill the gaps in current knowledge on ecosystem service concepts and to turn the goals into outcomes for research and innovation.

¹ Carpenter SR, et al. (2009) Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment. *Proc Natl Acad Sci USA* 106:1305-1312.

2. INTRODUCTION

Al Bio has brought together key stakeholders and experts to set out a strategic framework—the Ecosystem Services Roadmap—that will catalyze innovation and competitiveness in the resource sectors, and create opportunities for Alberta to brand itself as a leader in land and environmental management. The mission for this Roadmap is:

To facilitate the development and practical application of leading-edge knowledge focused on enhancing ecosystem services, through market-based instruments, integrated systems and collaborative processes.

Ecosystem services are the benefits that people obtain from the environment, including such things as air and water filtration, food and fibre production, and recreation.

Ecosystem services are important to Alberta in terms of the changing demands in land use, for biomass production, maintenance of native ecosystems, and provision of services that have traditionally not been included in decision-making. As populations increase, it becomes more critical to consider long-term ecosystem health and its role in enabling human habitation and economic activity—we all depend on ecosystem services for our survival and high quality of life.

An ecosystem services approach is intended to alter the demand for different land use and management in order to enhance ecosystem services that have both monetary and inherent value to all citizens. This change can be intentionally facilitated by the use of market-based instruments, which help establish values for non-market goods and services that usually do not have monetary pricing.

Market-Based Instruments are policy or program tools that use markets or economic incentives to change behaviour in order to achieve socially desirable outcomes.

Underlying an ecosystem services approach is the determination of the value of these services to human well-being and our impact on the environment and ecosystem services, so that we can make informed decisions. In this regard, the role of institutional collaboration becomes critical to the success of a new environmental paradigm. Using market-based instruments to assign economic values to those ecosystem services for which markets do not exist helps to inform decision-makers (government, industry, and the public) about the relationships between ecosystem services and human well-being, and the crucial tradeoffs and opportunities that are a part of every ecosystem decision.

A **Market-Based Approach** is based on the idea of using market forces to represent the costs of degraded ecosystem services. This helps identify the cost of ecosystem services losses, so those costs can be passed on to those creating the most negative impact. A market-based approach involves the use of market-based instruments and policies to add value to non-market ecosystem services so they are not overlooked during development decisions.

Institutional collaboration refers to the sharing of resources (financial, human and knowledge) among multiple partner institutions. In an ecosystem service approach the collaboration may be between the landowners, industry, environmental organizations and local governments with their provincial and federal counterparts. In an institutional collaboration approach, the institutions involved do not have to have similar interests or similar levels of expertise but they do need to have resources that other institutions would like to share.

While humans have made significant advances in the areas of material wealth and economic development through the extraction and use of renewable and non-renewable resources, such activities have resulted in the degradation of global ecosystem services. The science is becoming increasingly clear that when subjected to severe change, ecosystems may cross thresholds and move into different and often less socially desirable ecological states or trajectories.² As our ecosystems change, so does the reliability and flow of the mix of services we extract from nature.

Many organizations have contributed to research in support of market-based approaches to ecosystem service enhancement and management. This research explores the options for ecosystem services markets and other emerging opportunities. The Roadmap builds on previous work by:

- The Millennium Ecosystem Assessment. Established by the United Nations in 2000, it is the world's standard in defining ecosystem services. It created an innovative model to illustrate the interdependence and substitution effect of ecosystem services.
- The Government of Alberta Land Use Secretariat. It implemented a public input and land use planning system to develop desired outcomes by region.
- The former Institute for Agriculture, Forestry and the Environment. It supported the development of a knowledge base for ecosystem service markets, developed a policy framework to relate ecosystem service decisions to the marketplace and identified critical components required for such a system.
- The Alberta Biodiversity Monitoring Institute. It prototypes monitoring and benchmarking to measure real changes in the landscape.
- The former Alberta Water Research Institute. It conducted funded research related to valuation of water, new market-based approaches to water management, and stakeholder lead watershed management.
- The Alberta Conservation Association. It conserves, protects and enhances fish, wildlife and habitat for all Albertans to enjoy, value and use. It has been working with various industry, government, and not-for-profit groups around voluntary conservation offsets and other habitat conservation initiatives.
- Ducks Unlimited. It is the leader in wetland conservation, and has significant capacity, experience and knowledge related to wetlands and conservation programs.
- Government of Alberta departments.
- Other key contributors.

This previous work has identified the knowledge gaps, and explains next steps. On-the-ground, applied proofs of concept have been selected as the best method for addressing the gaps. These proofs take the phased approach required to enhance ecosystem services through market-based instruments, and work through any unexpected issues.

Phased Approach: by using a phased implementation and adaptive management approach, the Roadmap is able to move forward, despite uncertainty, with a course of action that facilitates learning and continuous improvement. The approach will include defining the problem, selecting research or proofs of concept to test hypotheses, monitoring progress, and evaluating the results (including revising the hypotheses when necessary). The lessons learned from current initiatives will be incorporated into our management and decisions regarding future pursuits.

² Pushpam Kumar (ed). "The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations, in Chapter 2: Biodiversity, ecosystems and ecosystem services" Earthscan, London, U.K. (October 2010) 456 pgs.

Alberta's economy is driven by natural resource extraction, and our resource-based industries need policy to protect the ecosystem services provided by nature. Recent policy, such as the Land-use Framework, has been pushing towards "cumulative effects management" instead of "project-by-project management" to enable a broader understanding of the overall environmental impacts of development.

In Alberta, legislation and targets related to cumulative effects management are yet to be set. Clear targets will assist in stimulating environmental innovation and new efficiencies, and will drive innovation in businesses and institutions. "New" ecosystem services from the land and water will be seen and developed as potential new profit centres for businesses; however, creating the climate and infrastructure to capture the benefits of these new services will not be as straightforward as exporting natural resources.

PURPOSE

The purpose of this Roadmap is to bring together an expert network of stakeholders and practitioners to jointly put in place the systems, tools, and knowledge to ensure the effective application of market-based instruments for the enhancement of ecosystem services. This work will support the province in achieving the long-term land use and management objectives outlined in regional land use plans.

GOAL

To build the capacity, knowledge and systems to bring Alberta to the forefront of innovation in the provision of ecosystem services through use of market-based instruments, to achieve green growth and sustainable development

The goal of this Roadmap directly supports the Government of Alberta's three priority areas:

- **Investing in Families and Communities** - Supporting healthy and strong families and communities is an investment in Albertans and Alberta's future.
- **Securing Alberta's Economic Future** - Making strategic investments in both human capital and infrastructure to strengthen Alberta, grow our knowledge-inspired economy, and improve Alberta's competitiveness in the global marketplace.
- **Advancing World-leading Resource Stewardship** - Developing our natural resources responsibly to protect our environment and grow our markets. "

OBJECTIVES

This Roadmap intends to assist Alberta in expanding capacity in the following areas by 2015:

1. Necessary scientific, biophysical and socio-economic knowledge related to ecosystem services in place.
2. Institutional capacity to enable the enhancement of ecosystem services using market-based instruments.
3. Credible, open data and information management to facilitate timely, transparent knowledge exchange and enable verification, validation and proof of environmental integrity.
4. New ventures and business opportunities associated with the provision of environmental solutions and the enhancement of ecosystem services.

The Roadmap will also assist the Government of Alberta in:

- Achieving its objective to "green growth" and improve environmental outcomes;
- Providing a basis to support economic diversification;
- Enhancing competitiveness opportunities for energy, agriculture and forestry, and other managers of natural resources; and
- Branding Alberta as the leader in environmental management.

2.1 ALBERTA'S ENABLING POLICY DIRECTION

Harvard Business School economist and strategy professor, Michael Porter, asserts that well-designed regulation enhances competitiveness.³ Considerable research has and continues to be conducted to examine the theory behind his approach.⁴ Porter challenged regulators to examine the likely impacts of their actions and choose regulatory mechanisms that would foster innovation and competitiveness. In the economy, using market-based instruments to achieve environmental objectives can lead to a number of beneficial outcomes:

- Sustained resource revenues for firms that exceed environmental compliance.
- Innovative management practices and strategies as firms compete for conservation revenues.
- A more robust and transparent environmental compliance framework for industrial land users, resource-based companies and urban developers.
- A mechanism for companies, individuals and whole sectors to benefit from converting inputs to economic outputs while seeking to reduce environmental impacts and increase efficiencies.⁵

In Alberta today, important policy signals are enabling the use of market-based instruments for ecosystem services. The following initiatives provide policy direction for the future, and opportunities for innovation.

2.1.1 Land-use Framework (2008)

The Land-use Framework is a comprehensive approach to managing public and private lands and natural resources. It divides the province into seven regions and commits the Alberta government and regional committees to develop integrated regional plans that define outcomes (e.g., economic, environmental and social) for land and natural resource use. Regional plan development and implementation will adopt a cumulative effects management approach that is based on setting thresholds and consideration of the potential impacts of all activities within a region. The supporting legislation (*Alberta Land Stewardship Act*, enacted in 2009) enables the development and implementation of conservation and stewardship tools, including market-based instruments (e.g., conservation easements, offsets, directives, and transfer of development credits), and the policy infrastructure that would form the basis of an ecosystem services market.

The Act lays out the process and focus areas for Alberta's land use planning efforts, and enables the use of market-based instruments, such as conservation offsets as tools for land use planning in Alberta. Currently, the first two of seven regional planning processes are underway for the Lower Athabasca region and the South Saskatchewan region. This planning process is proving to be difficult because of the complexity of integrated land management. As the first two regional plans are developed, it is evident that the major

Integrated Land Management: is the strategic planned approach to managing and reducing the human-caused footprint on public land. By working together, land-users can reduce their impact on the land by sharing land, planning the use of the land together, building understanding and practicing stewardship (Alberta Environment and Sustainable Resource Development). It is different from traditional land use management, which bases planning decisions on a variety of triggers that are not coordinated among land users.

³ Consistent with the growing trend towards performance-based and/or market-based environmental regulations.

⁴ Sustainable Prosperity. *The Porter Hypothesis at 20: Can Environmental Regulation Enhance Innovation and Competitiveness*, Ottawa, ON (June 29th, 2010) available online: <http://www.sustainableprosperity.ca/article223>

⁵ Michael Porter, *The Competitive Advantage of Nations* (Free Press, 1990).

challenge for land use planning is to effectively determine regional objectives and outcomes. This will likely be a continuing challenge while developing the remaining five regional plans. However, integrated land management can be facilitated through the use of a market-based approach, by promoting conservation of ecosystem services with market-based instruments, and thereby reducing the human-caused footprint on the land base.

2.1.2 Water for Life – Alberta’s Strategy for Sustainability (2003), and Water for Life – A Renewal (2008)

Alberta’s well established system for allocating and managing water has served the province well; however, Alberta’s growing population and economy have increased the demand for water, while a changing climate has highlighted the need to adapt and plan for future challenges. Alberta Environment and Sustainable Resource Development’s current review of the water allocation management system will create a diverse suite of policy options and tools that address provincial strategic outcomes. The former Alberta Water Research Institute, now a part of Alberta Innovates – Energy and Environment Solutions, is also addressing some of these issues.

2.1.3 Launching Alberta’s Energy Future: Provincial Energy Strategy (2008)

The Government of Alberta strategy for positioning Alberta is guided by a vision that the province should aspire to be “a global energy leader, recognized as a responsible world-class energy supplier, an energy technology champion, a sophisticated energy consumer, and a solid global environmental citizen”. Innovation is a recurring theme within the strategy. It also recognizes the increasingly important role of “renewable” in Alberta’s energy future. Alberta Innovates – Energy and Environment Solutions, is also addressing these opportunities.

2.1.4 Former Institute for Agriculture, Forestry and the Environment Ecosystem Service Market Policy Framework

In 2008, the Premier mandated the Institute for Agriculture, Forestry and the Environment to develop a policy framework for market-based approaches for providing ecosystem services. In March of 2010, the Institute submitted a framework to the Government of Alberta that outlined a phased approach to creating a coordinated, integrated market system for enhancement of ecosystem services, which would offer many benefits to the Government of Alberta, to companies doing business in this province, and to Albertans. Although the policy framework has not yet been released, this Roadmap builds on the extensive research and knowledge compiled to inform it, and key components of the proposed market-based system.

3. BACKGROUND AND CONTEXT

Alberta is one of the most resource-rich provinces in Canada and natural resource extraction has been occurring here for many centuries. The province has seen a dramatic change in its landscapes as the energy and forestry industries, as well as urban development have re-shaped land use patterns and impacted the mix of existing ecosystem services received by Albertans. Alberta is also an export-oriented province that sells products such as beef, wood products, canola, and oil and gas abroad.

Alberta's current economic success and growth has been related to an energy-driven boom that has caused rapid growth in population and economic activity. This is placing considerable pressure on Alberta's ecosystems as oil and gas, forestry, mining, agriculture, recreation, housing and infrastructure all compete to use the land. At the same time, environmental limits are being approached, causing biodiversity, water conservation and climate change to become new drivers for innovation and intentional management for competitiveness.

3.1 ECOSYSTEM SERVICES APPROACH

Ecosystem services are all around us, and every land management decision we make (e.g., watershed preservation, resource extraction, food production, recreation or residential area development) requires that choices be made (consciously or unconsciously) about ecosystem services. Ecosystem services play a central role in both adaptation to and mitigation of existing environmental problems.

Consumer expectations related to ecosystem services are changing, and recent announcements by major multi-national corporations like PepsiCo⁶ and Walmart⁷ demonstrate a corresponding shift in business decisions. This trend presents a significant opportunity for Alberta-based companies to differentiate themselves and their products based on their enhancement of and contributions to the provision of ecosystem services. While many of the companies operating in Alberta are at smaller scales, they often supply their products to large corporations. This relationship between buyer and seller requires a unique environment to enable the large corporations to achieve broader environmental objectives by extending environmental standards through the supply chain to the small-scale producers.

When we focus on ecosystem services, an integrated approach to land and resource management is the result. This approach requires coordination and collaboration across sectors and disciplines and relies on transparent and credible science-based information about the state of ecosystem services. An ecosystem services approach shifts Alberta from a prescriptive command and control approach to environmental management that is focused on outcomes and results, and which must be structured to create opportunities for innovation, competitiveness, and leadership to allow for:

- Strengthening of Alberta's resource industries by creating opportunities for business innovation to add value, improve competitiveness and investment, and align environmental performance with enhanced efficiency.
- Achievement of multiple desired outcomes through bundling and integration of ecosystem services on a landscape basis, thereby ensuring that businesses have access to a range of tools and options to facilitate their effective participation in the market.
- Achievement of existing policy direction integrated through the regional plans developed under the Land-use Framework.

⁶ PepsiCo has established water conservation and GHG reduction objectives for its water sourcing/bottling facilities.

⁷ Walmart recently enacted a series of five-year goals focusing especially on farming and the food supply chain.

- Positioning of Alberta as a global leader in environmental policy related to land and resource use.
- Opportunities for new jobs as a result of healthier resource industries, increased investment in Alberta's economy and the formation of new businesses needed to support market operation.
- Enhanced water quality and quantity, wildlife habitat, recreation opportunities, scenic beauty and biodiversity, and quality of life for Albertans.
- Expanded opportunities to choose products and services based on their documented environmental integrity.
- A broader stream of resource revenues for firms that enhance their environmental performance and go beyond compliance.
- Opportunities to improve competitiveness through innovative management practices and strategies that better position firms to compete for ecosystem services revenues.
- A mechanism for companies and whole sectors to benefit from converting inputs to economic outputs as they reduce their production of waste and the footprint of their operations and developments, and as they improve efficiencies in resource inputs.
- More investment certainty through a performance-based approach that rewards innovation and improved efficiency.
- Opening the opportunity for new ventures in support of the ecosystem market in the areas of accumulation, validation, verification and certification.
- The development and strengthening of property rights, which in turn creates a more sound definition of wealth and corresponding cash-flow generation.

One of the Land-use Framework's basic principles relates to cumulative effects management. It is an approach to land-use decision making that considers the potential impacts of all activities within an area, rather than the impacts of development on a project-by-project basis, and involves establishing desired outcomes and targets or limits for various land uses. An ecosystem services approach links to cumulative effects management by allowing policy makers to understand the long-term effects of ecosystem service choices.

Cumulative Effects Management: considers the environmental impacts of development across entire regions, and uses collaborative approaches to develop shared outcomes and objectives, build partnerships, and set regional limits (e.g., North Saskatchewan Watershed Alliance).

An ecosystem services approach ensures that we consider the nature and magnitude of the service, how it would change if the ecosystem changed, who makes use of the service (in what way and for what purpose), what alternatives they have, and what trade-offs there might be between the different kinds of services that an ecosystem might provide (e.g., carbon sequestration versus biodiversity, agricultural production versus water quality, current water use versus future water needs). Management decisions might focus on the immediate provision of an ecosystem service, at the expense of this same ecosystem service or other services in the future. Identifying trade-offs allows there to be an understanding of the long-term effects of choosing one ecosystem service over another and the consequences of focusing only on the present provision of a service rather than its future.

Ecosystem services will play a central role in both adaptation to and mitigation of existing environmental problems.

3.2 MARKET-BASED APPROACH TO ENHANCING ECOSYSTEM SERVICES

A market-based approach for ecosystem services relies on market forces to regulate the supply of and demand for ecosystem services. This type of approach involves the use of market-based instruments, which are policies or programs, to place a value on ecosystem services so they are not overlooked during development decisions. This helps identify the cost of ecosystem services losses so those costs can be passed on to those creating the most negative impact. This way society isn't burdened by the consequences of degraded ecosystem services.

The creation of new markets for ecosystem services can expand business opportunities and investment in Alberta's natural resource sectors, while protecting and restoring the services provided by Alberta's ecosystems. By creating economic and regulatory incentives for conservation and stewardship of ecosystem services, markets can guide people's behaviour in directions that support desired environmental and economic outcomes.

3.2.1 CRITICAL COMPONENTS OF A MARKET-BASED SYSTEM

The former Institute for Agriculture, Forestry and the Environment outlined the opportunities for Alberta to use market-based tools and policy instruments to improve business innovation and enhance the provision of ecosystem services in Alberta. Research completed to support the Institute's work identified the critical components of a market-based system, including the development of an ecosystem services assessment, a verification and validation system, an information and knowledge management system, use of adaptive management, an ecosystem service trading platform, and a new governance model as seen in Figure 1. AI Bio has used this model to guide the Roadmap.

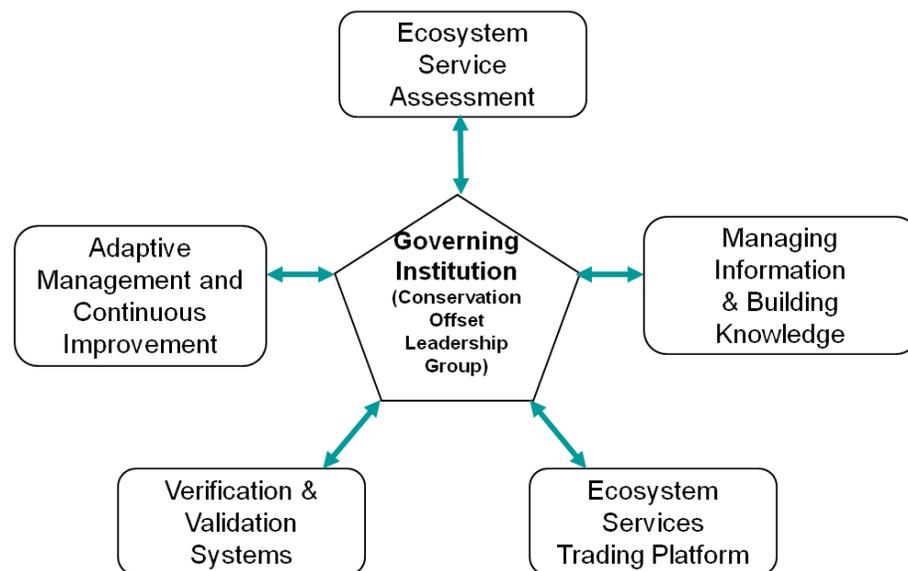


Figure 1: Components for a Successful Market-based System to Enhance Ecosystem Services.
Source: Pembina Institute, Market-Based Approaches for Ecosystem Services (March 2010).

3.2.1.1 ECOSYSTEM SERVICE ASSESSMENT

Assessments must be completed to identify the supply of ecosystem services and determine the condition and extent of each of the ecosystem services in a given region. The ecosystem service assessment enables the establishment of metrics and currencies to facilitate identification and registration of ecosystem service (i.e., stewardship) units, and facilitate the following marketplace measurement functions:⁸

- Estimating the quantity and quality of ecosystem service units.
- Identifying and describing the spatial relationship between management actions and ecosystem change in a region and the expected impact on ecosystem services.
- Establishing baselines against which to measure future changes in ecosystem services.
- Assessing the location of ecosystem service outcomes and their relative value to adjacent communities.
- Assessing the timing of ecosystem service outcomes.
- Assessing the risk and certainty of management outcomes based on predicted human and natural factors.
- Enabling the scaling-up of ecosystem service outcomes to assess the positive and negative impacts for other markets and large-scale ecosystem functions.

The assessment of ecosystem services will build from new and existing data sets and inventories, and be integrated across local, regional and provincial scales to enable prioritization and assignment of a value (or currency) to the particular ecosystem service attached to the area.

3.2.1.2 MANAGING INFORMATION AND BUILDING KNOWLEDGE

Managing data, information and building knowledge is critical to the management of ecosystem services and use of market-based instruments. Establishment of the long-term supporting mechanisms necessary for credible environmental management and for markets is important for overall provincial success with environmental outcomes. These mechanisms are similar to those needed for all resource management approaches and include:

- Research and policy analysis capacity; and
- Data procurement and development of supporting models.

A robust information management system is based on collaboration, cooperation, transparency and data sharing among all stakeholders and partners to achieve efficiency, effectiveness and increased transparency. A solid foundation of collaboration and cooperation between government, business and communities will change the way solutions are developed for complex environmental issues. Shared participation and collaboration across all resource management sectors will help to bring about a new environmental management paradigm and brand Alberta as an environmental leader. Some of the main components of the information management system include:

⁸ Whitten et al., *Market-based Instruments*.

- A spatial ecosystem service inventory.
- An ecosystem service indicator database to provide an understanding of trends in ecosystem services provincially, regionally and sub-regionally.
- An economic valuation database to identify local and regional benefits.

Connected with information management is the need to build a distributed knowledge infrastructure that supports data management, policy instrument evaluation and the integrity of marketplace transaction and institutional networks. This infrastructure in turn will build capacity in personnel, science, research, and policy analysis management to ensure the functioning of individual instruments and the overall ecosystem service marketplace.

Knowledge networks have been an effective approach to facilitate the collaboration of researchers and policy analysts working on similar natural resource and environmental issues. Similarly, a knowledge network, or centre of excellence will be needed to support a market-based approach to ecosystem services.

Collecting and sharing information required to support land use planning and decision-making is critical to the success of the ecosystem services market. Creation of an integrated system to ensure decision makers have access to the information they need is fundamental.

3.2.1.3 VERIFICATION AND VALIDATION SYSTEMS

Setting environmental targets requires verification of environmental responsibility. A demonstrable commitment to environmental integrity is now a requirement for a successful resource based economy; local and regional environmental impacts must be addressed to maintain or enable market access. Markets require open information, certainty and credibility, and markets for ecosystem services will also require verification and validation systems so that the exchanges between buyers and sellers are valid. This means developing specific protocols to ensure that those who assess the exchanges are proficient and fully understand the metrics involved so that the correct credits are associated with the action. Correct in this context includes quantity and quality validation.⁹

Documenting ecosystem service outcomes is based on the use of quantitative methods to measure the ecosystem services achieved by applying a particular instrument and in

Convention on Biodiversity: Clearing-House Mechanism

The Convention on Biological Diversity's (CBD) Clearing-House is a type of knowledge network that supports the approach of the Roadmap. It is based on the philosophy that broad participation and easy access to information must be a top priority. The Clearing-House brings together a network of non-government organizations, other institutions and governments to promote the goals of the CBD.

The mission of the CBD Clearing-House is to:

- Promote and facilitate technical and scientific cooperation, within and between countries
- Develop a global mechanism for exchanging and integrating information on biodiversity
- Develop the necessary human and technological network

The committee works in a transparent and cooperative manner to promote awareness of the multiple needs and concerns facing various communities, countries and regions.

⁹ For more information, see the work of the Willamette Partnership, described at <http://www.willamettepartnership.org/>

verifying that the action directly achieves or connects to the broader ecosystem outcomes. The ecosystem service marketplace will rely on globally recognized third-party verification systems as the basis for documenting the integrity of ecosystem service units.

The system provides opportunities for traditional commodity producers to use tools like eco-labelling or branding to tell consumers when a product is validated to be “environmentally friendly”. Traditional products supplied by marketplace participants can be assessed to validate the products and assure consumers that they meet specific environmental standards. Branding is about providing a consistent quality product based on a credible certification system. The economic effect of branding and differentiation is based on the assumption that customers perceive an increase in the quality of the product, which influences either their willingness to pay more, or simply to select one particular supplier over another (e.g., to support a company’s corporate social responsibility program).

A credible, globally recognized validation system will assure Albertans and global consumers that desired ecosystem outcomes and transactions are being achieved and that claims made in the marketplace are legitimate.

Once a price is placed on ecosystem services and it is possible to verify that the desired ecosystem outcomes are being achieved, companies and resource managers will receive price-based feedback, positively or negatively, on their management practices. This creates an enhanced opportunity for innovation and commercialization of new, more sustainable approaches as businesses seek to improve their economic performance.

3.2.1.4 ECOSYSTEM SERVICES TRADING PLATFORM

A trading platform to facilitate and register transactions in the marketplace is required when a trading permit or credit scheme is considered. Indeed, a properly operating platform provides credibility and transparency, is efficient, and can provide a starting point for building on and interacting with international market exchange platforms. Examples of international markets for ecosystem services that currently exist include:

Alberta – *Alberta’s greenhouse gas emissions trading system allows companies to have three options to handle emissions that exceed their reduction target: Emission Performance Credits (buy, trade performance credits from other regulated companies that reduced their emissions more than they needed to), Tech Fund Credits (pay into the Climate Change and Emissions Management Fund at a set price), and Emission Offsets (voluntarily purchase Alberta offsets).*

Australia – *The New South Wales Government’s Biodiversity Banking and Offsets Scheme (or ‘BioBanking’) helps to address the loss of biodiversity values, including threatened species. BioBanking is a market-based scheme that provides a streamlined biodiversity assessment process for development, a rigorous and credible offsetting scheme as well as an opportunity for rural landowners to generate income by managing land for conservation.*

US – *The US wetland mitigation banking sector continues to develop as part of a growing family of ecosystem services markets. “Bankers” come from diverse backgrounds (farmers, restoration consultants, and private firms) participate with tradable wetland products.*

The ecosystem services trading platform serves as a central point for buyers and sellers to exchange ecosystem system service units. The trading platform will be robust enough to incorporate a range of potential functions including:

- **Bilateral trades:** where one-on-one negotiations are undertaken through a bargaining process and market participants only requires the registration of the traded ecosystem service units.
- **Exchanges:** a public forum where buyers and sellers can meet and exchange ecosystem service units in a transparent pricing environment.

Along with facilitating transactions, the ecosystem service trading platform will include the management or coordination of the following components:

- **Data inventory:** Ecosystem services baselines need to be calculated for each regulated component and, overall, for an ecosystem. Baselines help identify appropriate ecosystem targets and monitor change.¹⁰
- **Registry:** A registry enhances the credibility and transparency of environmental transactions and provides confidence to the marketplace, which reduces risk and facilitates lower transaction costs. It acts as an exchange-recording entity and a custodial system for credits.
- **Common protocols:** Use of an internationally accepted ecosystem services accounting methodology increases the interchangeability of credits and the legitimacy of the program.
- **Determination of initial allocation:** Fair and clearly defined allocation of credits and limits of credits is integral to reducing uncertainty for regulated parties. This forms the basis for initial ownership for ecosystem services as recorded in the registry.
- **Public reporting:** Public reporting encourages transparency and accountability of the trading platform.

3.2.1.5 INSTITUTIONS AND GOVERNANCE

A good governance structure with clear delineation of decision-making and of the roles and responsibilities of government, business, and other stakeholders is critical to the success of a market-based approach.

Governance refers to the process of making and implementing decisions. Among other things, good governance is participatory, accountable, transparent, responsive, effective and efficient, equitable and inclusive, and follows the rule of law. With a market-based policy approach, the government would continue to be responsible and accountable for the public assurance component of ecosystem management, including compliance with and monitoring of outcomes.

Individuals, communities, industry, municipalities and non-profit organizations all have an important role to play in ecosystem services markets. Opportunities for timely stakeholder engagement need to be provided at key decision points while markets and potential market instruments are being considered, developed, and evaluated.

At a minimum, there will be specific governance roles for buyers and sellers of ecosystem services, for the marketplace regulator, and for government in ensuring market and policy efficiency and effectiveness. Implementing the Roadmap is best achieved through an

¹⁰ See also: Alberta Boreal Conservation Offsets Advisory Group, *Regulated Conservation Offsets with Banking: A Conceptual Business Model and Policy Framework* (2009).

independent, multi-stakeholder body, acting in the public interest, that coordinates and provides oversight and executive management functions to support the market. This body would be accountable to the Government of Alberta in its public assurance role over the province's natural resources and would report to the Government and to Albertans on a regular basis. Governance of a functioning marketplace must be supported by:

- Coordinating and managing the components to ensure a functioning market system;
- Undertaking appropriate evaluation and analysis of costs and benefits to help inform decision making;
- Adopting risk management and mitigation strategies;
- Engaging stakeholders and developing partnerships;
- Creating and maintaining distributed networks;
- Building capacity;
- Maintaining arm's length governance integrity;
- Communicating and reporting; and
- Financing and funding of the market structure.

3.2.2 EMERGING ECOSYSTEM MARKETS

Markets for some of nature's benefits are already well-developed, such as the provision of forest products and agricultural crops. However, markets for most ecosystem services are lacking, even though they provide important benefits such as carbon storage in forests, water regulation from riparian and wetland areas, pest control by key plants and insects, and wildlife habitat, to name a few.

Alberta is well-positioned to explore new price- and quantity-based approaches to ecosystem services. Experience gained from the creation of a carbon market (offsets and emission performance credits) under the Alberta Specified Gas Emitters Regulation, supplemented by policy drivers and commitments in the Land-use Framework and Water for Life Strategy, set the stage for developing these markets, where appropriate. Market-based instruments are being evaluated by various government departments, agencies and councils in Alberta for application related to environmental issues facing specific regions of the province:



FIGURE 2 – MARKET-BASED INSTRUMENTS UNDER EVALUATION IN ALBERTA (2012)



FIGURE 3 – MARKET-BASED INSTRUMENTS USED IN ALBERTA IN 2012

Medium-term opportunities include participation in national and global regulated carbon markets that are expected to be in place in the next few years and, in the longer term, global biodiversity markets may be an opportunity as they are of increasing international interest.¹¹

With a market-based approach, enhancement of ecosystem services, brought about by resource efficiencies found in existing supply chains, may need to be certified and verified in order to achieve credibility and transparency necessary for market function. The objective is to supply uniform and guaranteed quality products, built on evaluation systems that use scientific methods. Quality is assured based on a certification system, which ensures that standards and practices are met and followed, and are ideally verified by a third party.

It is clear that we are still in the very early stages of developing and using market-based instruments. Alberta can continue to develop its own markets to enable uncompetitive industries to become competitive, and meet environmental objectives. These tools are not a quick fix, and they will also demand better information about the environment than has been available in the past. We clearly need more information about practical application, but there is significant potential to use market-based instruments to drive innovation, and provide economic incentives for good natural resource management. Implementing a market-based approach for additional services will expand the options and choices available for profit-seeking businesses.

The following links relate to ecosystem service initiatives in other jurisdictions:

<http://willamettepartnership.org/about> (Oregon’s multi-stakeholder conservation initiative)

<http://www.ecosystemmarketplace.com> (New York’s “Ecosystem Marketplace”)

<http://www.ecosystemsproject.org/> (Australia’s project to study ecosystem services)

¹¹ Deloitte, *Global Ecosystem Markets, overview of global ecosystem markets and identification of potential opportunities for Alberta’s agriculture and forestry sectors* (March 16, 2009)

4. STATE OF KNOWLEDGE

4.1 EXISTING CAPACITY AND CAPABILITY

The concepts of ecosystem services, cumulative effects management, and the Land-use Framework offer an integrating mechanism and an approach to address resource management needs in a multidisciplinary manner across sector boundaries.

Alberta has developed capacity, expertise and skill to support an ecosystem services approach. Leading expertise exists in Alberta within the following organizations:

- Alberta Biodiversity Monitoring Institute
- Alberta Conservation Association
- Alberta Innovates Bio Solutions
- Alberta Innovates Technology Futures
- Boreal Offsets Initiative
- Ducks Unlimited
- Land Use Secretariat
- Miistakis Institute
- Pembina Institute for Sustainable Development
- Silvacom Group and Green Analytics
- University of Alberta
- University of Calgary
- University of Lethbridge

4.2 RESEARCH OVERVIEW

Considerable research has been conducted locally, nationally, and internationally related to ecosystem services; however, much remains to be understood in terms of how ecosystem services are provided and the factors influencing the provision of ecosystem services. Appendix A provides a compendium of existing reports and studies on concepts related to the ecosystem service approach. Most current research has been done on an ad-hoc basis without a clear research and development agenda guiding the research questions. This Roadmap seeks to move the community of practice in Alberta to an understanding of ecosystem services that incorporates social, economic and environmental factors. It will be a platform for business opportunity, innovation, and job creation.

Organizations such as the former Alberta Agricultural Research Institute and the former Alberta Forestry Research Institute, which are now part of AI Bio, as well as the former Alberta Water Research Institute and the former Alberta Energy Research Institute, which are now part of Alberta Innovates Energy and Environment Solutions, have funded environment-related research. Various federal and provincial government departments have also conducted environment-related research. To continue that momentum, theory must be moved into practice through adaptive management. The information must be integrated into a systems approach, and evidence must be gathered to replace assumptions in a comprehensive, coordinated, and multidisciplinary approach.

5. GAPS

While Alberta has many sources of ecosystem data and information, there are a number of specific gaps identified by stakeholders (based on previous work completed by the Land Use Secretariat; the former Institute for Agriculture, Forestry and the Environment; the Millennium Ecosystem Assessment, the RUBICODE Project, and others). For example:

- In its Ecosystem Services Market Policy Framework, the former Institute for Agriculture, Forestry and the Environment noted that the context for potential policy intervention related to an ecosystem service or environmental issue and the context within which the particular policy is to be developed and applied must be clearly understood, and environmental outcomes must be clearly defined.
- Reports stemming from the Millennium Ecosystem Assessment identified multidisciplinary, community-based leadership as the major gap in assessing ecosystem services. These reports suggest that an ecosystem services assessment requires a multidisciplinary approach that accounts for physical, ecological and socio-economic inputs to ecosystem services.
- The RUBICODE Project identified numerous areas that urgently require additional research, including quantifying the role of biodiversity in ecosystem function and service provision, methods for integrated assessment of ecosystem services at different scales, and improving understanding of the role of the cultural, economic and policy contexts in ecosystem service assessment.¹²

Gaps have been categorized to align the Roadmap goal into priority areas of focus:

Capacity Gaps:

1. A network of engaged experts to move the ecosystem service approach forward from industry, government, environmental non-governmental organizations and land manager perspectives.
2. Training and education on best management practices, assessment, measurement and monitoring of ecosystem services.
3. Governance.

Scientific, Biophysical and Socio-economic Understanding Gaps:

4. The development of a comprehensive ecosystem services assessment approach.
5. Protocols for measuring ecosystem service units in a manner that supports market transactions.
6. The main drivers of behavioural change in individuals and corporations to support an ecosystem service approach, including development of market-based instruments.
7. Causal and quantity relationships between pro-ecosystem service actions and resulting outcomes for ecosystem functions.
8. Information to support economic valuation to properly account for the costs and benefits people receive from ecosystems.
9. Production and process technology to reduce impacts and enhance ecosystem services, linking management to delivery of ecosystem services.

¹² Anton, C, et al. Ecosystem Services and Biodiversity Conservation: Knowledge gaps and roadmap for future research. (http://www.rubicode.net/rubicode/RUBICODE_Roadmap_of_Research_Needs.pdf)

Data and Information Management Gaps:

10. Information management systems to enable the spatial and temporal assessment, verification and validation of changes in ecosystem service provisioning.
11. A central publically accessible clearing house for spatial data on ecosystem services, including: natural assets, ecosystem functions, and responses to natural and human driven changes.
12. The development of a protocol for the recognition of and payment for copyright and patent material in the information management system.

Market Opportunity Gaps:

13. An integrated system to coordinate and manage market-based instruments and the various initiatives to enable the achievement of environmental targets and desired ecosystem outcomes.
14. The size of niche opportunities for eco-labelling and certification of forestry and agricultural products.
15. The opportunity for sustainably managed bio resources as supplements to fossil fuel and petrochemical products.

6. ADDRESSING THE GAPS – THE PATH FORWARD

To support the province in achieving the long-term land use and management objectives outlined in regional land use plans, AI Bio is collaborating with leading experts, analysts and main land use sectors of the province (forestry, agriculture and energy) to address knowledge gaps, advance data and information management, evaluate benefits and costs of a market-based system, conduct ecosystem services assessments and provide resources for testing market-based management concepts for ecosystem services management.

As identified by the Millennium Ecosystem Assessment, a key challenge ahead is to learn more about ecosystem services in a multidisciplinary way, across sectors, and to work with and through community and expert stakeholders to assess the potential of applying market-based instruments effectively to enhanced ecosystem services.

This Roadmap action plan moves the state of knowledge and information on ecosystem services and market-based approaches into applied proofs of concept for using conservation offsets, as the first type of market-based instrument ready for further development.

Three workshops were held to obtain input and direction for the preparation of the Roadmap. Stakeholders from a variety of Alberta-based institutions including Alberta Innovates, Land Use Secretariat, Ducks Unlimited, North American Waterfowl Management Plan, Agriculture and Agri-Food Canada, Government of Alberta departments (Environment and Sustainable Resource Development, Agriculture and Rural Development), and others collaborated in bringing together the information and approach for the Roadmap.

In order to enhance ecosystem services using conservation offsets, it is necessary to conduct proofs of concept to better understand the processes, infrastructure and science gaps, implications and stakeholder acceptance of market-based instruments. To assist with developing our knowledge around ecosystem services, on-the-ground, applied proofs of concept for ecosystem services using conservation offsets will be undertaken. Knowledge gained in understanding the inner workings of conservation offsets will speed up understanding of the workings of other market-based instruments.

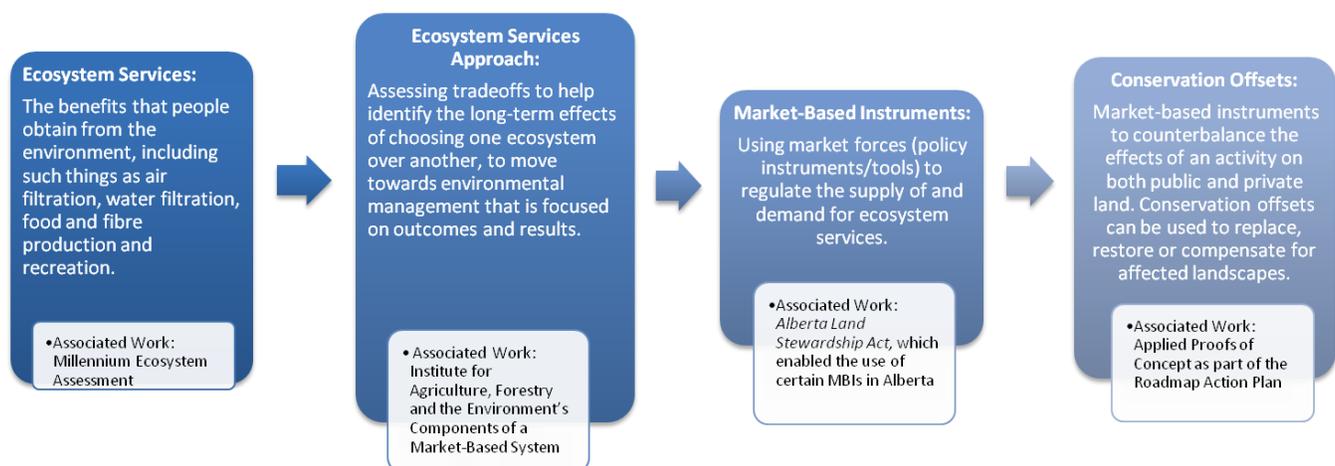


FIGURE 4: Using an Economic Approach to Enhance Ecosystem Services Through the Use of Conservation Offsets

6.1 APPLIED PROOFS OF CONCEPT FOR CONSERVATION OFFSETS

International experience indicates that conservation offsets can be an effective policy tool to mitigate the environmental impacts of land use and encourage conservation-based land development. The successful mid- to long-term use of conservation offsets will depend on:

- Advancing science and knowledge to fill gaps.
- Ensuring effective institutional and management structures are in place.
- Sufficient financial flows to incent behavioural change.
- Stakeholder engagement and capacity to adopt the program.
- Functioning verification and validation systems to ensure applicability and achievement of offset objectives.¹³

The applied proofs of concept will uncover gaps in knowledge, science and practice and give a substantive benchmark for policy development in this area. This approach will assist Alberta in redefining itself as a recognized leader in land use and environmental management and improve Alberta's international environmental reputation.

The applied proofs of concept will allow for co-creation of the fundamental knowledge, tools and systems required to understand the supply of ecosystem services in Alberta landscapes. The proofs will focus research on conservation offsets, one of the market-based instruments recently enabled by the *Alberta Land Stewardship Act*. Conservation offsets will be used as part of the proofs of concept to test the effectiveness of using a market-based instrument for restoration, mitigation and conservation. These proofs will be accomplished by assembling and compiling relevant sources of data and information, designing the ecosystem services assessment and valuation protocols, place-based field testing and validation (in existing community or watershed based groups), defining local ecosystem services objectives, and ultimately designing and selecting the most appropriate approach to conservation offsets. This will result in:

- Collaboration with networks of experts and specialists, market actors, community stakeholders, and policy advisors in a creative and effective open innovation environment.
- The building of local, regional and provincial capacity.
- Development of a science-based process for assessment, valuation and delivery of ecosystem services.
- Appropriate and effective selection, design and use of conservation offsets to best achieve community or place-based ecosystem services objectives.
- Building from business and market fundamentals; innovation and sector competitiveness.
- Successfully transitioning through new governance, institutional reform and fostering open innovation.
- A Centre of Excellence in data, knowledge and information for enhancing ecosystem services through market-based instruments.

Three areas for the applied proofs of concept have been identified as initial projects to be carried out in the Lower Athabasca region, the South Saskatchewan region and, potentially, a province-wide proof of concept. These proofs of concept aim to address data and information gaps, the

¹³ Business and Biodiversity Offsets Program, (2008). <http://bbop.forest-trends.org/guidelines/odh.pdf>

applicability of conservation offsets, and the stakeholder acceptance of these market-based instruments for the purpose of conservation through an ecosystem services approach.

Within each region, the baseline information will be converted into potential conservation offsets through a series of optimization models. This will represent the total supply of conservation offsets available in the region. By processing data obtained from stakeholder meetings and business analysis, the demand for conservation offsets can then be determined. This data will help to form the preliminary stages of a market-based system. These proofs of concept will be designed to advance Alberta towards a provincial ecosystem services approach for conservation offset trading.

6.1.1 PROOF OF CONCEPT ADVISORY COMMITTEE—Conservation Offset Leadership Group

The Conservation Offset Leadership Group is a multidisciplinary collaboration of multi sector organizations interested in becoming the recognized group to carry out the applied proofs of concept to enhance the development of conservation offsets in Alberta. This group has a common interest in improving the knowledge, science and practice of conservation offsets as one way of enhancing the provision of ecosystem services in Alberta, while engaging community stakeholder groups throughout the process. Participating organizations collaborating on this project include:

- Alberta Biodiversity Monitoring Institute
- Alberta Innovates Bio Solutions
- Alberta Conservation Association
- Alberta Innovates Energy & Environment Solutions
- Alberta Innovates Technology Futures (Center for Market-Based Instruments)
- Alberta Livestock and Meat Agency
- Climate Change and Emissions Management Corporation
- Ducks Unlimited Canada
- Land Stewardship Centre
- Land Use Secretariat (Government of Alberta)
- Oil Sands Leadership Initiative
- The Silvacom Group
- Green Analytics
- Agriculture and Agri-Food Canada

This group has expertise and resources in a variety of areas that align with the key components of a market-based system as shown in Figure 5. Additionally, organizations within the Conservation Offset Leadership Group have financial resources to put towards the applied proofs of concept.

This group intends to work with regional stakeholders and the Government of Alberta to develop a mechanism whereby tangible changes in the Alberta landscape can be efficiently translated into conservation credits in the development of a conservation offset system.

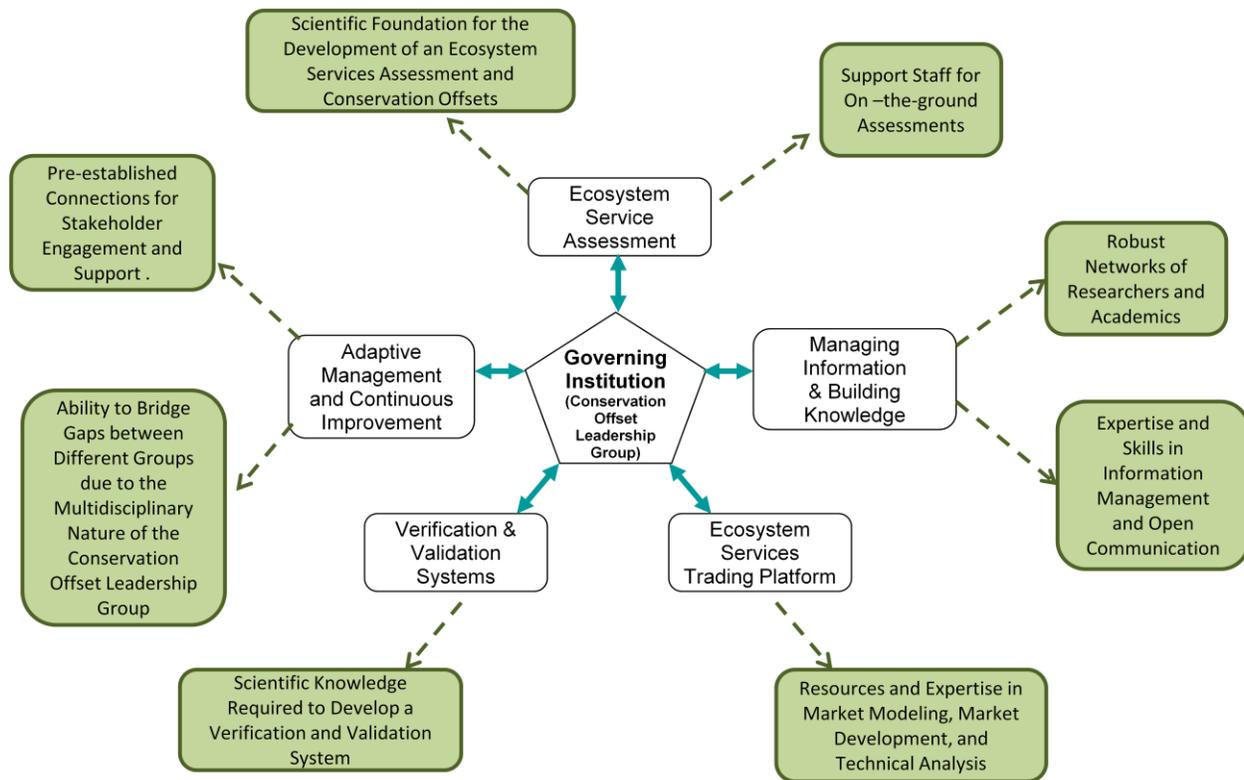


Figure 5: Integration of the Components for a Successful Market-based System and the Conservation Offset Leadership Group's Resources and Expertise.
 Adapted from Source: Pembina Institute, *Market-Based Approaches for Ecosystem Services* (March 2010).

6.1.2 APPLYING CONSERVATION OFFSETS TO ENHANCE ECOSYSTEM SERVICES

The proofs of concept will be conducted in three geographic regions over the next 5 years, using stakeholder engagement to work through the application of conservation offsets to enhance ecosystem services. The approach is multidisciplinary and expands across sectors to advance innovation related to land and water management. Two geographic areas for the proofs of concept initially will be the Lower Athabasca region and the South Saskatchewan region. These two regions are described below based on the Land-use Framework regional profiles for these areas¹⁴. The third proof of concept will be conducted at a province-wide scale, if time and resources permit.

6.1.2.1 LOWER ATHABASCA PROOFS OF CONCEPT

The Lower Athabasca region is located in northeastern Alberta and encompasses many different economic activities including oil sands development, forestry, agriculture, natural gas production and recreation. While the bulk of the area within the Lower Athabasca is comprised of boreal forest natural regions, a small portion of the Lower Athabasca includes the Canadian Shield. The major challenge in this region is the high level of development due, in most part, to the development and expansion of Alberta's oil sands and the loss of

¹⁴ Land-use Framework: <https://landuse.alberta.ca/Pages/default.aspx>

key habitat for species at risk such as Woodland Caribou. Conservation offset objectives in this region could target the following:

- Woodland Caribou habitat
- Abandoned, un-reclaimed lands

6.1.2.2 SOUTH SASKATCHEWAN PROOFS OF CONCEPT

The South Saskatchewan region is the southernmost region in Alberta. The landscape varies from dry mixed prairie to the Rocky Mountains, allowing for many different land uses and industries including farming, ranching, forestry, oil and gas development and recreation. This region faces major challenges with water resource allocation as demands for water increase due to agricultural development and population growth. Conservation offset objectives in this region could target the following:

- Water quality/quantity
- Prairie grasslands
- Wildlife habitat
- Biodiversity intactness

6.1.2.3 PROVINCE-WIDE PROOF OF CONCEPT

Alberta is a diverse province comprised of many natural ecosystems and land uses. Alberta landscapes range from the boreal forest in the north to the prairies in the south, with a variety of ecosystems in between. Not only do the natural landscapes vary dramatically throughout the province, the land use demands are also very dynamic. Pressures for land use in Alberta include urban and rural development, oil and gas exploration, agriculture, forestry, parks and recreation, wildlife habitat and other development activities. Because of the inherent diversity of Alberta landscapes, a province-wide proof of concept for conservation offsets would portray the benefits and pitfalls of trading offsets across a variety of boundaries. Since it would be an extensive project to do a province-wide study, this proof of concept is dependent on resource availability and interest.

6.1.3 COMPONENTS OF THE APPLIED PROOFS OF CONCEPT

To create measurable environmental outcomes (that go beyond compliance and result in innovation and improved system efficiency) through an applied proof of concept approach, a number of key data, leadership and financial components are needed to support these studies. Figure 6 depicts a proposed approach to developing the proof of concept strategy for conservation offsets in Alberta.

The proof of concept toolbox (depicted by blue boxes) represents key components that are necessary to support the proof of concept implementation (depicted in green). In some cases the tools are already under development; in other cases the tools need significant work to move these pieces to a point where they can support the proofs of concept.

While the implementation strategy is portrayed in a linear fashion, it is likely to be a much more organic process in reality. The purpose of the diagram is to highlight the key steps that may be required to sufficiently implement conservation offsets in Alberta over 5 years.

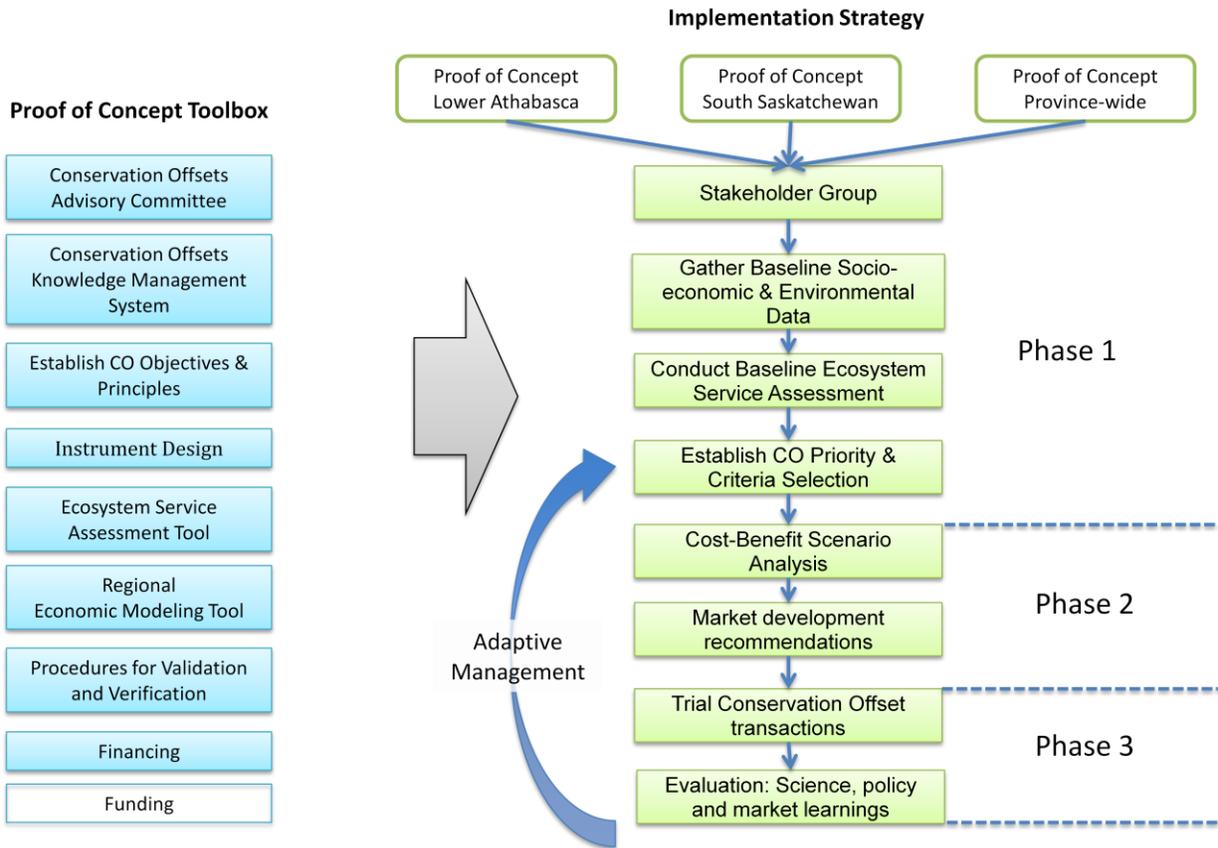


Figure 6: Proposed Approach for Conservation Offset Proofs of Concept

6.2 PROJECTED PROOF OF CONCEPT DEVELOPMENT TIMELINE

STRATEGIC ACTION	YEAR 1	YEAR 2	YEAR 3
1. Ecosystem Services Assessment			
<i>Integrate existing ecosystem service related information</i>			
Spatial database of biophysical and socio-economic attributes based on currently available information	✓		
Technical report documenting existing data, including hard copy maps of biophysical and socio-economic attributes in Alberta	✓		
<i>Create new ecosystem service knowledge to fill priority gaps</i>			
Field campaign to measure terrestrial and wetland biodiversity at approximately 150 ABMI grid sites in Alberta	✓		
Field campaign to measure terrestrial biodiversity at 15 off-grid ABMI sites in relatively undisturbed rangelands in southern Alberta, and 15 sites in highly-disturbed wetlands in northern Alberta, to determine reference conditions	✓		
Preliminary (year 1) and revised (year 3) maps of predicted biodiversity intactness in Alberta, based on field data from ABMI on-grid and off-grid sites	✓		✓
Peer-reviewed publication explaining the data sources and analytical methods used to create maps of predicted biodiversity intactness		✓	
<i>Map ecosystem service supply and demand</i>			
Peer-reviewed publication explaining the methods used to represent ecosystem service supply and demand in Alberta (biodiversity, forest and rangeland health, water quality)		✓	
Web portal to deliver ecosystem service information (maps, data summaries) over the internet		✓	✓
Symposium of leading experts to review the methods used to assess ecosystem services, and discuss ways to apply the assessment approach to support environmental innovation and market approaches		✓	
<i>Develop three innovative ecosystem service applications</i>			
Technical report documenting ecosystem service scorecards	✓		
Technical report documenting the calculation of ecosystem service units for use in a conservation offset market approach		✓	
Technical report documenting the application of ecosystem service supply and demand for watershed and regional planning			✓
2. Bio-resource Information Management System (BRIMS)			
<i>Evaluate current biomass inventory</i>	✓		
<i>Incorporate outstanding data sources</i>	✓		
<i>Finalize biomass data layers</i>	✓		
<i>Address short-term data gaps</i>	✓		
<i>Develop a long-term data acquisition strategy</i>		✓	
<i>Assess changes in biomass</i>			✓
<i>Incorporate into ecosystem services assessment</i>			✓
3. Ecosystem Services Communication			
<i>Develop an ecosystem services Centre of Excellence</i>	✓		
<i>Develop a quarterly newsletter on ecosystem services progress</i>	✓		
<i>Finalize a network of collaborating organizations and their roles</i>	✓		

GLOSSARY

Biodiversity

The assortment of life on earth—the variety of genetic material in all living things, the variety of species on earth and the different kinds of living communities and the environments in which they occur.

Command and Control

An approach that relies on prescribing rules and standards and using sanctions to enforce compliance.

Conservation

The responsible preservation, management and care of our ecosystems including land, air, water and biodiversity. This concept includes conservation of our natural and cultural resources.

Conservation Covenant

A conservation covenant is a written agreement between a landowner and a conservation organization in which the owner of the land promises to protect the land in specified ways.

Conservation Directive

A tool to set aside valued land for conservation purposes. Conservation directives may permanently protect, conserve, manage and enhance environmental, natural scenic, aesthetic or agricultural values. Conservation directives are not voluntary and could restrict a landowner's ability to use his or her land in certain ways, even though they still maintain ownership.

Conservation Easement

A voluntary legal agreement between a landowner and a government or a qualified organization to protect, conserve and enhance the environment.

Conservation Offsets

A market-based instrument enabled by the *Alberta Land Stewardship Act* to counterbalance the effects of an activity on both public and private land. Conservation offsets can be used to replace, restore or compensate for affected landscapes.

Conservation/Land/Biodiversity Bank

An entity where habitat and/or other ecosystem resources are conserved and managed in perpetuity for the purpose of offsetting impacts occurring elsewhere to similar resource values. Industries purchase credits to mitigate the adverse environmental impacts of their development from a conservation bank.

Credit

A single unit of trade that quantifies the provision (or right of use) of a regulated or non-regulated ecosystem service.

Cumulative Effects Management

An approach to land use decision making that considers the potential impacts of all activities within an area, rather than the impacts of development on a project-by-project basis.

Ecosystem Services

Ecosystems, and the biodiversity contained within them, provide a range of goods and services which are essential for society's well being. Ecosystem services are the benefits that people obtain from nature. They can be categorized as:

- Cultural Services – the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.

- Provisioning services – the goods or products people obtain from ecosystems, such as food, fuel, fibre, fresh water, and genetic resources.
- Regulating services – the benefits people obtain from the regulation of ecosystem processes, including air quality maintenance, climate regulation, erosion control, regulation of human diseases, and water purification.
- Supporting Services – processes necessary for the production of all other ecosystem services, such as primary production, production of oxygen, and soil formation.

Ecosystem Services Approach

An ecosystem services approach involves making land management decisions based on an understanding of the long-term effects of choosing one ecosystem over another, and the tradeoffs necessary in informed land management.

Environmental Labelling and Certification Programs

Two tools used to promote environmental responsibility within industry. They are largely voluntary programs that provide consumers with environmental information about the products or services they are purchasing. By enabling environmental criteria to be considered during purchasing decisions, labelling and certification programs help consumers to “vote through the marketplace” for more environmentally responsible products.

Financial Incentives

A variety of tools that influence organizations, companies and individuals to change their behaviour to obtain environmentally-desirable behaviour. Financial incentives include:

- Tax write-offs, investment tax credits, and flow through arrangements
- Government loans, loan guarantees, and subsidized interest payments
- Grants, subsidies, and cost-sharing programs

Grey Literature

Information produced at all levels of government, academia, business and industry in electronic and print formats, not controlled by commercial publishing.

Institutional Collaboration

The sharing of resource (financial, human and knowledge) among multiple partner institutions. In an ecosystem service approach the collaboration may be between the landowners, industry, environmental organizations and local governments with their provincial and federal counterparts. In an institutional collaboration approach, the institutions involved do not have to have similar interests or similar levels of expertise but they do need to have resources that other institutions would like to share.

Integrated Land Management

The strategic planned approach to managing and reducing the human-caused footprint on public land. By working together, land-users can reduce their impact on the land by sharing land, planning the use of the land together, building understanding and practicing stewardship.

Land Use Management

The long-term development or conservation of an area and the establishment of a relationship between local objectives and regional goals.

Market

A market is any structure that allows buyers and sellers to exchange any goods, services and information

Market-based Approach

A market-based approach is based on the idea of using market forces to represent the costs of degraded ecosystem services. This helps internalize the cost of loss of ecosystem services. A market-based approach involves the use of market-based instruments and policies to add value to non-market goods and services so they are not overlooked during development decisions. This approach shifts policy from a prescriptive command – control approach to environmental management that is focused on **outcomes** and **results**, which creates opportunities for innovation, competitiveness, and leadership.

Market Attributes

The characteristics or aspects of the marketplace. The regulator of the market can make changes to the attributes of a market that enable it to lower transaction costs, introduce additional efficiency to the chosen policy instrument and provide additional incentives or disincentive to produce a given outcome.

Market-based Instruments

Market-based instruments (or MBIs) are policy tools that use markets or economic incentives to change behaviour in order to achieve socially desirable outcomes.

Market Friction Instruments

These instruments aim to improve the operation of existing markets by reducing the costs of operating in those markets. Further, market friction instruments can be used to provide additional information to consumers and enhance product differentiation. Examples include green labelling and web-based water entitlement exchanges.

Natural Capital

Natural capital is the “stock” of ecological assets and ecosystem resources such as the land and water that surrounds us (e.g. raw materials and natural cycles) that yield ecosystem services (benefits to humankind) or ecological goods and services (benefits to all living organisms) on a continuous basis.

Offset Protocol

The act of compensating for unavoidable impacts from development. In a cap and trade system, for example, an offset is an action carried out by a third party to generate credits (by reducing or avoiding pollution or resource use). These offset credits can then be sold to polluters or resource users.

Phased Implementation Approach

A strategy of implementing an innovation in an organization in a phased way, so that different parts of the organization are implemented in different subsequent time slots.

Policy Instruments

The means and tools available to achieve policy goals.

Price-based Instruments

These instruments assign a price to environmental impacts or attributes through positive instruments (e.g., payment, auctions and grants) or negative instruments (e.g., charges and taxes).

Quantity-based Instruments

These instruments influence behaviour by modifying or specifying rights or obligations associated with the use of natural resources. Rights and obligations created or altered are often tradable. Examples include compliance offsets and tradable emissions permits.

Stewardship

An ethic whereby citizens, industry, communities and governments work together to responsibly care for and manage natural resources and the environment.

Suasive Instruments

Suasive instruments increase the effectiveness of market and command and control policy approaches by providing relevant information to targeted actors. They include education, training, providing information and social recognition.

Tradable Permit Scheme

A policy instrument under which rights to pollute or exploit resources can be exchanged through either a free or a controlled permit market. Examples include individual transferable quotas in fisheries and tradable depletion rights to mineral concessions.

APPENDIX A – ECOSYSTEM SERVICES RESEARCH

The pursuit of understanding related to ecosystem services is a rapidly growing area of research. A number of global research and policy developments are shaping the direction of using market-based approaches for sustaining and enhancing ecosystem services.

1. The **Millennium Ecosystem Assessment** (a United Nations initiative) evaluated the consequences of ecosystem change on human well-being from 2001 to 2005. The Assessment involved more than 1,360 experts worldwide, and concluded that human activity is having a significant and escalating negative impact on the biodiversity of world ecosystems. The Assessment measured 24 ecosystem services, concluding that only four showed improvement over the last 50 years, 15 were in serious decline, and five were in a precarious condition¹⁵. The report indicated that:
 - a. Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fibre and fuel.
 - b. The changes that have been made to ecosystems have contributed to substantial net gains in human financial well-being and economic development, but these gains have been achieved at growing costs in the form of:
 - The degradation of many ecosystem services;
 - Increased risks of nonlinear changes; and
 - The exacerbation of unequal income distribution for some groups of people.
2. Completed in 2009, the **RUBICODE Project** (under the European Commission's Sixth Framework Programme) has drawn attention to the overwhelming pressures facing many ecosystems and has communicated the need to bring awareness to the important link between conserving biodiversity and maintaining a high quality of life. The report outlined new gaps in the basic science on ecosystem services, and delivered a "roadmap" to direct future research on ecosystem services and to support the further development of efficient research policies. It summarized the urgent need for research to:¹⁶
 - Quantify the role of biodiversity in ecosystem function and service provision.
 - Develop trait-based approaches to ecosystem service assessment.
 - Develop improved methods for the integrated assessment of ecosystem services at different spatial and temporal scales, including methods for: (i) investigating interactions between the demand and supply of multiple ecosystem services; (ii) upscaling and downscaling; and (iii) integrating valuation processes and results in impact assessments and models.
 - Identify thresholds in the relationships between biodiversity, ecosystem functioning, ecosystem services and human well-being to identify points beyond which the level of ecosystem service delivery changes dramatically and perhaps irreversibly.
 - Identify and quantify the impact of direct and indirect socio-economic and environmental drivers on ecosystem services, and develop tools to design and evaluate policy options for ecosystem service management under uncertain futures.
 - Improve understanding of the role of the cultural, economic and policy contexts in ecosystem service assessment, particularly in the choice of: (i) metrics, valuation and appraisal methods; (ii) stakeholder involvement; (iii) required levels of precision; and (iv) policy instruments and decision support tools.

¹⁵ Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-Being: Current State and Trends* (Island Press, Washington, DC).

¹⁶Anton, et al The RUBICODE Project: Ecosystem Services and Biodiversity Conservation: Knowledge gaps and roadmap for future research.

- Develop an improved classification for ecosystem services and values, which includes values of flows of ecosystem services and stocks of ecosystem assets and allows for the distinction between final and intermediate services.
 - Enhance the usefulness of value, price and cost estimates for ecosystem services by: (i) improving database coverage, quality, depth and access; (ii) filling key gaps in valuation evidence; (iii) investigating replication, validity and transfer of functional assumptions and values estimates; and (iv) developing agreed protocols for comparing and transferring value estimates.
 - Develop tools, methods and decision-support systems to assist the multi-level governance of ecosystem services.
 - Quantify the role of multifunctional land management and landscape patterns on the provision of ecosystem services and develop options to conserve biodiversity and maintain ecosystem integrity outside protected areas.
 - Develop tools and methods to promote the uptake of business opportunities associated with the sustainable management of ecosystem service delivery.
3. In 2011, **The Economics of Ecosystems and Biodiversity (TEEB) Reports** (hosted by the United Nations Environment Programme and supported by the European Commission) were released, which shaped the policy options and mechanisms available to local, national, and international policymakers. The Economics of Ecosystems and Biodiversity study and its subsequent reports represent:

“...a major international initiative to draw attention to the global economic benefits of biodiversity, to highlight the growing costs of biodiversity loss and ecosystem degradation, and to draw together expertise from the fields of science, economics and policy to enable practical actions moving forward.”¹⁷

These international bodies of work (Millennium Ecosystem Assessment, RUBICODE, TEEB) demonstrate that many options exist to use the market to change the production of current ecosystem services in ways that reduce compliance or business costs or, in some cases, provide positive benefits for business operations or ecosystem services with the goal of meeting societal expectations. The researchers point to the possibility of reversing ecosystem service degradation over the next 50 years with the appropriate policy and practice.

The scientific and public interest in ecosystem services has increased as a result of these international bodies of work. Further, the scientific community has reaffirmed that there is a lack of understanding about the relationships between ecosystem services and human well-being. This information is needed to understand the limits and consequences of biodiversity loss and the actions needed to maintain or restore ecosystem functions.

We need to build on the innovative nature of international assessments like the Millennium Ecosystem Assessment, the RUBICODE Project and The Economics of Ecosystems and Biodiversity reports to analyze ecosystem services at multiple scales in Alberta, with consideration for such indirect ecosystem drivers as demographics, economics, socio-political and cultural factors.

¹⁷ The Economics of Ecosystems and Biodiversity (2011), available online: <http://www.teebweb.org/>

APPENDIX B – COMPENDIUM OF LITERATURE ON ECOSYSTEM SERVICES AND MARKET-BASED INSTRUMENTS

The items in this compendium were identified by Alberta Innovates Bio Solutions and compiled by scanning a reference list to identify key ecosystem services and market-based instruments and focussing on academic studies and other officially published grey literature. References to websites, presentation, fact sheets, etc., were ignored. Each item was verified for relevancy and accuracy and finally, categorized into relevant themes. Throughout the compendium, there is some duplication of references under different categories due to the multidisciplinary and multi-themed nature of the subject matter.

Global Ecosystem Service Valuation

Costanza, R., D'Arge, R., De Grot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'neill, R., Paruelo, J., Raskin, R., Sutton, P., Van den belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature*, 387, 253–260.

Naidoo, R., Balmford, A., Costanza, R., Fisher, B., Green, R.E., Lehner, B., Malcolm, T.R., and Ricketts, T.H. (2008). Global mapping of ecosystem services and conservation priorities. *PNAS*, 105(28): 9495-9500.

TEEB (2010). *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.*

Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis.* Island Press, Washington, DC

Classification of Ecosystem Services

Brown, T. C., Bergstrp, J. C., and Loomis, J. B. (2007). Defining, valuing, and providing ecosystem goods and services. *Natural Resources Journal* 47: 329.

Boyd, J., and Banzhaf, H.S. (2006). What are ecosystem services? The need for standardized environmental accounting units. *Resources for the Future, Discussion paper RFF DP 06-02.*

Costanza, R. (2008). Ecosystem services: multiple classification systems are needed. *Biological Conservation*, 141(2): 350–352.

de Groot, R.S., M.A. Wilson, and R.M.J. Boumans (2002). A Typology of the Classification, Description and Valuation of Ecosystem Functions, Goods and Services. *Ecological Economics*, 41 (3): 393-408.

Fisher, B., and K. Turner (2008). Ecosystem services: Classification for valuation. *Biological Conservation*, 141(5): 1167-1169.

Fisher, B., Turner, R., & Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological Economics*, 68(3): 643-653.

Wallace, K. (2007). Classification of ecosystem services: Problems and solutions. *Biological Conservation*, 139(3-4): 235-246.

Ecosystem Services: Theory, Implementation and Commentary

Daily, G., and Matson, P. (2008). Ecosystem services: From theory to implementation. *PNAS*, 105 (28): 9455-9456.

Maler, K., Aniyar, S., Jansson, A. (2008). Accounting for ecosystem services as a way to understand the requirements for sustainable development. *PNAS*, 105(28): 9501-9506.

National Research Council of the National Academies. (2005). Valuing ecosystem services: Toward better environmental decision-making. Washington, D.C: The National Academies Press.

Valuing Water Resources

Emerton, L., & Bos, E. (2004). Value: Counting ecosystems as water infrastructure. Gland, Switzerland: IUCN.

Wetland Ecosystem Services

Gabor, T.S., A.K. North, L.C.M. Ross, H.R. Murkin, J.S. Anderson, and M. Raven (2004). The importance of wetlands and upland conservation practices in watershed management: functions & values for water quality & quantity. Ducks Unlimited, Canada.

Gleason, R.A., Laubhan, M.K., and Euliss, N.H. (2008). Ecosystem services derived from wetland conservation practices in the United States prairie pothole region with an emphasis on the U.S. department of agriculture conservation reserve and wetlands reserve programs. U.S. Geological Professional Paper 1745.

MBI for Water Quality

Abdalla, C., Borisova, T., Parker, D., & Sacke Blunk, K. (2007). Water quality credit trading and agriculture: recognizing the challenges and policy issues ahead. *Choices*, 22: 117-124.

Department of Environment and Conservation (2006). Hunter River Salinity Trading Scheme: Working together to protect river quality and sustain economic development. Department of Environment and Conservation, New South Wales.

MBI for Clean / Renewable Energy

Butler, L., & Neuhoff, K. (2006). Comparison of feed in tariff, quota and auction mechanisms to support wind power development. *Renewable Energy*, 33(8): 1854-1867.

McHenry, M. (2009). Policy options when giving negative externalities market value: Clean energy policymaking and restructuring the western Australian energy sector. *Energy Policy*, 37(4): 1423- 1431.

Tradable Disturbance Permits

Anderson, J., Gomez, C. W., McCarney, G., Adamowicz, V., Chalifour, N., Weber, M., Elgie, S., & Howlett, M. (2010). Natural capital: Using ecosystem service valuation and market-based instruments as tools for sustainable forest management. A state of knowledge report. Sustainable Forest Management Network, Edmonton, Alberta.

Carbon Trading and Offsets

Anderson, J., Gomez, C. W., McCarney, G., Adamowicz, V., Chalifour, N., Weber, M., Elgie, S., & Howlett, M. (2010). Natural capital: Using ecosystem service valuation and market-based instruments as tools for sustainable forest management. A state of knowledge report. Sustainable Forest Management Network, Edmonton, Alberta.

Corbera, E., González Soberanis, C., & Brown, K. (2009). Institutional dimensions of payments for ecosystem services: An analysis of Mexico's carbon forestry programme. *Ecological Economics*, 68 (3): 744.

Koehler-Munro, K., Goddard, T. & Haugen-Kozrya, K. (2008). Alberta's Carbon Offset System and Agriculture. Alberta Agriculture and Rural Development. Edmonton, AB.

Conservation and Biodiversity Banking and Offsets

Business and Biodiversity Offsets Programme (BBOP). (2009). Biodiversity offset design handbook: Appendices. BBOP, Washington, D.C.

Carroll, N., Fox, J., and Bayon, R. (2008). Conservation and biodiversity banking: A guide to setting up and running biodiversity credit trading system. EarthScan.

Kate, K., Bishop, J., & Bayon, R. (2004). Biodiversity offsets: Views, experience, and the business case. IUCN, Gland, Switzerland and Cambridge, UK and Insight Investment, London, UK.

Auctions

Department of Sustainability and Environment (2008) BushTender: Rethinking investment for native vegetation outcomes. The application of auctions for securing private land management agreements. State of Victoria, Department of Sustainability and Environment, East Melbourne.

Eigenraam, M., Strappazon, L., Lansdell, N., Ha, A., Beverly, C., & Todd, J. (2006). EcoTender: Auction for multiple environmental outcomes. National Action Plan for Salinity and Water Quality. Report prepared for Department of Primary Industries, Victoria.

Payment Programs for Ecosystem Services on Forest Lands

Alix-Garcia, J., de Janvry, A., Sadoulet, E., & Torres, J. (2005). An assessment of Mexico's payment for environmental services program. Report prepared for the Comparative Studies Service Agricultural and Development Economics Division, United Nations Food and Agriculture Organization (FAO).

Bond, I., Grieg-Gran, M., Wertz- Kanounnikoff, Hazlewood, P., Wunder, S., and Angelsen, A. (2009). Incentives to sustain forest ecosystem services: A review and

lessons for REDD. Natural Resource Issues No. 16. International Institute for Environment and Development, London, UK.

Kosoy, N., Corbera, E., & Brown, K. (2008). Participation in payments for ecosystem services: Case studies from the Lacandon Rainforest, Mexico. *Geoforum*, 39: 2075-2083.

Landell-Mills, N., & Porras, T. I. (2002). Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor. Instruments for Sustainable Private Sector Forestry series. International Institute for Environment and Development, London.

Liu, J., Li, S., Ouyang, Z., Tam, C., and Chen, X. (2008). Ecological and socioeconomic effects of China's policies for ecosystem services. *PNAS*, 105(28): 9477-9482.

Payment Programs for Ecosystem Services on Agricultural Lands

Bohlen, P.J., Lynch, S., Shabman, L., Clark, M., Shukla, S., & Swain, H. (2009). Paying for environmental services from agricultural lands: an example from the northern Everglades. *Frontiers in Ecology and the Environment*, 7: 46-55.

Gagnon, B. (2005). Remuneration for ecological goods and services produced by agriculture: Elements for a Quebec analysis. Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, Canada.

Goldman, R., Thompson, B.H., and Daily, G.C. (2007). Institutional incentives for managing the landscape: Inducing cooperation for the production of ecosystem services. *Ecological Economics*, 64 (2): 333-343.

Hodge, I., & Reader, M. (2007). Maximizing the provision of public goods from future agri-environment schemes. Final Report Project No. 15932, Land Use Policy Group, Department of Land Economy, University of Cambridge.

Kroeger, T., & Casey, F. (2007). An assessment of the market-based approaches to providing ecosystem services on agricultural lands. *Ecological Economics*, 64: 321-332.

Liu, J., Li, S., Ouyang, Z., Tam, C., and Chen, X. (2008). Ecological and socioeconomic effects of China's policies for ecosystem services. *PNAS*, 105(28): 9477-9482.

Impact of Market-based Instruments on Business and Trade

Sann, K., & Thornber, K. (2003). Impact of market-based instruments and initiatives on the trade in forest products and sustainable forest management, Global project: Impact assessment of forest products trade in the promotion of sustainable forest management (GCP/INT/775/JPN). Food and Agricultural Organization (FAO).

IUCN. (2007). Markets for eco-system services: New challenges and opportunities for business and the environment. Business and Ecosystems, IUCN.

Market Friction, Certification and Labelling

Archer, H., Kozak, R., & Balsillie, D. (2005). The impact of forest certification labeling and advertising: An exploratory assessment of consumer purchase intent in Canada. *The Forest Chronicle*, 81(2): 229-244.

Auld, G., & Bull, G. (2003). The institutional design of forest certification standards initiatives and its influence on the role of science: The case of forest genetic resources. *Journal of Environmental Management*, 69: 47-62.

Cashore, B., van Kooten, G., Vertinsky, I., Auld, G., & Affolderbach, J. (2003). Private or self-regulated? A comparative study of forest certification choices in Canada, the United States and Germany. *Forest Policy and Economics*, 7: 53-69.

Cashore, B., Auld, G., & Newsom, D. (2004). Governing through market: forest certification and the emergence of non-state authority. Newhaven & London: Yale University Press.

Environment and Ecosystem Management (EEM). (2008). Environmental paper procurement: Review of forest certification schemes in Canada.

Gulbrandsen, L. (2004). Overlapping public and private governance: can forest certification fill the gaps in the global forest regime? *Global Environmental Politics*. 4(2): 75-99.

Haener, M., & Lukert, M. (1998). Forest certification: Economic issues and welfare implications. *Canadian Public Policy*, 24: S83-S94.

Hatanaka, M., Bain, C., & Busch, L. (2005). Third-party certification in the global agrifood system. *Food Policy*, 30 (3): 354-369.

Jayasinghe, P., Allen, D., Bull, G., & Kozak, R. (2007). The status of forest certification in the Canadian value-added wood products manufacturing sector. *The Forestry Chronicle*. 83(1): 113-125.

Klooster, D. (2005). Environmental certification of forests: The evolution of environmental governance in a commodity network. *Journal of Rural Studies*. 21(4): 403-417.

Kozak, R., Cohen, D., Lerner, J., & Bull, G. (2004). Western Canadian consumer attitudes towards certified value-added wood products: An exploratory assessment. *Forest Products Journal*. 54(9): 21-24.

Newsom, D., Bahn, V., & Cashore, B. (2006). Does forest certification matter? An analysis of operation-level changes required during the SmartWood certification process in the United States. *Forest Policy and Economics*, 9: 197-208.

Ozinga, S. (2001 a). Behind the logo: An environmental and social assessment of forest certification schemes. Fern.

Policy and Strategic Pieces

Acheterman, G., Aylward, B., Duncan, et. al. (2008). Policy cornerstones and action strategies for an integrated eco system marketplace in Oregon. Prepared by the Institute for Natural Resources for The Willamette Partnership and Defenders of Wildlife.

Agriculture and Agri-Food Canada. (2008). Cost-efficiency analysis of possible environmental goods and services (EG&S) policy options - Final Report. Prepared by Eco Resources Consultants, International Institute for Sustainable Development and Institut de recherche et de développement en agroenvironnement. Ottawa, Canada.

Agri-Environmental Partnership of Alberta. (2009). Ecosystem services and environmental markets prepared by the ecosystem services project team and the environmental market opportunities project team for the AEPA Board. Edmonton, AB.

Alberta Boreal Conservation Offsets Advisory Group. (2009). Regulated conservation offsets with banking: A conceptual business model and policy framework. Unpublished report.

Binning, C., Baker, B., Seona, M., Cork, S., & Kearns, A. (2000). Making farm forestry pay - markets for ecosystem services. Rural Industries Research and Development Corporation.

Claro, E., Lucas, N., Sugathan, M., Marconini, M. & Lendo, E. (2007). Trade in environmental goods and services and sustainable development: Domestic considerations and strategies for WTO negotiations. ICTSD Environmental Goods and Services Series, Policy Discussion Paper. International Centre for Trade and Sustainable Development. Geneva, Switzerland.

Frameworks, Guides, and Decision Support for Practitioners

BDA Group, & CSIRO. (2007). Report to NSW CMA Chairs Council: Use of market-based instruments by catchment management services in NSW to achieve landscape scale change. Australia: BDA Group and CSIRO.

Business and Biodiversity Offsets Programme (BBOP). (2009). Biodiversity offset design handbook: Appendices. BBOP, Washington, D.C.

Carroll, N., Fox, J., and Bayon, R. (2008). Conservation and biodiversity banking: A guide to setting up and running biodiversity credit trading system. EarthScan.

Coggan, A., Whitten, S.M., Yunus, F. (2008). Best practice mechanism design: Concepts and case studies for biodiversity. Final Report for the Australian Government Department of Environment, Water, Heritage and the Arts. Australia: CSIRO Sustainable Ecosystems.

Collins, D., & Scoccimarro M. (2008). Market-based instruments decision support tool. Market-based Instruments Capacity Building Program (part of Market-based Instruments Pilot Program and the National Action Plan for Salinity and Water Quality. Department of Natural Resources and Water, Brisbane, Australia.

Cowling, R., et.al. (2008). An operational model for mainstreaming ecosystem services for implementation. *PNAS*, 105(28): 9483-9488.

Damanica, R., Hatch.J. (2005). Protecting eden: markets or government? *Ecological Economics*, 53: 339- 351.

Department of Environmental Affairs and Development Planning. (2007). Provincial guideline on biodiversity offsets. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

Dymond, J.R., Ausseil, A.E., & McC. Overton, J. (2008). A landscape approach for estimating the conservation value of sites and site-based projects, with examples from New Zealand. *Ecological Economics*, 66: 275–281.

Eigenraam, M., Strappazon, L., Lansdell, N., Beverly, C., & Stoneham, G. (2007). Designing frameworks to deliver unknown information to support market-based instruments. *Agricultural Economics*, S37: 261-269.

FAO, UNDP, and UNEP. (2008). UN-REDD framework document. UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD).

Forest Trends, UNEP, & the Katoomba Group. (2008). Payments for ecosystem services, getting started: a primer. Washington, DC.

Jack, B., Kousky, C., & Sims, K. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS*, 105 (28): 9465-9470.

OECD. (1999). Handbook of incentive measures for biodiversity: Design and implementation. OECD Environment Programme. Paris, France.

Ranganathan, J. et. al. (2008). Ecosystem services: A guide for decision makers. World Resource Institute.

Public Opinion in Canada

Alberta Council for Environmental Education. (2009). Provincial polling on environmental education and market-based instruments. Alberta: Ipsos Reid Public Affairs.

Bailey, R., & Greenslade, L. (2006). Alternative Land Use Services (ALUS) a benchmark survey of public opinion on the environment in relation to farming and the quality of life in Norfolk, County. Prepared by Econometrica Communication Inc. for the Norfolk Federation of Agriculture and Partners.

Cocklin, C., Mautner, N., & Diben, J. (2007). Public policy, private landholder: perspectives on policy mechanisms for sustainable management. *Journal of Environmental Management*, 85: 986-998.

Environics Research Group. (2006). National survey of farmers and ranchers: Ecological goods and services. Prepared for Wildlife Habitat Canada. Toronto, ON.

Environment Canada. (1999). The importance of nature to Canadians: Survey highlights. Ottawa, ON. DuWorks, E., Villeneuve, M., Filion, F., Reid, R., Bouchard, P., Legg, P., Boxall, P., Williamson, T., Bath, A., & Mels, S.

Global Case Studies / Existing / Pilot Programs:

Forest Trends and the Ecosystem Marketplace. (2008). Payments for ecosystem services: Market profiles. Forest Trends and the Ecosystem Marketplace.

To Explore Further:

Business and Biodiversity Offsets Programme (BBOP). (2009a). Biodiversity offset design handbook: Appendices. BBOP, Washington, D.C.

Appendix

- United States of America: Wetlands Compensatory Mitigation
- United States Fish and Wildlife Services: Habitat Evaluation Procedure
- US wetland and stream assessment methods in practice
- Birds and Habitats Directive
- European Liability Directive
- Victoria, Australia: Habitat Hectares Method
- Western Australia: Net Environmental Benefit
- South Australia: Significant Environmental Benefit (SEB) Methods
- Western Cape of South Africa's Draft Provincial Guidelines

Coggan, A., Whitten, S., Reeson., & Shelton, D. (2007). Case studies of market-based instrument applications. (RIRDC Publication No.07) Australia: Rural Industries Research and Development Corporation.

A River Tender Project:

Curtis A., Sample R., & McDonald S. (2008). Social research evaluating river tender program outcomes: A report to the North East Catchment Management Authority. Charles Stuart Institute for Land, Water and Society.

Conservation Reserve Program

Laing, B. (2008, February). Prairie/Parkland Ecosystem Goods and Services Valuation Pilot Project-Phase 1. Prairie Conservation Forum. (location not available).

Liu, J., Li, S., Ouyang, Z., Tam, C., and Chen, X. (2008). Ecological and socioeconomic effects of China's policies for ecosystem services. PNAS, 105(28): 9477-9482.

Canadian Wind Energy Association. (2006). Remote community wind incentive program. Retrieved from: http://www.canwea.ca/images/uploads/File/Wind_Energy_Policy/Federal/Budget_06_ReCWIP.pdf

Maloti Drakensberg Transfrontier Project. (2007). Payment for ecosystem services: Developing an ecosystem services trading model for the Mnweni/Cathedral Peak and Eastern Cape Drakensberg areas. Mander (Ed) INR Report IR281. Development Bank of Southern Africa, Department of Water Affairs and Forestry, Department of Environment Affairs and Tourism, Ezemvelo KZN Wildlife, South Africa. 1-103.

O'Grady, D. & Wilson, M.A. (date unavailable). Phosphorous trading in the South Nation River watershed, Ontario Canada. CH2M Hill Canada and South Nation Conservation. ON, Canada