CWN: Proposal Summary

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Summary

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Project

RFP Being Addressed

RFP20066 Demand-Supply Management Strategies

Title of Proposed Project

More Value From the Same Water: Maximizing Water's Sustainable Contribution to the Canadian Economy

Project Abstract

Description

Problem Formulation

Maximization of value from scarce resources results from allocations through well-functioning markets. Maximization of value from water resources in Canada is hampered by out-dated municipal and provincial regulations governing pricing and allocation of water. Provincial governments issue water use permits with little evidence of the value of proposed use and permit pricing has nothing to do with waterâ s scarcity value. Municipal water pricing remains divorced from the value of water and the marginal costs of supply. Insufficient funds are collected for necessary infrastructure improvements. This is changing slowly. Some provinces have recently raised water permit fees and some municipalities have adopted increasing block rates. The common theme is recognition of water as an economic resource and the willingness to use economic instruments (prices and tradable permits) to promote waterâ s efficient use. To date, however, these initiatives have not been coordinated across levels of government and are constrained by the lack of data, models, trained personnel, and institutional capacity. The seriousness of this problem is compounded by the inability of current regulations to deal with competing water demands and the looming possibility of climate change-induced reductions in supplies. Misallocation of water ultimately threatens aquatic ecosystems and reduces the well-being of current and future Canadians.

Objectives

This project has several goals with one overarching objective. Given the uncertainty surrounding the potential impacts of climate change upon water supplies, it is imperative for the current and future well-being of Canadians that Canada use its scarce water supplies in a more efficient and sustainable way than it has done in the past. This will ensure that water will produce more value for Canadians by making a greater contribution to Canadaâ s economy. The specific goals include:

1 Advance the state of knowledge regarding the factors governing water use, firms and householdsâ valuation of water, and decisions to adopt water-conserving technologies.

2 Develop and apply specific templates for the design of efficient municipal water pricing rules and provincial water allocation mechanisms and enhanced water demand forecasting methods.

3 Translate knowledge regarding estimated water demands, the design of efficient water prices, efficient provincial allocation rules and water demand forecasting methods to partners and end users. Implementation of this information will lead to improved rate-setting and allocation rules, more efficient water use decisions and, ultimately, an increase in the value enjoyed sustainably from water.

Proposed Outcomes

The research outcomes are directed at improving the conceptual models used by decision-making water managers by providing them with improved pricing strategies and allocation rules, as well as enhanced demand measurement and forecasting methods. Combined, these results will enable Canada to use its existing or even diminishing water supplies in a more efficient and sustainable way; thus producing more value for Canadians.

Methods and Approach

The project is organized in three main sets of tasks. The first involves understanding and estimating the structure of the basic behavioural relationships (water demands and adoption of water-using technologies) that govern water use in the main water-using sectors in Canada. The second involves the understanding and design of the most important incentive structures facing water users. For large self-supplied water users this involves the nature of provincial water allocation rules and for smaller publicly supplied water users, this involves municipal water prices. Both sets of incentives structures will be redesigned to provide improved signals of the costs of water use and thus promote water use efficiency and investment in water conserving technologies. The third involves combining the outputs of the previous two tasks and applying them to end usersâ decision-support tools and forecasting models in order to predict water usersâ responses to reformed incentive structures and demonstrate the gains in efficiency and water use values from

implementing enhanced incentive structures.

Role of Key Partners, Identified End Users

This research has support from a diverse set of partners and end users including Environment Canada, the Ontario Ministry of the Environment, the Alberta Research Council, Utilities Kingston, the Canadian Waterworks Association and several Canadian universities in three provinces. This is indicative of the extent to which the issues raised and the approach taken resonate with the broad community in Canada concerned with water, in general, and water management, specifically. Partner organizations are involved in all stages of the project: development of conceptual models, data collection, estimation of demand models, design of efficient prices and water markets and knowledge translation through the application of estimated models to end usersâ’ decision-support tools.

Problem/Issue Addressed

Description

The Problem and Its Significance: Maximization of value from water resources in Canada is hampered by out-dated municipal/ provincial regulations governing pricing and allocation of water, leading to an inability to resolve competing water demands. The looming possibility of climate change-induced reductions in supply exacerbates the situation. Our partner, the Canadian Water and Wastewater Association, the national Association of municipal water services, notes in its support letter â' that the proposed research program is aimed principally and directly at addressing â'¦ [this] global problem faced by all stakeholders.â' The CWWA is â' very much interested in the proposed research and its outcomesâ' and â' believes that the research project will examine and report on options for the development of a modern framework for sectoral allocation of an increasingly scarce resource and one that is vital to the environmental and economic sustainability of Canada.â'

Benefits of Resolving the Problem: As noted above, water managers recognize many potential benefits from resolving misallocations: greater value from existing supplies; reduced operating/capital costs through slowed growth in water use; accelerated development in conservation technologies; prevention of damages to aquatic ecosystems.

State Of Management Knowledge: Water management in Canada does not promote efficient use. Provincial governments issue water use permits with little evidence of the value of proposed use and permit pricing has nothing to do with waterâ' s scarcity value. Municipal water pricing remains divorced from marginal costs of supply and the value of water. This results in over-expanded systems, over-use of water; reliance on ad hoc measures to curb water use in times of shortage and insufficient funds for necessary infrastructure improvements (Renzetti, 1999; Renzetti, 2007). This is changing slowly. Some provinces have recently raised water permit fees and some municipalities (our partner, Utilities Kingston) have adopted increasing block rates. The common theme is recognition of water as an economic resource and the willingness to use economic instruments (prices and tradable permits) to promote efficient use. To date, these initiatives have not been coordinated across levels of government and are constrained by the lack of data, empirical models, trained personnel, and institutional capacity.

Key Factors Affecting Decision-Making: Empirical evidence indicates that agricultural, commercial and industrial water demands are affected by water's price, prices of other inputs, the level of output, nature of water-using technology and environmental regulations. Residential water demands are determined by prices of water and sewage treatment, price of electricity, household income and characteristics of water-using appliances.

Teamâ' s Perspective on the Availability and Maturity of Knowledge

This project addresses the imbalance between our conceptual understanding of the three main areas of research in this proposal (water demand modeling and forecasting, design of water allocation mechanisms and design of water prices) and the paucity of practical experience and knowledge that can only be gained by econometric and statistical analysis, case studies and other empirical applications. Examples of this imbalance include:

â'¢ models of technology adoption have identified factors influencing farmersâ' uptake of new irrigation technologies but have not been tested with Canadian data

â'¢ theoretical properties of efficient municipal pricing rules are well understood, however, they require baseline Canadian values (currently lacking) for supply and demand parameters to implement them.

Project Outcomes

Description

The research outcomes are directed at improving the conceptual models used by decision-making water managers by providing them with improved pricing strategies and allocation rules, as well as enhanced demand measurement and forecasting methods. Combined, these results will enable Canada to use its existing or even diminishing water supplies in a more efficient and sustainable way; thus protecting aquatic ecosystems and producing more value for Canadians. From a broader perspective, improved allocation mechanisms will result in greater transparency and perceived fairness of regulatory decisions and less uncertainty for decision-makers. The research will address a number of important water management goals:
â'¢ Extend and make more realistic water demand models that underlie empirical modeling and forecasting
â'¢ Promote efficient water use by directing water to the highest valued uses. This will provide a greater contribution of water to the Canadian economy
â'¢ Contribute to an acceleration of technological innovation and uptake of new methods for re-using water by end users, particularly, industrial users
The research will give regulators the tools they need to develop and implement more flexible and transparent regulations for water allocation. This will allow provincial water managers to respond better to unforeseen water shortages and changes in the rate and source of growth of water demands.
The research will provide a number of improved conceptual models:
â'¢ hybrid models of water demands and user decision-making regarding the adoption of water-conserving technologies that combine economic and engineering/agronomic perspectives
â'¢ design of efficient water allocation mechanisms including water markets
â'¢ efficient nonlinear water rate setting models
Demonstrating the capacity of a new management solution.
University researchers and team partners will work jointly to translate conceptual models into improved management capabilities. These efforts will include:
â'¢ Work with Brandes of POLIS and Mundell of Kingston Utility to assess its pricing rules and DSM strategies
â'¢ Work with Villeneuve and Schaefer of Environment Canada to augment its Water Use and Analysis Model with the estimated water demand/technology adoption models
â'¢ Work with Taylor of Ontario Ministry of Environment to update demand models and water demand forecasting methods currently used by the Ministry.
â'¢ Work with Weber of Alberta Research Council to update its agricultural water demand use model
Evaluation of past decision making
Much of the motivation for the proposed research stems from our partnersâ' expressed dissatisfaction with current tools and strategies for measuring and managing water demands. The research program includes an assessment of the following practices: 1) inefficient municipal water rate-setting; 2) allocation of provincial water-use permits in the absence of information on the value of proposed and existing water uses; and 3) irrigation water demand forecasting based on fixed coefficient production models and exogenously determined output levels and irrigation capital stocks.

Project Description and Methodology

Description

Rationale for project design

The project is designed to achieve the desired outcomes described in the previous section. Once the outcomes were identified by all the project participants (academics, government employees, policy analysts, industry representative, and water utility partner), information needs were identified. The most important of these were identifying and modeling the incentive structures (prices and allocation mechanisms) that direct users towards more efficient, highly valued, water use and the behavioural models that allow predictions of water usersâ' reaction to these mechanisms. In addition, these information needs led the project team to recognize the areas where additional conceptual modeling was required and what data needed to be collected. The remaining parts of the project design were the matching of team members to tasks, development of HQP and knowledge translation strategies.

Overview of methodology

The project is organized around achieving three main sets of tasks. The first task involves estimating the structure of the basic behavioural relationships (water demands) that govern water use in the main water-using sectors in Canada. The second task involves redesigning the most important incentive structures facing water users. For large self-supplied water users, this involves the redesign of provincial water allocation rules, and, for smaller publicly supplied water users, this involves the redesign of municipal water prices. Both sets of incentives structures will be redesigned to provide improved signals of the full costs of water use and thus promote water use efficiency and investment in water conserving technologies. The third task combines the outputs of the previous two tasks and applies them to end usersâ' decision-support tools and forecasting models in order to predict consumersâ' responses to reformed incentive structures and demonstrate the gains in efficiency and water use values from implementing enhanced incentive structures.

Task 1: Conceptual modeling and estimation of hybrid water demand/technology adoption models.

This set of tasks begins with the development of a set of hybrid water demand/technology adoption models for each of the three main water-using sectors that combine economic and engineering/agronomic perspectives on water use. This will result in the estimation of models that reflect constrained optimizing behaviour with respect to water use and with respect to investment in water-using capital by households, firms and farms. These models represent an extension of recent work by members of the research team (Reynaud, Renzetti and Villeneuve, 2005; Renzetti, 2006; Bruneau and Renzetti, 2007) and are an advance over existing models of water demands (Caswell, 1991; Cameron and Wright, 1990; Pint, 1999; Renzetti, 2002; Dupont and Renzetti, 2001). The econometrically estimated demand models will yield important information about the degree of sensitivity of water use and adoption of water-using/conserving technologies to water rates and will provide information crucial to the development of efficient prices in Task 2. This analysis will also yield estimates of the value of water to the different water using sectors. By adopting an integrated demand framework across all sectors we will be able to assess and compare the effects of different demand side management instruments for water along a number of lines, including efficiency and equity of water use, administrative costs and long-run incentives for altering water using behaviour. Data on residential water consumption are available at an aggregate level from Environment Canadaâ' s Municipal Water Use Database. In addition, through partnership with Utilities Kingston, we have a panel data set (time series and cross-section) on individual household water consumption levels and prices. This will support detailed econometric analysis of residential water demands in response to alternative price and non-price conservation instruments. The econometric method will employ a two-stage estimation technique which corrects for endogeneity of pricing structure (Reynaud, Renzetti and Villeneuve, 2005). Data on industrial/ commercial water use will be obtained from Environment Canadaâ' s Industrial Water Use Database. Collected every five years, this unique national database is comprehensive in its coverage of both publicly and self-supplied water-using industrial firms. It will be used to estimate joint industrial water demands and water recycling models, and how they have changed over time. Data on agricultureâ' s use of water come from the 2006

Census of Agriculture, which for the first time (in 2006) collected data on irrigation water use and irrigation capital expenditures. In the case of agriculture, as investigated in Bjornlundâ' s SSHRC-supported survey of irrigators, important explanatory factors are expected to be input prices, crop choices, soil conditions and farmersâ' risk perceptions. This will build on the recent work reported in Bruneau, Renzetti and Villeneuve (2007); Bjornlund (2006a and 2006b); Madramootoo (2006); Webber, Madramootoo et al (2006). The residential water demand work will be led by Dupont with assistance from Mundell, and Villeneuve. The industrial water demand modeling will be lead by Renzetti with assistance from Villeneuve. The agricultural demand modeling will be co-led by Madramootoo and Renzetti with assistance from Bjornlund, Weber and Taylor.

Task 2: Conceptual modeling and design of efficient provincial water allocation mechanisms and municipal water prices.

This employs the parameters estimated in Task 1 and begins with the development of conceptual models for the design of both efficient non-linear municipal water rate schedules and efficient provincial water allocation mechanisms. Once again these models represent an advance over the current state of understanding (Renzetti, 2007; Renzetti, 1999; Renzetti and Dupont, 1999; Bjornlund, 2004; Bjornlund, 2003). The estimated municipal water rate schedules will extend existing models of efficient nonlinear pricing (Armstrong, Cowan and Vickers, 1995) to account for utility costs, uncertain and complex consumer demands, uncertain raw water availability and environmental regulations. It is expected that these price schedules will be non-linear functions of supply-side factors such as water quality and reliability, break-even constraints, time of consumption and distance from source, as well as demand-side features such as the distribution of price elasticities and risk preferences across households and differences in price elasticities across user groups. Water utility costs will be estimated using a stochastic cost frontier model of water agency operations with publicly available data for Ontario water agencies. In contrast, the research related to the design of efficient provincial water allocation mechanisms is divided into two components to reflect the current split in provincial practices regarding water allocation (e.g., provinces such as Ontario and Quebec use permit prices and provinces such as Alberta are moving towards water markets). Given this dichotomy in practices, our conceptual models will have two separate orientations. The first relates to the design of provincial water markets. The emphasis in this component of the research will be to assess the potential interactions and synergies between specific design features of water markets (such as the relative efficiency of informal leasing arrangements versus permanent sales) and other aspects of provincial water management (such as education/public participation programs and programs promoting Best Management Practices) in encouraging more efficient water use. In addition, research will be aimed at assessing the linkages between likely management responses by water users to the development of water markets and usersâ' values, objectives and production characteristics. The second relates to the development of efficient permit prices (or charges) for provincial water abstraction permits. In order for these charges to promote efficient water use and protection of aquatic ecosystems, they must reflect the full opportunity cost of water use (including the costs of the environmental impacts of reduced water quality arising from water use). Research will be conducted on the efficacy of tailoring these charges more closely to reflect local water supply-demand balances and to protect vulnerable ecosystems by varying the provincial permit charge regionally or temporally (for example, the fee could rise in summer months to reflect higher opportunity costs of withdrawals under diminished river flows and lake levels). In summary, both municipal water prices and provincial water use fees will be designed to reflect the full opportunity cost of water use; the difference being that, in the case of municipal pricing, it is necessary that prices reflect the costs of treatment, storage and delivery, as well as the value of the water in situ. The municipal water pricing calculations will be co-led by Dupont and Renzetti with assistance from Mundell and Brandes. The analysis of efficient provincial water allocation mechanisms will be led by Bjornlund with assistance from Renzetti, Weber and Taylor).

Task 3: Knowledge Translation to End Users

The first two parts of the research provide the â' raw materialsâ' for the analysis and assessment of policies and procedures aimed at improving water use efficiency and, more generally, improving the decision-making capacities of water managers. These will be combined and applied to augment end usersâ' decision-support

tools and other water-related computer models. There are several specific applications that will be carried out. Firstly, they will be used to design and evaluate efficient non-linear pricing rules and other conservation measures for municipalities. This will be done by applying our findings to the case of Utilities Kingston. We will also work with the CWWAâ' s National Water Use Efficiency and Conservation Committee to identify additional collaboration opportunities. Secondly, changes in water demands associated with more efficient pricing will be used to forecast the welfare gains associated with water conservation. Thirdly, waterâ' s value in different sectors will be estimated and used to calculate efficient charges for provincial water abstraction permits and evaluate the reallocation of available water across the sectors. This reallocation approach will be implemented in representative river-basins in Alberta and Ontario in order to illustrate the potential for undertaking value-based river-basin-level water planning. Fourthly, the water demand models will be used to predict the impacts of the extension of water markets in Alberta. A particular emphasis will be placed on sharing our models and predictions with the Alberta watershed boards/councils and irrigation districts already associated with Bjornlundâ' s SSHRC-support research. These will show the impacts on the agricultural sector and how those impacts vary with assumptions regarding the nature of other provincial water management programs. Finally, they will be used to improve water demand forecasting carried out by Environment Canada and the Alberta Research Council. An important feature of improved forecasts is that they will incorporate predictions for changes to water-use efficiencies reflecting changes in water using technologies. The applications analysis will be co-led by Dupont and Renzetti with the assistance of Weber, Bjornlund, Villeneuve, Mundell, Pleasance and Taylor.

Integration of Components to Achieve Outcomes

Several features of the project design ensure that it optimizes opportunities for integration and delivery of desired outcome across disciplines and perspectives:

-Strong support and participation of research partners and end users across all spectrums will lead to achievement of desired outcomes for two reasons. First, partner agencies have revised their work plans to reflect participation in the project and thus will demand results. Second, participation by individual partners in project components will keep them focused on the task of applying the estimated demand models and prices/allocation mechanisms and the goal of improved water allocations.

-Project teams are organized to achieve transdisciplinary integration with clearly defined responsibilities for all team members and timelines for all tasks

-Overall project is designed so that one componentâ' s output is anotherâ' s input, e.g. estimated water demand and technology adoption models from Task 1 are used in forecasting and pricing models (Tasks 2 and 3)

-The project PIâ' s have established strong lines of communication with all team members and will hold semi-annual meetings with team members to review each teamâ' s progress reports and to maintain co-ordination

-The project is also integrated methodologically in that all components have the same structure: conceptual modeling, empirical estimation and application to end users

-The project is integrated sectorally as all main water using sectors are addressed

Role of team participants

All project team members have clearly defined roles and responsibilities. The following identifies each participantâ' s primary responsibility; however, most participants have subsidiary responsibilities and will provide assistance to all teams.

Project Leaders

Dupont â' Principal Investigator: lead research team concerned with development, estimation and application of residential water demand models; lead valuation of water uses component and application of sectoral water demand models to Environment Canadaâ' s national forecasting model.

Renzetti â' co-Principal Investigator: lead research concerned with development, estimation and application of hybrid engineering-economic industrial water demands and the estimation of efficient municipal water prices; also co-lead development, estimation and application of agricultural water demand models.

Both PIâ' s will be responsible for overall project administration and implementation of the projectâ' s

knowledge translation strategy
Other Researchers:
Bjornlund : lead projectâ’ s research into enhanced provincial water allocation mechanisms and look at factors affecting water use practices (particularly technology adoption) of livestock operations.
Madramootoo: co-lead (with Renzetti) the development, estimation and application of agricultural water demands and technology adoption models
Non-funded Researchers:
Brandes (POLIS): communications support such as updates and briefing notes for specific target audiences; promote and disseminate project focusing on turning research into good public policy
Mundell (Utilities Kingston): data collection and development and assessment of municipal water pricing and non-price DSM measures for Utilities Kingston
Villeneuve (Environment Canada): data collection and estimation of sectoral water demands and application of these models to national forecasting model
Weber (Alberta Research Council): development of agricultural water demand models and provincial water allocation mechanisms
Partners:
Pleasance (CWWA): knowledge translation and assessment of water conservation measures
Schaefer (Environment Canada): assessment of industry and agriculture technology adoption models, assessment of provincial water allocation mechanisms and knowledge translation
Taylor (OMOE): design and assessment of enhanced provincial water allocation mechanisms and assist in applying water forecasting models at the provincial and water basin level
Graduate Students:
One graduate student will be assigned to each of the academic researchers and will complete their theses on topics directly related to the project. As such, graduate students will participate in the development, estimation and application of the water demand and technology adoption models, as well as the provincial allocation mechanisms and efficient municipal prices and DSM measures.
Milestones:
The following timelines provide the schedule for the project and identify its most important milestones.
Year One:
1 Literature review; data collection and organization.
2 With input from partners, finalize development of separate conceptual hybrid engineering/agronomc-econometric models to explain both water demand and technology adoption for each of the major water using sectors
3 Evaluate results from Bjornlundâ’ s SSHRC-supported survey of irrigators in the South Saskatchewan River Basin that show perceptions of achieving efficiency/productivity improvements and impediments to their ability to do so.
4 Evaluate impacts of introducing increasing block rate pricing and other non-price DSM efforts by Utilities Kingston
5 Present preliminary work at CWN conferences.
Year Two:
1 Econometric estimation of water demand/technology adoption models for residential water and industrial sectors separately.
2 Calculate value of water for each water using sector using current consumption patterns and prices.
3 Design efficient municipal water price schedules and analyse provincial water markets.
4 Assemble data for agricultural estimation and incorporate results on irrigatorsâ’ perceptions of the use of economic instruments for encouraging technology adoption to conserve on water use.
5 Present results from household and industrial demand research at academic conferences and to target users.
6 Work with partners to integrate estimated models into their decision-support tools and computer models
Year Three:
1 Econometric estimation of joint irrigation water demand and technology adoption model for agriculture and

calculation of value of water
2 Create Excel-based templates similar to those used in Renzetti and Dupont (Canadian Public Policy, 1999) to simulate alternative pricing rules and provincial water allocation mechanisms for different water using sectors.
3 Present results from agricultural demand research at academic conferences and to target users.
Year Four:
1 Produce forecasts of future water demands under various scenarios
2 Evaluate impacts of pricing rules according to forecasted future water demands and analyze effects using goals of efficiency, equity, administration costs, and sustainability on adoption of water-conserving technologies
3 Combine predictions from three sectors to examine impacts upon river-basing planning
4 Create Excel-based template to assist in evaluation of river-basing planning

Links to Other Work

Description

Relationship of the proposed project to similar work:
There is a significant amount of research currently being conducted regarding the economics of water resources. Important specific areas of current research include the following: estimation of water demands under non-linear price structures, design of efficient municipal water prices, analysis of structures of water markets leading to efficient allocations and estimation of agricultural water demands. This project addresses all of these issues and the project methodology is designed to make advances in all of these areas.
Team linkages to other work:
The project team is composed of researchers active in this field and already has strong links with a number of groups working in this area. Examples of these national and international linkages include the following:
â'¢ Dupont is currently working with researchers at Resources for the Future, University of Alberta and the Centre for Social and Economic Research on the Global Environment, University of East Anglia on the development of methods for estimating residential usersâ' valuation of water use and of reductions in risk in water-borne contaminants.
â'¢ Renzetti is currently working with researchers at University of Saskatchewan and Environment Canada on the estimation of industrial water demands and development of improved water demand forecasting methods. Renzetti has a continuing research link with Laboratories dâ' Economie des Resources Naturelles (LERNA), University of Toulouse, France regarding the design and assessment of water prices and estimation of industrial water recycling models.
â'¢ Bjornlund is working with other researchers at the University of Lethbridge to conduct multidisciplinary research into the value of water and the impact of climate change in Alberta (Klein et al. 2006). Bjornlund also is PI on a SSHRC application that has just received funding for 2007-2009 (joint with Renzetti, Kurt Klein of Lethbridge and Rob de Loe of Guelph) that will investigate management responses by irrigators to the use of different water policy instruments.
â'¢ Madramootoo has an ongoing research program concerned with optimizing water use in the Quebec agriculture sector and has a number of international projects examining water use, irrigation decision-making and reduction of pollution from agricultural operations.
Collaboration with other major efforts:
The project teamâ' s existing research and consulting linkages will ensure continuing strong connections with the water research community in Canada and internationally. These ties will be strengthened through participation in this project by POLIS Institute and the CWWA.
How work and outcomes will contribute to the overall effort in this area:
The project will provide a number of specific advances to the state of conceptual and applied knowledge regarding water demands, water pricing and water allocation mechanisms. These include:
â'¢ Estimated hybrid engineering/agronomic-economic water demand and technology adoption models
â'¢ Consistent estimates of the value of water use in alternative applications
â'¢ Improved understanding of the synergies between water market design and other regional water management policies

Knowledge Translation Strategy

Description

The primary motivation for the proposed program of research is the strong demand evidenced at all levels of Canadian government for improved understanding of water demands and enhanced tools to promote water demand management. The development of our KT strategy has been guided by the CWNâ' s KT toolkit and has three principle components.

Integration of User Priorities

Usersâ' priorities have been central to the defining of the research questions, choice of methodologies and form of research outputs that are the basis of this application. This has been achieved by researchersâ' review of partnersâ' programs and objectives and partnersâ' review of the research proposal. For example, all partnersâ' agencies expressed the need for enhanced and updated water demand models and this now forms a central part of the proposal. Environment Canada and the Ontario Ministry of the Environment have pointed to the current lack of models of agricultural water demand and irrigation technology choice. The development and estimation of these models is also a priority in the project. The CWWA has pointed to the need to assess alternative means to promote water conservation and our water pricing efforts and review of allocation rules will address this need. Overall, the integration of user priorities is evidenced in our partnersâ' letters of support and their provision of significant resources in support of the project.

Involvement of Target Users

In addition to participating in the framing of the research proposal, target users are involved in all components of the project. This is demonstrated by the presence of partners on the research subcomponent teams. Technical experts from partner agencies (Michel Villeneuve, Marian Weber, Brent Taylor and Ken Mundell) will participate in data collection and estimation of demand and pricing models. Other partners (Oliver Brandes, Karl Schaefer, Glen Pleasance) will participate through application of estimated models and diffusion of findings to the broader user community.

Diffusion Strategy

Diffusion of the research output and uptake of the estimated demand models, forecasting methods, provincial allocation mechanisms, and pricing rules is critical to the success of this project. Researchers and graduate students will undertake these specific actions to ensure this:

â'¢ Work with Brandes of POLIS and Mundell of Kingston Utility to assess its pricing rules and Demand Side Management (DSM) strategies,

â'¢ Work with Schaefer and Villeneuve of Environment Canada to augment its Water Use and Analysis Model with the estimated water demand/technology adoption models

â'¢ Work with Taylor of Ontario Ministry of Environment to update demand models currently used by the Ministry to assess the planned introduction of permit charges

â'¢ Work with Weber of Alberta Research Council to update its agricultural water demand use model.

â'¢ Work with Pleasance of Canadian Waterworks Association to disseminate findings through its National Water Use and Efficiency Committee.

These specific actions will be complemented by the following communication activities:

â'¢ presenting research findings at academic, CWRA, CWN and Federation of Canadian Municipalities (FCM) conferences and workshops for water utility managers

â'¢ publication of research in academic journals (including CWRJ and Canadian Public Policy) and other forums such as PRIâ' s Horizons and FCMâ' s Municipal World.

â'¢ development of best practice manuals/templates for demand estimation, forecasting, and pricing and allocation rules

Excellence/Strength of Project Team

Description

As described in the project outcomes section, there are two broad aspects to this research program. Each requires a different trans-disciplinary approach. Firstly, water demand modeling and forecasting requires knowledge about and understanding of the processes and technologies underlying current water use and future water technology adaptation choices, as well as the economic/environmental factors helping to determine these water consumption and innovation decisions. Economists (Dupont, Renzetti, Weber, Villeneuve), geographers (Bjornlund), a conservation and demand management advisor (Mundell), and an engineer (Madramootoo) will work together with partner Environment Canada (Schaefer) to provide a coherent understanding of the interrelationships between economics and engineering for domestic, industrial and agricultural water demands. Secondly, in order to assess current water allocation and rate-setting schemes and design improvements to the status quo, the project combines a broad array of expertise from different institutional settings: academic (Dupont, Renzetti and Bjornlund), public policy analysis (Weber), legal expertise (Brandes), federal government (Villenenuve, Schaefer), provincial government (Taylor) and water utility (Mundell). Thus, the project team is both multi-disciplinary- spanning social sciences (economics and geography) and sciences (agriculture and engineering) – and multi-perspective, since it encompasses professor and student members from academic communities (Brock, McGill, Lethbridge), members from the broader policy research community in Canada (Alberta Research Council, POLIS), members from government ministries involved in monitoring and regulating water use (Environment Canada and Ontario Ministry of the Environment), and partner members from water utilities (Utilities Kingston, CWWA). Finally, the team also has members from a number of regions in Canada: central, west coast, and prairies. Identify particular strengths of each member of the proposed research team. You should clearly identify their role in the project.

Research Team Members are:

Diane Dupont (Economist, Brock)

Particular Strengths: one of Canadaâ’ s leading authorities on non-market valuation; recipient of Brock Universityâ’ s Chancellorâ’ s Chair Award for Research; broad range of applied econometrics skills; expert knowledge about socio-economics of Canadian â’ water industryâ’ ; expertise in undertaking cost-benefit analysis of social aspects (comparison of efficiency versus equity effects) of regulatory policies; experience in working on and administering multi-disciplinary research projects

Roles:

1. Project Co-Principal Investigator and Co-Administrator (with Renzetti)
2. Work with Mundell (Utilities Kingston) to analyse residential water consumption data to evaluate impacts of move to increasing block rate pricing and effects of other non-price DSM programs and create a â’ case studyâ’ that can be presented to other water utilities in cooperation with CWWA
3. Lead the research team concerned with estimation and application of residential water demand models (work with Villeneuve and Brandes)
4. Lead the research related to valuation of water uses and application of sectoral water demand models to Environment Canadaâ’ s national forecasting model (work with Villeneuve)

Steven Renzetti (Economist, Brock)

Strengths: one of Canadaâ’ s leading experts on the economics of water resources; expertise in water demand estimation, experience in evaluating impact of water price reform in altering consumption decisions; extensive knowledge of water resources policy; consulted for the World Bank, Environment Canada and the Canadian Council of Ministers of the Environment

Roles:

1. Project Co-Principal Investigator and Co-Administrator (with Dupont)
2. Lead the research concerned with the modeling, estimation and application of industrial water demands and the estimation of efficient municipal water prices (Work with Bjornlund, Villeneuve, and Weber)

3. Co-lead (with Madramootoo) the hybrid engineering-economic modeling, estimation and application of agricultural water demand models (work with Bjornlund, Villeneuve, and Weber)
4. Work with team designing enhanced provincial water allocation mechanisms (work with Bjornlund, Weber and provincial partner (Taylor, Ontario Ministry of Environment))

Henning Bjornlund (Economic geographer, Lethbridge)
Strengths: Tier II Canada Research Chair in Water Policy; expertise in operation of water markets; connections to work being done on water markets in Australia
Roles:
1. Lead the work on evaluating factors leading to adoption of water-saving technology by livestock agricultural operations in the South Saskatchewan River Basin (Work with Renzetti, Madramootoo) and adaptation of this work to factors hindering or encouraging water-saving decisions with respect to irrigation
2. Lead research into enhanced provincial water allocation mechanisms, focusing upon features leading to efficient outcomes from either water markets or permit price setting (work with Renzetti, Weber, and provincial partner (Taylor, Ontario Ministry of Environment))

Chandra Madramootoo (Agricultural Engineer, McGill)
Strengths: James McGill Professorship at McGill University; Dean of the Faculty of Agricultural and Environmental Sciences; Founding Director of the Brace Centre for Water Resources Management; extensive international research experience in projects relating to water table management, irrigation, drainage, water quality, watershed management and land reclamation.
1. Co-lead (with Renzetti) hybrid engineering-economic modeling, estimation and application of agricultural water demand models (Work with Bjornlund, Villeneuve, and Weber)

Marian Weber (Resource Economist, Alberta Research Council)
Strengths: expertise in the evaluation of economic instruments, land use water management, climate change and adaptation and biological conservation
Roles:
1. Work on team developing agricultural water demand models, including evaluation of barriers and incentives to adopting water saving/reusing technology (work with Madramootoo, Renzetti, and Bjornlund)
2. Work on team that evaluates impacts of alternative provincial water allocation mechanisms (work with Renzetti, Bjornlund, and provincial partner (Taylor, Ontario Ministry of Environment))

Michel Villeneuve (Senior Policy Advisor, Environmental Stewardship Branch, Environment Canada)
Strengths: expertise in studies related to water demands and water valuation; is responsible for the development and implementation of important databases: the Industrial Water use Survey and the Municipal Water-use Survey.
Roles:
1. Lead the organization and manipulation of MUD (municipal water use data) and IWUS (industrial water use data) into format amenable to evaluation and estimation (Work with Dupont and Renzetti)
2. Work on teams estimating sectoral water demands (Residential with Dupont; Industrial with Renzetti)
3. Work on teams applying results of estimated demands to Environment Canadaâ’ s national forecasting model

Ken Mundell (Conservation and Demand Management Advisor, Utilities Kingston)
Strengths: expertise in measurement and instrumentation; unique knowledge of rate setting by Utilities Kingston
Roles:
1. Provide access to residential water consumption data
2. Work with Dupont to review municipal demand estimation models to tailor them to the circumstances particular to Utilities Kingston and then to evaluate the effect of the recent change in rate-setting approach to water pricing
3. Work with Dupont and Brandes to assess the impacts of alternative rate-setting rules and effects of non-price DSM instruments
4. Work with Dupont, Brandes and Pleasance to disseminate results of Utilities Kingston case study to other

municipal water utilities
Oliver Brandes (Senior Research Associate and Project Leader, University of Victoriaâ’ s POLIS Project on Ecological Governance)
Roles:
1. Communications support such as updates and briefing notes for specific target audiences (work with Dupont and Renzetti)
2. Review draft materials and promote and disseminate project results through our broad network of stakeholders (work with Dupont and Renzetti)
3. Assist in mobilizing the knowledge to individuals facing the challenge of implementing new sustainable approaches to water management (work with Dupont, Mundell, Renzetti and Pleasance)
4. Offer knowledge and experience of background in ecological economics and law

List of Project Team Members

Name	% of Time	CWN Proposed Funding Year 1	Year 2	Year 3	Year 4
Diane Dupont <diane.dupont@brocku.ca>	25%	$19000	$23000	$19250	$24250
Title, Affiliation	Dr. and Chancellor's Chair for Research Excellence, Brock University				
Role	Project Co-Principal Investigator and Co-Administrator (with Renzetti) 1. Work with Mundell (Utilities Kingston) to analyze residential water consumption data to evaluate impacts of move to increasing block rate pricing and effects of other non-price DSM programs and create a â' case studyâ' that can be presented to other water utilities 2. Lead the research team concerned with estimation and application of residential water demand models (work with Villeneuve and Brandes) 3. Lead the research related to valuation of water uses and application of sectoral water demand models to Environment Canadaâ' s national forecasting model (work with Villeneuve)				
Steven Renzetti <steven.renzetti@brocku.ca>	35%	$19000	$23000	$19250	$24250
Title, Affiliation	Dr., Brock University				
Role	Project Co-Principal Investigator and Co-Administrator (with Dupont) 1. Lead the research concerned with the modeling, estimation and application of industrial water demands and the estimation of efficient municipal water prices (Work with Bjornlund, Villeneuve, and Weber) 2. Co-lead (with Madramootoo) the hybrid engineering-economic modeling, estimation and application of agricultural water demand models (Work with Bjornlund, Villeneuve, and Weber) 3. Work with team looking into enhanced provincial water allocation mechanisms (work with Bjornlund, Weber and provincial partner (Taylor, Ontario Ministry of Environment)				
Marian Weber <weber@arc.ab.ca>	5%	$	$	$	$
Title, Affiliation	Dr., Alberta Research Council				
Role	1. Work on team developing agricultural water demand models, including evaluation of barriers and incentives to adopting water saving/reusing technology (work with				

	Madramootoo, Renzetti, and Bjornlund) 2. Work on team that evaluates impacts of alternative provincial water allocation mechanisms (work with Renzetti, Bjornlund, and provincial partner (Taylor, Ontario Ministry of Environment)				
Chandra Madramootoo <chandra.madramootoo@mcgill.ca>	10%	$29000	$28000	$29250	$29250
Title, Affiliation	Dr., James McGill Chair, McGill University and Brace Centre for Water Resources Management				
Role	Co-lead (with Renzetti) hybrid engineering-economic modeling, estimation and application of agricultural water demand models (Work with Bjornlund, Villeneuve, and Weber)				
Henning Bjornlund <henning.bjornlund@uleth.ca>	20%	$29000	$28000	$29250	$29250
Title, Affiliation	Dr. and Tier II CRC in Water Policy, University of Lethbridge				
Role	1. Lead the work on evaluating factors leading to adoption of water-saving technology by livestock agricultural operations in the South Saskatchewan River Basin (Work with Renzetti, Madramootoo) and adaptation of this work to factors hindering or encouraging water-saving decisions with respect to irrigation 2. Lead research into enhanced provincial water allocation mechanisms, focusing upon features leading to efficient outcomes from either water markets or permit price setting. (Work with Renzetti, Weber, and provincial partner (Taylor, Ontario Ministry of Environment)				
Michel Villeneuve <Michel.Villeneuve@ec.gc.ca>	10%	$	$	$	$
Title, Affiliation	Senior Policy Advisor, Environmental Stewardship Branch, Environment Canada				
Role	1. Lead the organization and manipulation of MUD (municipal water use data) and IWUD (industrial water use data) into format amenable to evaluation and estimation (Work with Dupont and Renzetti) 2. Work on teams estimating sectoral water demands (Residential with Dupont; Industrial with Renzetti) 3. Work on teams applying results of estimated demands to Environment Canadaâ’ s national forecasting model				

Ken Mundell <kmundell@utilitieskingston.com>	5%	$	$	$	$
Title, Affiliation	Conservation and Demand Management Advisor, Utilities Kingston				
Role	1. Provide access to residential water consumption data 2. Work with Dupont to review municipal demand estimation models to tailor them to the circumstances particular to Utilities Kingston and then to evaluate the effect of the recent change in rate-setting approach to water pricing 3. Work with Dupont to assess the impacts of alternative rate-setting rules and effects of non-price DSM instruments 4. Work with Dupont and Brandes to disseminate results of Utilities Kingston case study to other municipal water utilities				
Oliver Brandes <omb@uvic.ca>	9%	$	$	$	$
Title, Affiliation	Senior Research Associate and Project Leader, University of Victoriaâ’ s POLIS Project on Ecological Governance				
Role	1. Communications support (updates and briefing notes for specific target audiences) 2. Dissemination of project results to turn research into good public policy and mobilization of knowledge to water managers and regulators 3. Provide perspectives of ecological economics and law to the trans-disciplinary nature of the project.				

Training of Highly Qualified Personnel

Description

This project combines the expertise of individuals with a diverse set of background training: natural/environmental resource economics, agronomy, agriculture, engineering, geography and law. However, these individuals have two important characteristics in common. First, they have a great deal of experience working on multi-disciplinary and multi-sectoral research teams. Second, they share a vision of applying the richness of their individual skills to a common objective: the provision of practical and appropriate solutions to improve water management in Canada. By introducing students to this type of focused but broad research mandate early in their training, this project will encourage them to think beyond their narrow disciplinary boundaries. In addition, since the focus of the project is to provide real solutions to some of Canadaâ' s most pressing water management problems by working with water utilities, government ministries, and public policy analysts, the project will provide students with valuable contacts and enable them to be part of a group assisting in the inevitable transformation of water management policies in Canada. More particularly, Madramootooâ' s students will be exposed to models and analyses that include economic considerations in water use/water technology adoption choices. These students will assist in modeling agricultural demands that reflect economic constraints imposed upon particular operations according to soil conditions. The Masters/PhD students working with Bjornlund, Dupont, and Renzetti will see the importance of incorporating engineering processes and environmental constraints into economic models capable of yielding the most relevant analyses of water management policies. We will provide all students with the tools needed to discuss issues/problems through a web-based chat room format. By having the students work together towards the common goal of improved water management we will encourage brainstorming to produce new approaches that are less tied to disciplinary lines.

Outside of our activities we will have students participate in CWN-sponsored student workshops and provide incentives for them to get involved with the student sections of CWN and CWRA and to present their research at conferences that attract many disciplines (e.g., American Water Works/Canadian Water Works Associations and government sponsored conferences on water quality).

Students working with Dupont and Renzetti will receive valuable training through the co-op component of their Masterâ' s program arranged by Brockâ' s Co-op Office. Potential employers include government agencies such as Environment Canada or Statistics Canada or the Ministry of the Environment or companies that focus upon resource management issues. Participation in the co-op promotes independence and professional maturity, as well as providing exposure to a number of different career paths. In addition to assisting students with their resumes, the co-op part of the training teaches students how to prepare for job interviews. Prior to taking the co-op students are encouraged to develop a set of learning objectives and at the end of the co-op, their performance is evaluated by their employer. This teaches students two practical skills: how to set goals and how to achieve them.

List of Highly Qualified Personnel

Name	Role	Affiliation
TBA - Year 1	Assist in evaluation of Utilities Kingston change in water rate effects on demand and conservation (work with Dupont)	Brock
TBA - Year 2	Estimate residential demand models using Federal database (MUD) and obtain elasticities of demand and water values to evaluate potential for adaptation of household capital stock to higher water price environment (work with Dupont)	Brock
TBA - Year 4	Assist in sectoral valuation of water uses and application of sectoral water demand models to Environment Canadaâ’ s national forecasting model (work with Dupont)	Brock
TBA - Year 3	Incorporate demand estimation results into format capable of simulating impacts (efficiency, equity) of alternative pricing rules for three sectors of water users (work with Dupont)	Brock
TBA - Year 1	Assist in development of conceptual hybrid engineering-econometric models to explain both water demand and technology adoption by the manufacturing sector (work with Renzetti)	Brock
TBA - Year 2	Estimation of econometric water demand/technology adoption models for manufacturing sectors (work with Renzetti)	Brock
TBA - Year 3	Undertake econometric estimation of joint irrigation water demand and technology adoption model for agriculture and calculation of value of water for this sector (work with Renzetti)	Brock
TBA - Year 4	Combine water demand and value predictions from three sectors to examine impacts upon river-basing planning (work with Renzetti)	Brock
TBA - Years 1 and 2	Evaluate results from survey of irrigators in the South Saskatchewan River Basin that show perceptions of achieving efficiency/productivity improvements and impediments to their ability to do so (work with Bjornlund)	Lethbridge
TBA - Years 3 and 4	Evaluate potential gains from introduction of efficient water markets into provincial allocation approaches (work with Bjornlund)	Lethbridge
TBA - Years 1 and 2	Water use efficiencies associated with adapting irrigation systems to increases in water rates (Work with Madramootoo)	McGill
TBA - Years 3 and 4	Hybrid Agronomic-Economic-Engineering approach to modelling irrigation technology adaptation to water scarcity (Work with	McGill

Madramootoo)

Partners

Description

This research proposal is fortunate to have elicited support from a very diverse set of partners. This is indicative of the extent to which the issues raised and the approach taken to provide answers to them in the research proposal resonate with the broad community in Canada concerned with water, in general, and water management, specifically. We have grouped the partners into several sectors (water utilities, provincial government, federal government, universities, research and policy analysis institutions).

Water Utilities

Utilities Kingston is able to contribute to the project with a number of in-kind contributions. These contributions include: providing Dupont and Renzetti access to the residential water consumption data that Utilities Kingston has been collecting; expert reviewing of proposed research methodology by staff members; providing background information on how Utilities Kingston rate-setting rules are determined; participation of staff in assessing merits and impacts of proposed alternatives to rate-setting rules; and participation of staff in report writing and assistance in dissemination of results. The total value of this contribution is $9,500 over the four years of the project.

Duncan Ellison, Executive Director of the Canadian Water and Wastewater Association, has written a letter of support for the proposal and will monitor and review results examining alternative allocation rules. Members from CWWA's Water Use and Efficiency Committee will assist in mutually beneficial collaborative efforts. While these in-kind contributions have not been valued, the oversight and monitoring of the research by various committees of the CWWA will significantly assist in our knowledge translation efforts and strengthen our ability to translate our research into a format that can usefully â' address the global problem faced by all stakeholders in the issueâ' (Duncan Ellison).

Provincial Government

The Land and Water Policy Branch of the Ontario Ministry of the Environment provides a leadership role in forming Ministry of the Environment policies and programs relating to managing Ontario's water resources. They are concerned with both water quality and quantity issues. The proposed research will assist the Branch in achieving both short-term and long-term goals. In terms of short-term goals, the Branch is currently developing a proposal for water taking charges (permit fees) and recognizes that information on municipal and provincial water charging and the role of water pricing in managing water in Canada is lacking. The Branch's long-term goals of alternative approaches to water allocation in the face of increasing demand for water in Ontario will also be assisted by this research proposal. Brent Taylor, Senior Policy Analyst with the Branch, along with other personnel from the Branch will offer valuable expertise arising from practical experience in areas such as water management, water allocation, conservation, and water charging. Ministry staff also has direct access to staff in other ministries (e.g., Agriculture and Natural Resources) who will provide valuable insight into sector-specific water use. In addition, the Branch will provide data on water permits, water use and reporting data that will yield baseline information on the extent of current water withdrawals. These contributions, accounting for staff release time to participate in the project and data acquisition costs, represent approximately $25,000 per year in in-kind support from the ministry for the duration of the project.

Federal Government

The Water Conservation Division in the Environmental Stewardship Branch of Environment Canada supports this work as noted in the letter of support from John Karau, Director. His division is responsible for sustainable water management in Canada and he notes that the research will help provide a better understanding of sectoral water use patterns in Canada; promote demand-side management instruments and tools to encourage water use efficiency; promote sustainable water management in municipal and key industrial sectors, and advance collaboration with other Canadian jurisdictions on water and watershed management by developing and promoting cooperative sustainable water management concepts, principles, and approaches. Our specific partner in Mr. Karau's branch is Michel Villeneuve, Acting Manager for the

Water Resources Strategy Section of Environment Canada. Villeneuve and his staff will provide expert advice and data for this research project. In addition, he will provide make available valuable data from Environment Canadaâ' s key databases for the projectâ' s use (Industrial Water Use Database (IWUS) and its Municipal Water Use Database (MUD)). Villeneuve will work with Dupont (on residential data) and Renzetti (on industrial data) to estimate sectoral water demands. Finally, he and his staff will assist the team to apply the results of the estimated demands to Environment Canadaâ' s national forecasting model. Provision of expert advice and data to the project represent an in-kind contribution of $46,000 over four years.

In addition, Karl Schaefer of the National Water Research Institute, Environment Canada, will provide unpriced in-kind services in development and implementation of estimation of the water demand/technology adoption models. He will also assist Brandes in translating knowledge generated in the project to policy analysts and policy makers.

Universities

A number of units at Brock University support the project in two broad ways: provision of time release (Dean of Social Sciences) and in-kind secretarial and administrative support (Department of Economics) for Dupont and Renzetti and financial and in-kind support to the eight graduate students (Masters of Business Economics) who will do their theses under the supervision of Professors Dupont and Renzetti (Brockâ' s Office of Graduate Studies and Brockâ' s Co-Op Office). With respect to the time releases, the Dean is providing a 25% reduction in teaching load for either Professor Dupont or Professor Renzetti in each year of the four years of the grant. The normal teaching load is 2 courses per semester over the fall and winter semesters. The time releases provide the researchers with the most valuable commodity: research time. With respect to cash support towards the project, the Office of Graduate Studies provides financial support to each full-time graduate student accepted into the MBE program. Based on 2006/07 levels of financial support, the typical funding package includes a graduate fellowship of $8,500 per year and a teaching assistantship of $5,100, and an international fellowship of $6,340 (if the student is international). This amounts to a total estimated cash value of $108,800. In the absence of financial worries, students are better able to devote themselves to the research project and become active partners in the research. With respect to the Co-op Office, the total support towards providing the students with invaluable co-op experience during their graduate program is $9,490 per student per year for a total support of $75,920 cash over the project. There is another in-kind aspect of this support that is difficult to value since it involves goodwill and the creation of contacts for students with potential employers upon graduate. This is an example of knowledge translation in a broad sense of educational expertise flowing to the general economy and improving the overall level of welfare of Canadians since a better educated population gives rise to higher levels of per capita income and higher living standards. Thus, Brockâ' s total support towards this research proposal is valued at $236,720.

The University of Lethbridge support to the project will greatly assist Bjornlund to perform to his optimum on this research project. Support takes the form of both cash and in-kind resources. The University of Lethbridge is providing Bjornlund with two course time releases per year valued at $25,000. Second, in recognition of his position as a CRC II, the University is giving Bjornlund administrative support for his research. This is a $25,000 per year cash contribution. Total support over the four years of the project is valued at $200,000.

McGill University has pledged support for this research in the form of the use of the Brace Centre for Water Resources Managementâ' s facilities, labs, offices, support staff and technicians to help carry out Professor's Madramootoo's research on agricultural water demands and water technology adoption strategies. The Brace Centre will also provide facilities for hosting of workshops to bring researchers and end-users together for brainstorming and knowledge translation sessions. This is valued at $50,000 per year for each year, for a total support to the research proposal of $200,000.

Research Institutes

The Alberta Research Council is providing two kinds of support. One of its researchers, Marian Weber, will provide 5% of her time (1 day per month) as an in-kind contribution. She will work on the team developing agricultural water demand models and on the team that evaluates the impacts of alternative provincial water

allocation mechanisms. This is valued at $12,000 per year. ARC has also provided further in-kind support in the form of giving the researchers a GIS data set for the South Saskatchewan River Basin which including layers for climate, soils and agricultural land water use. The value of the data set is approximately $10,000. Thus, ARCâ’ s total support to the project amounts to $58,000.

The POLIS Project on Ecological Governance (at the University of Victoria) through Oliver Brandes will provision staff time with an approximate annual value of $5,000 including access to data and support staff, to help develop the analysis and contribute to the identification of best practices and leading opportunities. Brandes will also provide key assistance with communications and outreach support through access to the POLIS network and by posting regular updates on professionally designed website â’ a well developed resource used by many practitioners and policy makers. This contribution to the project is estimated at $5,000 per year. Thus, POLISâ’ s total support to the research proposal amounts to $40,000.

Partners Contributions

Name	Letter of Support		Funding Year 1	Year 2	Year 3	Year 4
Brock University - Co-op Office **Academic**	Yes	**Cash**	$18980	$18980	$18980	$18980
		In-Kind	$	$	$	$
Location	St. Catharines, Ontario					
Description	Two students per year in the Masters of Business Economics program will work on this project under Professors Dupont and Renzetti. Part of the training that the students will receive involves two terms of a co-op experience. The Co-op office provides cash support to assist these students. The support is $9490 per student per year (so, per year this is cash support of this project of $18,980).					
Alberta Research Council **Other**	Yes	**Cash**	$	$	$	$
		In-Kind	$22000	$12000	$12000	$12000
Location	Edmonton, Alberta					
Description	Dr. Marian Weber will provide 5% of her time (1 day per month) as an in-kind contribution. This is valued at $12,000 per year. Further in-kind support will include the provision of a GIS data set for the South Saskatchewan River Basin including layers for climate, soils and agricultural land water use. The value of the data set is approximately $10,000.					
McGill University **Academic**	Yes	**Cash**	$	$	$	$
		In-Kind	$50000	$50000	$50000	$50000
Location	Montreal, Quebec					
Description	The support will include the use of Brace Centre facilities, labs, offices, support staff and technicians to help carry out Professor Madramootoo's research on agricultural water demands and water technology adoption strategies. The Brace Centre will also provide facilities for hosting of workshops to bring researchers together for brainstorming sessions.					
Environment Canada **Federal Government**	Yes	**Cash**	$	$	$	$
		In-Kind	$11500	$11500	$11500	$11500
Location	Ottawa, Ontario					
Description	Manager and staff of the Water Resources Strategies section will provide data and expert statistical and economic analysis in support of water demand modeling and estimation, as well as water demand forecasting.					
Environment Canada **Federal Government**	Yes	**Cash**	$	$	$	$
		In-Kind	$	$	$	$
Location	Burlington, Ontario					

Description	Schaefer will provide unpriced in-kind services in development and implementation of estimation of the water demand/technology adoption models. He will also assist in translating knowledge generated in the project to policy analysts and policy makers					
POLIS Project **Other**	Yes	**Cash**	$5000	$5000	$5000	$5000
		In-Kind	$5000	$5000	$5000	$5000
Location	Victoria, British Columbia					
Description	Provision of staff time with an approximate annual value of $5,000 including access to data and support staff, to help develop the analysis and contribute to the identification of best practices and leading opportunities. Also assist with communications and outreach support through access to POLIS network and by posting regular updates on professionally designed website, a well developed resource used by many practitioners and policy makers, we estimate this contribution at $5000 per year.					
University of Lethbridge **Academic**	Yes	**Cash**	$25000	$25000	$25000	$25000
		In-Kind	$25000	$25000	$25000	$25000
Location	Lethbridge, Alberta					
Description	The University of Lethbridge support will be through both cash and in-kind resources. First, the University provides a two-course teaching load reduction for Bjornlund, valued at $25,000 per year as an in kind contribution. Second, the University provides Bjornlund with part-time research administrative support for his research endeavours. This is $25,000 per year cash contribution to his research program.					
Utilities Kingston **Industry**	Yes	**Cash**	$	$	$	$
		In-Kind	$5000	$1000	$1000	$2500
Location	Kingston, Ontario					
Description	Utilities Kingston is able to contribute to the project with a number of in-kind contributions. These contributions include: providing Professor Dupont and Professor Renzetti access to the residential water consumption data that Utilities Kingston has been collecting; expert reviewing of proposed research methodology by staff members; providing background information on how Utilities Kingston rate-setting rules are determined; participation of staff in assessing merits and impacts of proposed alternatives to rate-setting rules; and participation of staff in report writing and assistance in dissemination of results.					
Brock University Economics Department **Academic**	Yes	**Cash**	$	$	$	$
		In-Kind	$1000	$1000	$1000	$1000
Location	St. Catharines, Ontario					
Description						

						Brock University will provide in-kind support, such as secretarial services, phone, photocopying, financial administration of $1000 per year.
Brock University (Dean of Social Sciences) **Academic**	Yes	**Cash**	$12000	$12000	$12000	$12000
		In-Kind	$	$	$	$
Location						St. Catharines, Ontario
Description						The Dean is providing a 25% reduction in teaching load for either Professor Dupont or Professor Renzetti in each year of the four years of the grant.
Brock University (Office of Graduate Studies) **Academic**	Yes	**Cash**	$27200	$27200	$27200	$27200
		In-Kind	$	$	$	$
Location						St. Catharines, Ontario
Description						The Office of Graduate Studies provides financial support to each full-time graduate student accepted into the MBE program. Based on 2006/07 levels of financial support, the typical funding package includes a graduate fellowship of $8,500 per year and a teaching assistantship of $5,100, and an international fellowship of $6,340 (if the student is international).
Ontario Ministry of the Environment **Provincial Government**	Yes	**Cash**	$	$	$	$
		In-Kind	$25000	$25000	$25000	$25000
Location						Toronto, Ontario
Description						The Ministry of Environment will ensure that the research produces practical outcomes that can be applied directly to its water policy initiatives. The Water and Land branch will also be a useful resource for the project by offering expertise in areas such as water management, water allocation, conservation and water charging. It also has direct access to staff in other ministries (e.g., agriculture, natural resources) that will be able to provide valuable insight into sector-specific water use. Lastly, it will provide data for the project, such as water permit information and water use and reporting data.
Canadian Water and Wastewater Association **Industry**	Yes	**Cash**	$	$	$	$
		In-Kind	$	$	$	$
Location						Ottawa, Ontario
Description						Supports the proposal and will monitor and review results examining alternative allocation rules. Members from CWWA's National Water Use and Efficiency Committee will assist in mutually beneficial collaborative efforts.

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Budget Justification

Description

Detailed Justification for Each Component of Requester CWN Funds
Salaries to Students
This project has Dupont and Renzetti hiring a total of eight undergraduate students (two per year) in each of the four summers in order to give them the opportunity to participate in research. Each student will be paid a summer salary amounting to approximately $6,000.
Two Masters Students per year will work on a thesis under Dupontâ s and Renzettiâ s direction at Brock University. The funding requested is for wages and benefits to these students during their semesters when they concentrate solely on their thesis research. They will be paid approximately $9,000 each (including benefits).
Two doctoral students per year will work (for an estimated two years each) under either Professor Bjornlund or Professor Madramootoo. They will be paid approximately $25,000 each per year (including benefits)
Materials, Supplies and Other Expenditures
Each researcher will receive $500 per year for each of the four years to assist in the purchase of office supplies, fax costs, telephone costs, and photocopy costs.
Computing Costs
In order to support the research, each of the four funded researchers will receive $3,000 in the first year to assist in purchasing computers and software either for themselves or for their research labs or students.
Conferences
In each of years 2,3, and 4 each of the four funded researchers will receive $1,000 to assist in travel to either CWN-sponsored or academic/association-sponsored conferences. The goal of conference attendance is to encourage transmission of ideas, promote knowledge translation and encourage networking with other researchers in areas that will provide synergy to this project.
Collaboration/Consultation
In each of years 2, 3, and 4 each of the four funded researchers will receive $1,000 to allow them to both collaborate with researchers at other institutions working on similar projects and to consult with each other and partners. The funding is intended to support travel to each otherâ s institutions and facilitate the semi-annual meetings that will foster innovations to the research as data and models are investigated.
Workshops
In each of years 2 and 4 we will put on a workshop. Workshop #1 (in year 2) will focus upon showcasing the work done with Utilities Kingston and allow us to invite other water utilities to come and learn how rate setting changes can improve both short run and longer run management goals. We will pay or defray some portion of the travel expenses of invited participants and speakers. We will use the Brace Centreâ s facilities (one of our partnerâ s in-kind contributions) for the location of this workshop. Workshop #2 (in year 4) will be held at the University of Lethbridge and will bring together researchers interested in river basin planning and provincial water allocation mechanism design. Again, the funding requested will pay or help to defray travel expenses of invited participants.
Dissemination Costs
In each of years 3 and 4 we have budgeted $4,000 to allow us to translate the knowledge generated in the project to a broader audience than workshop participants. We will combine this with the in-kind and cash contributions of our partner, POLIS, so that we translate the knowledge generated about the sensitivity of demand elasticities into a series of best management practices for utilities managers and into policy recommendations for individuals charged with the difficult task of allocated scarce water resources.
Publication Costs
In each of years 3 and 4 we have budgeted for $250 per funded researcher to assist in defraying costs associated with publication (journal submission fees and page charges).
Research Management

We have budgeted $1,000 for each of Dupont and Renzetti for each of the four years to enable them to manage the flow of information coming from researchers, to assist in setting up the web-based chat room for students, to provide travel assistance for students to attend CWN and other association conferences, and to defray administrative services associated with reporting to CWN.

Allocation and Use of Partner Cash and In-kind Contributions

In-kind contributions of data and staff time from Utilities Kingston, Environment Canada, the Ontario Ministry of the Environment, POLIS, and ARC will support the various components of all of the funded researchersâ' projects. Data on residential water use (from Utilities Kingston and Environment Canada) will be used first by Dupont to estimate residential water demands and then output from this will be used by Renzetti and Dupont and Bjornlund in the water allocation and valuation models. Data on industrial water use (from Environment Canada) will be first used by Renzetti and Villeneuve to estimate industrial water demands and water technology adoption (recycling) models and then used by Renzetti and Dupont and Bjornlund in the water allocation and valuation models. Data on agricultural water use (from Agriculture Canada) and on land features in the SSRB (GIS data from ARC) will first be used by Renzetti, Madramootoo, Bjornlund, and Weber and then used by Renzetti, Dupont, and Bjornlund in the water allocation and valuation models. Staff time will be used by all of the researchers as required. Each funded researcherâ's university contributions will be used as by the researchers and/or graduate students affiliated with that university as described in the partnership section. Other resources such as workshop space will be jointly used. All of the researchers will benefit from the knowledge translation and legal background services provided by Brandes of POLIS.

Relationship to Other Support Currently Held

Description

The team is able to draw upon three additional resources that complement the proposed research.
Firstly, during 2007/08 Bjornlund has a $40,000 SSHRC grant to support a research program that analyses irrigation district and private irrigatorsâ' perceptions of achieving efficiency and productivity improvements; what they see as impediments to achieve these goals; and what instruments they believe would further the process. He also has a total funding of $300,000 from the Alberta Ingenuity Centre for Water Research from 2005 to 2009 to look at the intensive livestock sector and its water use practices and the impact of this upon the health of the families involved in the industry.
Secondly, over the period 2006-2009 Dupont holds Brockâ' s Chancellorâ' s Chair in Research, an award worth $45,000 used to support her water valuation and management research.
Thirdly, Bjornlund and Renzetti are part of a four person team which has just received $144,000 for the next three years from the most recent SSHRC competition (announced April 2007) to generate new knowledge about: a) farmersâ' responses to new water policy instruments such as water markets; b) how such responses vary with farmer characteristics and local conditions; c) how such responses can be influenced by improved information; and d) the processes by which acceptable community compromises can be reached balancing the demand between competing users as part of the development of local water management plans and how economic models can be used to facilitate this process.

Budget Estimate

	Number of CWN Funded Persons				CWN Portion of Project Budget			
	Y1	Y2	Y3	Y4	Year 1	Year 2	Year 3	Year 4
Salaries to students (including benefits)								
Bachelors Canadian and Permanent Residents	2	2	2	2	12000	12000	12000	12000
Bachelors Foreign								
Masters Canadian and Permanent Residents	2	2	2	2	18000	18000	18000	18000
Masters Foreign								
Doctorate Canadian and Permanent Residents	2	2	2	2	50000	50000	50000	50000
Doctorate Foreign								
Salaries to Non-students (including benefits)								
Post-Doctorate Canadian and Permanent Residents								
Post-Doctorate Foreign								
Technical and Professional Assistants								
Other:								
Other:								
Other:								
Equipment (including powered vehicles)								
Purchase or Rental								
Maintenance and/or Operating Costs								
Material, supplies and other expenditures					2000	2000	2000	2000
Computing Costs					12000			
Travel								
Field Trips								
Conferences						4000	4000	4000
Collaboration/Consultation						4000	4000	4000
Workshops						10000		10000
User Fees								
Dissemination Costs							4000	4000
Publication							1000	1000
Research Management					2000	2000	2000	2000
Other:								
Other:								
Other:								
Notes								