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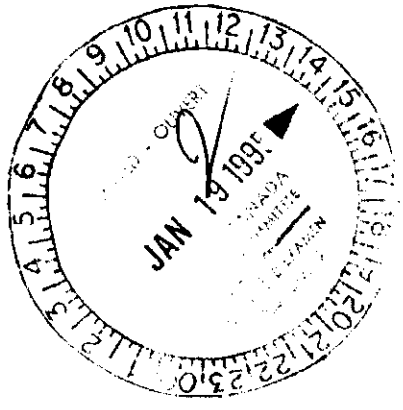
Economic Instruments for NO_x Emissions from Mobile Sources in Quebec

Prepared for:
Environment Canada



Proposal # K2231-4-2070

January 17, 1995

Prepared by:

APOGEE RESEARCH
STRATEM INC.

Reference No. 517 CEN

APOGEE RESEARCH
International, Ltd.

January 17, 1995

Mr. J. Jordan
Contract Officer
Conservation and Protection
Environment Canada
351 St. Joseph Blvd.
Hull, Que.
K1A-0H3

Dear Mr. Jordan:

RE: STUDY ON THE USE OF ECONOMIC INSTRUMENTS FOR THE REDUCTION OF NOX EMISSIONS FROM MOBILE SOURCES IN QUEBEC PROPOSAL NO. K2231-4-2070

We are pleased to submit this proposal to carry out the above study for your Department.

The theoretical promise of economic instruments in environmental protection has been identified for many decades now. Their potential to achieve environmental goals at lower cost than the traditional command-and-control approach is well-appreciated. What is now required are detailed designs for these instruments to let us judge whether the theoretical benefits can be realized in practice.

Our understanding is that that is precisely the purpose of this project: to produce detailed designs and implementation plans for economic instruments to reduce NOX emissions from mobile sources in the Quebec portion of the Quebec city-Windsor corridor.

We believe that our team is well qualified to carry out this important analysis for your Department. Our firm specializes in both transportation and environmental economics. One of our fastest growing business areas over the last three years has been the link between transportation and environmental protection. Air quality issues become a problem in heavily urbanized areas, and transportation is typically one of the major causes of the problems. Our firm was one of the pioneers in North America in developing market-based approaches, i.e. economic instruments, to assist in reconciling the need for better air quality with the transportation demands of an expanding economy. We provide references to this work in the attached proposal.

Transportation infrastructure is usually at the heart of a region's economic development programs. The implications of this fact for your work plan are two-fold. First, it is essential to the successful completion of this assignment that the proposed economic instruments be based on the realities of transportation and economic development programs of the Province. Secondly, the links also work in the opposite direction. The economic instruments proposed may affect the transportation and economic development

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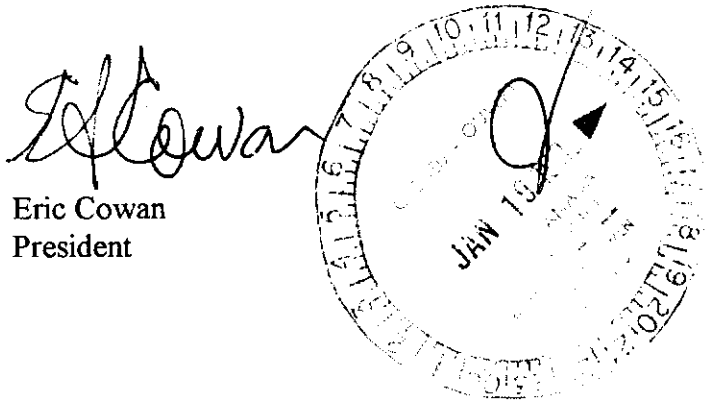
plans. For example: an instrument might have the second-order effect of reducing congestion. If the instruments are to be implemented successfully, they must be based on these realities.

Our research associates, Stratem Inc., based in Montreal, have considerable experience in the transportation and urban planning fields in Quebec. They will provide the close links necessary between the design work on economic instruments and the realities of transportation and economic development planning in the Province.

Notre équipe est bilingue. Les renseignements préparés au préalable et fournis aux participants, ainsi que toutes les entrevues et la recherche au Québec, serront en français.

Our work with your Department has always been rewarding. Thank you for inviting us to submit this proposal.

Yours truly,



Eric Cowan
President

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1. BACKGROUND AND PURPOSE

Air quality and transportation are inextricably interwoven in urbanized areas.

Ground-level ozone is formed when nitrogen oxides (NO_x) react with volatile organic compounds (VOC's) in the presence of sunlight. At concentration levels currently experienced in some larger cities in Canada, ground-level ozone can adversely affect human health and damage crops and forests. The Canadian Council of Ministers of the Environment (CCME) has established a NO_x/VOC management plan consisting of 31 specific initiatives to be implemented by the Provincial and Federal governments.

The Québec-Windsor corridor is one of three ozone non-attainment areas in Canada. In the Québec portion of the corridor, it is the transportation sector that is the largest single source of the NO_x and VOCs emissions that facilitate the formation of ground-level ozone. Both on-road and off-road sources contribute to the problem.

Practical strategies are now required to achieve the CCME goals, meet Canada's international obligations and reduce the health stresses on those living in the corridor.

There has been growing interest in Canada in the potential use of economic or market-based instruments (MBIs) as more cost-effective ways of achieving environmental objectives. As complements to regulatory measures, MBIs offer a number of theoretical advantages. However, the potential for the use of economic instruments to obtain reductions in NO_x emissions from the transportation sector in Québec has not yet been fully investigated.

A background study carried out for Environment Canada late in 1994 [1]identified three priority economic instruments that had the potential to contribute to reduction of NOX and VOCs in the Québec portion of the corridor.

The need now is for a more detailed investigation of the three priority economic instruments. Emphasis is to be on producing an analysis and design of a selected set of practicable economic instruments that is capable of being implemented in the context of Québec.

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1 *Economic Instruments for NOx emissions from Mobile Sources in Quebec: A preliminary investigation*, by Apogee Research, Dec. 1994

2. PROJECT DELIVERABLES

The deliverables for this project consist of three reports, as described in Exhibit 2.1. Each report will contain an appendix listing the individuals and organizations contacted during the research.

Four copies of the draft reports will be provided, including one unbound copy. We will provide two bound copies, one unbound camera-ready copy and a disk copy (WordPerfect 6.0) of the final report.

Exhibit 2.1
Project Deliverables

Deliverable	Contents	Delivery Date
Draft Report #1	Design Assessment Impact Assessment (Costs and Benefits)	+8 weeks
Draft Report #2	Comparative Assessment Conclusions and Recommendations	+12 weeks
Final Report	Draft Reports, appropriately revised Executive Summary	+15 weeks

3. WHY OUR TEAM

This is an important and sensitive project. The costs of meeting the Canadian ground-level ozone goals are likely to be quite high. Approaches such as economic instruments that offer the potential to reduce the costs of the traditional command-and-control approach need to be considered carefully.

The selected consultants should have the following skills and experience.

- *proven capability to design practicable economic instruments for environmental protection especially in the transportation sector*
- *detailed knowledge of the inter-relationships between environmental protection, the transportation sector and economic development*
- *familiarity with the Québec context of economic development, transportation planning and environmental protection*
- *the ability to work effectively in both official languages.*

Our team meets all of these requirements.

- *designing practicable economic instruments for environmental protection*

Apogee has designed numerous workable programs of economic instruments in Canada, the United States and other countries including the Philippines and Morocco.

In Canada, we have designed economic instruments for the federal and provincial governments. At the federal level, our work has been on tradable permits to achieve the phase-out of methyl bromide, harmonized economic instruments to deal with used tires and the design of instruments to reduce the generation of and improve the management of specific solid wastes. Our most recent work in Canada is in the detailed design and feasibility assessment of economic instruments (permits, fees and charges) for reducing the generation of, and improving the management of, three hazardous waste streams generated by industry. Our analysis of point-nonpoint source trading schemes is still used as the basis for designing similar programs. For the provincial governments, we have designed a set of economic instruments to achieve complex watershed water quality goals with a wide variety of sources of pollutants.

As you will see below, we have also designed numerous economic instruments for the transportation sector, all designed to contribute to environmental goals.

- *detailed knowledge of the inter-relationships among environmental protection, the transportation sector and economic development*

Apogee's two corporate specializations are in the economics of both the environment and transportation. The relationships between the two fields has been one of our largest growth areas in the last three years, as understanding of the links between the two has broadened in the view of policy-makers.

In North America, this linked emphasis has been most profound in the United States where the passage in 1990 of the Clean Air Act Amendments and in 1991 of the Inter-Modal Surface Transportation Efficiency Act (ISTEA) made major changes to the links between transportation planning and environmental protection. Economic instruments will play a major role in making these links work. Apogee has been integral in the implementation of the required planning, and has designed numerous programs of economic instruments for local planning authorities to help them meet local transportation goals while also meeting the goals for the reduction of ground-level ozone precursors. Our clients for this work have been the private sector which will require offsets, toll road authorities finding that their expansion plans are blocked by air quality issues, and local planning authorities that want both transportation growth and environmental quality. Our company is currently designing economic instruments such as transportation control mechanisms (TCM's) and vehicle scrappage programs in these areas.

- *familiarity with the Québec context of economic development, transportation planning and environmental protection*

The details of Québec's economic development , transportation planning and environmental protection plans will be important determinants of practicable economic instruments. Equally important will be a familiarity with existing Provincial, municipal and local agencies and commercial organizations that might be required to play roles in implementing the selected economic instruments. Our project partners have extensive experience in these areas in Québec. They are familiar with all of the agencies and organisations that might be required to implement economic instruments in both the transportation and environmental fields, and will provide the necessary contacts and context.

- *the ability to work effectively in both official languages*

All research in Québec should be conducted in French. Our team has a full bilingual capability.

4. KEY FEATURES OF OUR APPROACH

There are five key features of our proposed approach.

- *an emphasis on practicable designs of economic instruments that can be implemented*

We propose to design the economic instruments in sufficient detail that a practical implementation plan can be prepared. The theoretical benefits to Canada of economic instruments for environmental protection have been discussed in numerous reports over the last five years. What is needed now is detailed design work, identifying implementation difficulties and barriers along with strategies for overcoming them.

Detailed design of economic instruments means specifying: the purpose of the instrument; the target group of the instrument; the expected contribution of the instrument to the air quality (i.e. emission reduction) goals; the agencies and/or organizations required to implement, monitor and (possibly) enforce the instrument; legislative, regulatory, social and/or economic barriers to the effective introduction of the instrument; strategies and work plans for dealing with these barriers; the resource costs to the implementing groups and indications as to how these requirements will be met; the costs and related impacts on the affected target groups; and, finally, a detailed implementation plan for making the instruments work.

- *a strong presence in Québec with detailed familiarity of Québec transportation, economic development and environmental protection initiatives*

The economic and social contexts are very important factors in designing useful economic instruments. What works in one jurisdiction cannot always be transferred to another. Our team has good links to the Québec transportation and economic development groups that are preparing long-term strategies. This detailed knowledge is essential.

- *an emphasis of the links of the economic instruments to other pollutants and environmental programs*

These links work in both directions: other initiatives will affect the NO_x/VOC goals in the corridor, and the final set of economic instruments for NO_x/VOC will affect the other initiatives and goals. This point is particularly important when carrying out the comparative assessment (Task #3) of the work plan. The contributions that individual economic instruments make to these other objectives could influence the relative ranking of the instruments.

The economic instruments selected as a result of this study will affect the emissions of other pollutants and the achievements of other environmental goals. For example: emissions of both CO2 and SOx will likely be affected by changes that result from the selected instruments. Similarly, the National Action Plan on Global Warming will probably be furthered by the economic instruments.

The links will operate in the reverse direction also.

For example: the Canadian strategy on the use of low-sulphur diesel fuels, designed to benefit from the new engine technology being developed in the U.S., will contribute to the NO_x/VOC goals also.

- *close working relationship with the clients*

We recognize the sensitivity of this undertaking. We will maintain close reporting with the Environment Canada clients in Montreal and Hull. All contacts with the Québec Provincial government will be discussed in advance with the Environment Canada clients.

- *a bilingual capability*

All research in Québec will be conducted in French, unless otherwise indicated by the participants. All written material provided in advance to research participants will be prepared in French, and all queries from participants will be responded to in the official language of choice of the participant.

5. WORK PLAN AND SCHEDULE

Our work plan consists of four tasks, substantively as outlined in the Terms of Reference. We begin the project with an initiation meeting.

Project Initiation Meeting

At the project initiation meeting, we will discuss with the clients at least the following topics:

- the selection of target emission reduction levels;
- the criteria for assessing programme design and implementation (Task 1);
- the alternative policy options for the comparative assessment (Task 3);
- the criteria for the comparative assessment (Task 3); and
- the table of contents presented in Exhibit 5.5.

Task 1 Programme Design and Implementation

To evaluate programme design and implementation options, we will apply explicit assessment criteria to each economic instrument. Under each assessment criteria, we will list the options, describe the advantages and disadvantages of each option and, where appropriate, make recommendations on design features.

Exhibit 5.1 presents a preliminary list of design and implementation assessment criteria. At the initiation meeting, we will discuss the list with the client to ensure that it covers the issues of interest.

Exhibit 5.1
Preliminary List of Criteria for Assessing Programme Design and Implementation Options

Applicability

Level of Incentive

Geographic Coverage

Jurisdictional Authority

Administrative Responsibilities

Implementation Time

Instrument-Specific Design and Implementation Issues

Below, we define each assessment criteria.

Applicability: for which type(s) of vehicles is the economic instrument suitable? On-road vehicles are usually broken down into 7 categories:

- light-duty gas vehicles;
- light-duty gasoline trucks;
- heavy-duty gas vehicles;
- light-duty diesel vehicles;
- light-duty diesel trucks;
- heavy-duty diesel vehicles; and
- motorcycles.

We will assess instrument applicability for each of these categories. Primary attention will be paid to the sources with the largest contributions to NO_x reductions (heavy-duty diesel trucks, light-duty gas vehicles and light-duty trucks gas. However, in some cases, we will also assess applicability for more detailed categories of vehicles. For example, to address the vehicle fleets of large companies and organizations, an instrument may require specific design features. These will be identified and assessed.

Level of Incentive: what level of charge, tax or feebate is required to achieve specified levels of emission reductions? This assessment criteria will require us to evaluate own price elasticities and cross-price elasticities related to each type of vehicle. Some industry associations, including the Canadian Trucking Association and the Motor Vehicle Manufacturer's Association, have information relevant for assessing price responsiveness. In some cases, however, it will be necessary to estimate price elasticities from interviews with selected experts or to extrapolate price elasticities from other jurisdictions.

Geographic Coverage: could or should the instrument be applied to the entire province or to a limited area of the province (e.g., the Québec portion of the WQC)? This criterion may be most relevant in assessing a vehicle scrappage programme.

Jurisdictional Authority: what level of government is capable of, and most appropriate for, implementing the instrument? Will additional legislative or regulatory authority be required? Assessing this criterion will require extensive discussions with staff of the provincial and federal governments.

Administrative Responsibilities: which government offices, organizations, agencies, industry associations and companies would be responsible for administering the economic instrument? We will identify the roles and responsibilities for each relevant stakeholder.

Implementation Time: How much time would likely be required to implement the instrument? We will discuss the steps required to implement each instrument and, where possible, identify the likely amount of time required for the steps.

Instrument-Specific Design and Implementation Issues: what other design features should each instrument have to be effective and what other issues will arise in its implementation? Each instrument will have its own design issues not covered by the above assessment criteria. We will evaluate these design issues under this final criterion.

The end result of applying these assessment criteria will be a set of alternative designs for each economic instrument. Where one design is clearly preferable, we will identify that design. Where the preferred design is not so clear, we will summarize the advantages and disadvantages of each option.

We will carry out the assessment through a literature review and interviews. The literature review will involve obtaining more detailed information regarding analogous programmes in other jurisdictions and complementary programmes in Québec. For example, vehicle scrappage programmes are most common in California. We will obtain any reports that have assessed in detail the design and effectiveness of these programmes.

(Note: Apogee is currently designing the first scrappage programme for heavy duty vehicles. The information collected for that project will be available for this study.)

Some interviews will be conducted with the administrators of similar programmes in other jurisdictions. However, most interviews will be conducted with stakeholders in Québec. Exhibit 5.2 presents a preliminary list of some of the stakeholders that will be relevant during our research.

The interviews are a key component to ensuring that the instruments we design will be practicable. We will ask each contact to identify any "real-world" barriers that must be overcome before the instrument is implemented and to suggest approaches to overcoming the barrier. Barriers could be related to market structure, technological limitations, stakeholder acceptability, enforcement difficulties, etc. The range of our contacts will ensure that all potential barriers are taken into account in the analysis.

All interviews will be conducted in the official language of choice of the person being interviewed.

Exhibit 5.2
Preliminary List of Contacts

Government

- Ministère de l'Environnement
- Sous-Ministériat au Milieu Urbain
- Ministère des Affaires Municipales
- Ministère de la Santé & des Services Sociaux
- Ministère des Transports
- Ministère des Ressources Naturelles - Énergie
- Société québécois d'initiatives pétrolières (SOQUIP)
- Société de L'assurance Automobile du Québec
- Ministère de Revenu
- Environment Canada, Transportation Systems Division
- Transport Canada
- Revenue Canada
- Montreal Urban Community

Industry Associations

- Association québécoise de lutte contre la pollultion atmosphérique
- Association québécoise de lutte contre les pluies acides
- Association des propriétaires d'autobus du Québec
- Corporation des concessionaires d'automobiles du Québec
- Fédération auto-Québec
- Association des industries de l'automobile du Canada
- Association des fabricants de pièces de véhicles d'automobiles du Canada
- Canadian Motor Vehicle Manufacturers Association
- Canadian Automobile Association
- Canadian Truckers Association
- Canadian Urban Transit Association

Other Organizations

- Centre patronal de l'environnement du Québec
- Association pour la prévention de la contamination atmosphérique
- Réseau plein air
- Pollution Probe Foundation
- National Society for Clean Air & Environmental Protection

Task 2 Assessment of Programme Impacts

The assessment of programme impacts will cover the time period 1995-2005. We will disaggregate the costs and benefits by stakeholder (federal government, provincial government, industry and consumers). Where appropriate, we will also describe the impacts in terms of: total dollars to achieve specified emission reductions; dollars per tonne of NO_x reduction; and the change in dollars when reduction levels are changed.

Below, we describe our approach to assessing programme benefits and then programme costs.

Benefits

Emissions-based vehicle registration charges, emissions-based vehicle taxes and vehicle scrappage programmes generate benefits that are very complex and diverse. There are two reasons for this complexity.

First, these economic instruments affect the full range of pollutants generated by the on-road sector. Different benefits arise from different pollutants.

Second, to varying degrees, the instruments can reduce the number of vehicle miles traveled, encourage replacement of older vehicles with cleaner, newer vehicles, and encourage intermodal substitution. Each of these actions generate other benefits in addition to the benefits related to reduced emissions. For example, other transportation externalities, such as congestion, auto accidents, visibility, and noise, may also be reduced by the instruments.[2]

Exhibit 5.3 presents a list of benefits that may result from implementing one or more of the selected instruments. This list is not comprehensive. Other categories of potential benefits can also be identified.

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[2] For a detailed assessment of transportation externalities and a comprehesive review of cost estimates associated with these externalities, see Apogee Research (1994), *The Costs of Transportation*, prepared for the Conservation Law Foundation.

A Canadian study on the full costs of transportation is being initiated by the end of January by the National Roundtable on the Environment and Economy, the Ontario Roundtable on the Environment and Economy, Environment Canada and Canadian National Railways.

Exhibit 5.3
Selected Benefits Arising from the Economic Instruments Under Study

NO_x Emission Reductions (ground-level ozone precursor)

- improved visibility
- reduced morbidity (health care costs avoided, wages lost, willingness-to-pay)
- agricultural

SO_x Emission Reductions (acid rain)

- improved forest productivity
- improved agricultural productivity
- increased recreational fishing
- increased commercial fishing

CO_2 Emission Reductions (global warming)

- fewer heat-related illnesses and deaths
- less urban air pollution
- forest loss
- costs of mitigating sea-level rises

Particulate Emission Reductions

- reduced human morbidity
- reduced human mortality
- improved visibility

Encourage Purchase of New, Cleaner Vehicles

- stimulate economic activity
- lower operating costs due to better fuel efficiency

Reduced Vehicle Kilometres Travelled

- reduced congestion (travel time cost savings)
- reduced road maintenance costs
- reduced auto accidents

Since the full range of potential benefits is very complex and diverse, our priorities will be to:

(i) estimate the benefits associated with reduced NO_x emissions; and

(ii) quantify the reductions in the emissions of other major pollutants (VOCs, CO_2, CO, SO_x and particulates).

Quantification of emission reductions in all pollutants (including NO_x) will involve three steps:

(i) obtaining emission factors (and projections of the emission factors) from Environment Canada's Transportation Systems Division. This Division maintains MOBILE5.1C -- a model designed to estimate emission factors -- and makes this information available to studies of this nature. Indeed, many of the necessary emission factors are already contained within Environment Canada's Residual Discharge Information System (RDIS) for easy access;[3]

(ii) estimating the instrument's impact on fleet composition over the forecast period (1995-2005);

(iii) estimating the instrument's impact on vehicle kilometres travelled over the forecast period (1995-2005);

(iv) using the emission factors, projection of fleet composition and projection of vehicle kilometres travelled to estimate total emissions if the instrument is implemented; and

(v) subtracting a baseline emissions forecast from the new projections to obtain the emission reductions resulting from the instrument.

Steps (ii) and (iii) will use, where available, estimates of instrument impacts from other jurisdictions, adjusted for the Québec context. Where estimates do not exist, we will estimate the effect on vehicle composition based on interviews with relevant stakeholders (see list of contacts above).

All NO_x and VOC emission reductions will be measured as reductions from the baseline projection created for the NO_x/VOCs Management Plan, Phase I or, if available, up-dates of the emissions forecast produced by Environment Canada's Pollution Data Branch. For other pollutants, the baseline will be decided in consultation with appropriate Environment Canada staff (e.g., the Air Issues Branch has issued a baseline forecast of CO_2 emissions).

[3] Apogee Research constructed Environment Canada's national emissions forecasting model based on the Residual Discharge Information System. We are thoroughly aquainted with all aspects of the System.

After quantifying emission reductions for the various pollutants, we will estimate the benefits associated with the NO_x reductions. There are two optional approaches to valuing the benefits.

If Environment Canada's scientific modellers will estimate the change in ground-level ozone resulting from the NO_x emission reductions (supplied by Apogee), then it may be possible to estimate the associated benefits using existing dose-response relationships and benefit transfer techniques.

If the impacts of the NO_x reductions on ground-level ozone cannot be explicitly estimated, then we will extrapolate the likely value of benefits using existing estimates of the benefits of NO_x reductions. Nearly all existing relevant studies were completed for U.S. jurisdictions. Several Apogee reports already compile and assess these studies:

- Apogee Research (1995), *Measuring and Valuing Transit Benefits and Disbenefits*, prepared for the Transportation Research Board;
- Apogee Research (1994), *The Costs of Transportation*, prepared for the Conservation Law Foundation;
- Apogee Research (1993), *Valuing Environmental Externalities of Transportation*, prepared for a private sector client;
- Apogee Research (1993), *Incorporating Externalities into Highway Cost-Benefit Analysis*, prepared for the U.S. Federal Highways Administration; and
- Apogee Research (1992), *Benefits and Disbenefits of Transit*, prepared for the National Academy of Sciences.

This second approach would provide likely *ranges* of the actual benefits.

Costs

There are two distinct types of costs that we will assess: social costs; and transfers.

The need to assess social costs is clear. Policy decisions will be based, at least in part, on the relative magnitude of the social costs and benefits resulting from the programme. Social costs include:

- programme administrative costs;
- cost of switching to cleaner vehicles;
- cost of reduced vehicle kilometres travelled; and
- cost of using alternative modes (e.g. time, convenience).

The need to assess transfers is perhaps not so clear. Each of the instruments will transfer money from one group to another. For example, emissions-based vehicle taxes and regiustration charges involve payments by vehicle purchasers and registrants to the government. Scrappage programmes can involve collecting funds from purchasers of new vehicles and disbursing funds to people who scrap older vehicles.

While these transfers are not social costs, they are very important in policy decisions. Transfers also involve significant implementation issues. For example: is the revenue sufficient to finance a complementary programme? how much money will be disbursed during the first years of a vehicle scrappage programme and where will the money for rebates come from?

It is also important to recognize that somes costs will, to some degree, be offset by cost savings. For example:

- car owners that switch to public transit would forego parking charges;
- car owners that up-grade to new and cleaner vehicles may also save in fuel costs due to better fuel efficiency of new vehicles; and
- heavy-duty truck owners that purchase new vehicles operating on low-sulphur diesel will have lower vehicle maintenance costs.[4]

We will assess social costs, transfers and, where feasible offsetting costs.

Our estimation techniques will vary with the type of cost. Two examples will serve to illustrate our approach. For administrative costs, we will rely on several approaches:

- obtaining likely administrative costs directly from government staff that would administer the program; and/or
- obtaining administrative costs of current programmes that have administrative requirements similar to those that would be required for the selected economic instruments.

[4] See Apogee Research (1991), "Socio-Economic Impact Assessment of the Proposed On-Road Diesel Fuel Quality Regulation," prepared for Environment Canada.

For the costs of switching to cleaner vehicles, we will calculate the cost per switch as:

Annual Cost per Vehicle of Switching =

Opportunity Cost of the Investment (interest rate x new vehicle purchase price) +

Difference in Annual Insurance Costs +

Difference in Annual Fuel Costs +

Difference in Annual Maintenance Costs

The cost per switch will then be multiplied by the number of vehicle substitutions (new for old) expected to arise from each instrument.

In general, our cost estimations are provided in spreadsheets so that:

- assumptions are explicit for each stage of the cost calculations; and
- assumptions are easily changed to assess the costs under alternative scenarios.

Task 3 Comparative Assessment

Tasks 1 and 2 assess in detail the three selected economic instruments. Policy decisions, however, will require comparing these economic instruments with other policy options such as command-and-control regulations, voluntary approaches, information incentives and the other economic instruments identified in the background report prepared by Apogee Research.

We will start Task 3 by preparing a list of policy options to be included in the comparative assessment. The list will then be submitted for client review prior to starting the assessment.

We will use explicit assessment criteria for the task. A preliminary list of assessment criteria is provided in Exhibit 5.4.

Both the list of alternative policy options for assessment and the preliminary list of assessment criteria will be discussed at the initiation meeting.

Much of the information for the comparative assessment will be obtained during Tasks 1 and 2. However, where appropriate, we will conduct additional interviews to solicit stakeholder opinions on alternative policy options.

During the comparative assessment, we will pay particular attention to the ways in which the three selected economic instruments will interact with other programmes. For example, the draft National Action Plan on Climate Change and the Task Force on Economic Instruments and Disincentives to Sound Environmental Practices both proposed control options that would affect NO_x emissions from on-road sources.

To address such overlaps, we will evaluate whether, and how, the three selected economic instruments would complement, overlap or contradict control options proposed under other policy areas.

Transportation planning, urban planning and economic development issues will also influence the effectiveness of the three selected economic instruments. Such influences will be identified during Task 3.

Exhibit 5.4
Preliminary List of Criteria for the Comparative Assessment

Environmental Effectiveness

Cost Effectiveness

Impacts on Competitiveness and Trade

Impacts on Technological Innovation

Fairness and Equity

Stakeholder Acceptability

Administrative Efficiency

Task 4 Summarize Findings and Develop Conclusions

In Task 4, we will bring the study's findings together into a set of key conclusions and recommendations in a style suitable for making policy decisions.

As determined appropriate, our conclusions and recommendations will cover:

- the likely contribution of the instruments to reducing NO_x emissions in Québec;
- the magnitude of net benefits;
- the distribution of costs and benefits;
- links between these economic instruments and other programs (e.g. climate change, acid rain);
- special design features needed to apply the instruments to different on-road sources;
- next steps in implementing the economic instruments;
- any outstanding issues requiring further research.

Draft Report #2

Exhibit 5.5 presents a preliminary table of contents for Draft Report #2. At the project initiation meeting, we will discuss with the client the suitability of this table of contents.

We will provide four copies of the Draft Final Report, including one unbound copy suitable for photocopying.

Exhibit 5.5
Preliminary Table of Contents for the Draft Final Report

Final Report

We will submit the final report within two weeks of receiving comments on draft report #2. We will provide two copies of the final report, plus one unbound camera-ready copy and a disk copy (WordPerfect 6.0).

If desired, we will also make a presentation of the study's findings, conclusions and recommendations.

Work Shedule

Exhibit 5.6 presents the work schedule. We will complete the project by May 15, 1995 provided that:

- project initiation is on or before January 30, 1995; and
- review comments on the draft reports are provided within two weeks of submitting the report.

Exhibit 5.6
Work Schedule

Tasks/Deliverable	Weeks from Initiation
Design Assessment Impact Assessment (Costs and Benefits)	+1 to 8 weeks
Draft Report #1	+8 weeks
Comparative Assessment Preliminary Conclusions and Recommendations	+8 to 12 weeks
Draft Report #2	+12 weeks
Final Report	+15 weeks

6. TEAM MEMBERS AND ORGANIZATION

Our team combines Apogee's expertise in environmental and transportation economics, specifically in the design of economic instruments for environmental protection. Our research associates, Stratem Inc. of Montreal, provide the required in-depth knowledge of Québec's economic, transportation and environmental protection priorities.

This chapter provides an overview of the qualifications and experience of the team members. Exhibit 6.1 illustrates the organization of the project team. Below, we summarize the qualification of each team member. Complete resumes of each team member are provided in Appendix C. Exhibit 6.2 presents the preliminary allocation of our consultants to the tasks.

Consultant Team

The research project will be directed by **Mr. Eric Cowan**, the President of Apogee Research in Toronto. Mr. Cowan has directed many of Apogee's recent studies on economic instruments for environmental protection. He was project director for the design of economic instruments to assist in solving the water quality problems of the Fanshawe reservoir in Southwest Ontario, and has directed many of our Canadian design studies of economic instruments for environmental protection including: economic instruments to minimize hazardous wastes, market based approaches to reducing solid wastes, economic instruments to deal with used tires across Canada, tradeable permits to phase out methyl bromide in Canada, and others. He was invited recently by Environment Canada to provide practical advice to their nine regulatory review teams on economic instruments as alternatives to existing regulations. Mr. Cowan was invited by the U.S. EPA to co-facilitate the sessions on economic instruments at the International Conference on Environmental Enforcement and Compliance held in Oaxaca, Mexico in April 1994. In the field of air quality and emissions regulations, Mr. Cowan has directed Apogee's recent work for Environment Canada on developing a model to forecast emissions throughout the country in response to changes in factors such as economic growth, technology change, regulatory changes, etc. He has also directed the development of seven alternative long-term air toxics control strategies for the state of Washington, based on regulatory and economic instruments approaches. He has directed numerous regulatory impact assessments of air emissions regulatory proposals in Ontario and the state of Washington.

Mr. Cowan will direct the overall project, and will participate in all of the research tasks. He will be directly accessible to the clients at all times.

Mr. Ken Watson, an environmental economist and policy analyst, and Director of Apogee's Environment-Economy Services, will be the project manager. He specializes in designing economic instruments and cost-benefit analysis of environmental regulations. Most recently, he designed Canada's newest trading program, a system of tradeable consumption allowances for methyl-bromide. He has assessed economic instruments for achieving: water quality objectives in Ontario's Fanshawe Reservoir and waterbodies in Washington state; reduced solid waste by 50%; reducing hazardous waste generation and improving hazardous waste management; phasing-out contaminated chloranil-

Exhibit 6.1
Team Organization

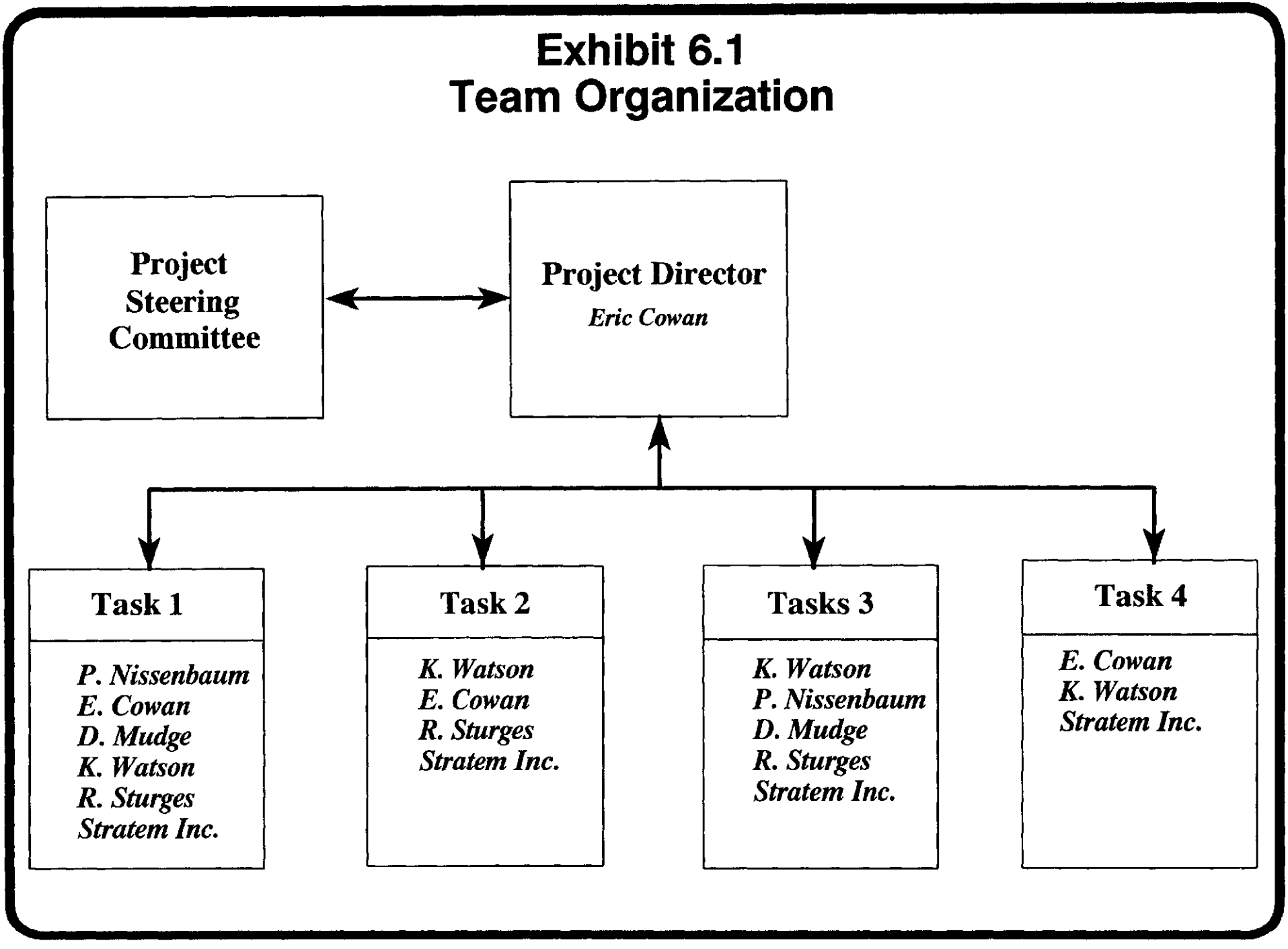


Exhibit 6.2
Allocation of Professional Services By Task

	Days of Consulting Effort				
Consultant	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Total Days**
E. Cowan	1	1		1	3
D. Mudge	1		1		2
P. Nissenbaum	3		2		5
K. Watson	7	2	5	4	18
R. Sturgess	2	2	2		6
Stratem Inc.	3	8	2	2	15
Total Days	**17**	**13**	**12**	**7**	**49**

derived substances; reducing NO_x emissions from mobile sources; and developing a framework for harmonizing national economic instruments. During Environment Canada's recent Regulatory Review, Mr. Watson provided expert advice on economic instruments to the nine regulatory review teams. Mr. Watson was also invited to prepare a discussion paper on expanding the legislative authority within CEPA to include economic instruments.

He has completed studies on economic instruments for the Canadian Council of Ministers of the Environment, Environment Canada, the Ontario Ministry of the Environment, the State of Washington Department of Ecology and others. Mr. Watson was the project manager on the earlier study for Environment Canada that identified the three priority economic instruments to be considered in this follow-on work.

Mr. Watson holds an M.A. (Economics) from Queens University and a B. Sc. (Quantitiative Economics) from the University of Toronto.

Dr. Richard Mudge—a nationally known expert in the economics and financing of transportation and related environmental—has more than 20 years of experience in strategic planning, economic evaluation, forecasting, policy analysis, and project management. Dr. Mudge has numerous publications and speaking engagements to his credit, as well as appearances as an expert witness before the U.S. Congress. As co-founder and President of Apogee Research, Dr. Mudge oversees the firm's work in transportation, clean air, applied finance, and strategic evaluation.

Much of Dr. Mudge's recent work involves the interaction between transportation and environment goals (the Clean Air Act Amendments in particular). Dr. Mudge has served as either project manager or senior economist on all the firm's work in this area. Recent efforts include work on a handbook on the overall effectiveness and cost-effectiveness of transportation control measures in helping to meet emission reduction targets in the Clean Air Act, prepared for the National Association of Regional Councils. At the local level, Dr. Mudge was part of Apogee's team working with MPOs in St. Louis and Northern New Jersey on plans to evaluate and implement TCMs. For FHWA he is part of a team providing a strategic analysis of the ability of TCMs and other control measures to meet mid- and long-term clean air goals. This work will be applied in six representative metropolitan areas.

Immediately prior to founding Apogee, Dr. Mudge served as Chief of the Public Investment Unit, Congressional Budget Office, focusing on long-term federal policy towards infrastructure finance. At the Rand Institute (New York City), Dr. Mudge was Program Leader for Economic Development Studies, directing the Institute's work in economic development and transportation. He received his Ph.D. and Master's degrees in Regional Economics from the University of Pennsylvania.

Paul Nissenbaum—Manager of Apogee's transportation/air quality group—has over eight years of experience in economic, financial and policy analysis of both transportation and environmental issues. Mr. Nissenbaum has managed more than twenty projects on air quality and other externalities associated with transportation, including five projects focused on transportation control measures (TCMs). His project experience includes work for the key federal agencies in transportation and air

quality (EPA, FHWA, FTA), state and local agencies (including state dots and several Metropolitan Planning Organizations), associations (including AASHTO and STAPPA/ALAPCO), and private organizations (including transportation and environmental interest groups).

Mr. Nissenbaum's TCM experience includes development of a handbook for the North Jersey Transportation Planning Authority (NJTPA) to assist local planners in evaluating the air quality impacts and implementation issues associated with TCMs; analysis of a package of TCMs for the St. Louis MPO; review and analysis of the literature on the emissions impacts and cost-effectiveness of TCMs for the National Association of Regional Councils (NARC); and cost-benefit analysis of a TCM program for several northeastern states, including quantification of several non-air quality benefits. He has also done extensive work on the costs and benefits of transportation, including analytic framework development and quantification of the user, governmental and societal costs of urban passenger modes and submodes under different land use densities; and analysis of the external costs and benefits of highway investments using EPA's MOBILE5A model and the newly developed Highway Economic Requirements System (HERS) model. Mr. Nissenbaum holds a Master's in Public Policy from Harvard University with a concentration in Urban/Regional Economic Development and Planning.

Mr. Richard Sturges, a senior economist with Apogee Research, specializes in charges and other means of financing environmental protection programs. Mr. Sturges has designed various fee schemes and is currently developing an industrial effluent discharge fee system for two pilot centres in the Kingdom of Morocco. He has prepared international training sessions on the use of fees to promote pollution prevention and minimization in the mining sector and is considered an expert on the use of charges to help finance site remediation programs.

Mr. Sturges holds a Masters in Public and Private Management, Economic Analysis from Yale University.

Édouard Préfontaine, Chargé de projet et conseiller principal, Stratem Inc.

Monsieur Préfontaine possède une vaste expérience dans les études à titre d'économiste, géographe et de diplômé M.B.A. Au cours de sa carrière, M. Préfontaine a travaillé cinq ans (1974-1979) comme économiste en transport au gouvernement fédéral à Ottawa puis a réalisé entre 1980 et 1994 plusieurs études de marché et de transport pour la firme Lavalin (1979-1986) comme directeur de projets et vice-président et pour Stratem (1986-1994). Outre cette expérience de travail, M. Préfontaine a réalisé au cours de son MBA plusieurs recherches dirigées relatives au transport.

Mentionnons que, parmi les nombreuses études en transport dirigées par M. Préfontaine chez Stratem, plusieurs portaient sur la tarification et la réglementation.

En ce qui a trait à l'environnement, M. Préfontaine a acquis une expérience considérable à titre de directeur de projet d'une étude sur le recyclage et le réchappage de pneus pour Recyc-Québec. Son implication dans différents dossiers portant sur la gestion des déchets depuis 1983 lui a également permis d'acquérir une très bonne expertise dans le domaine.

Audrée-Anne Gratton; analyste senior, Stratem Inc.

Madame Gratton est économiste et a réalisé de nombreux mandats dans le domaine des transports d'abord comme économiste pour la firme Lavalin puis pour le Port de Montréal et enfin comme contractuelle chez Stratem.

Parmi les études réalisées, mentionnons une étude des politiques tarifaires pour un service de navette; étude des stratgiés de développement des transports pour la région de Montréal.

7. PROJECT MANAGEMENT

In this chapter, we outline our approach to ensuring that quality work is produced on time and within budget. Our approach involves four components.

(i) the management skills of the project director and project manager;

(ii) our contingency provisions;

(iii) our cost and scheduling control techniques; and

(iv) our approach to client review and reporting.

7.1 Project Director and Manager

Two of our senior consultant personnel will be responsible for the direction and management of this project. Both will be directly accessible to the clients, and will participate at the decision and project review discussions.

We now describe the project direction and management experience of these two individuals. Their subject-matter experience has been presented in the previous section on our project team.

Mr. Eric Cowan will be the overall project director for this assignment. Mr. Cowan is the President of Apogee Research in Canada, the head of our North American environmental program design/review practice and the Director of Apogee's international environmental business development practice. He has many years of experience in directing this type of project and in ensuring the type of collaborative approach among diverse stakeholders that is called for in this assignment.

Apogee's project directors are integral members of the project teams. Mr. Cowan will be directly accountable to the client for the completion of the project to high professional standards, and for ensuring that the project is within time and cost constraints. He will participate at all decision and project review discussions, and will participate in a number of the project tasks.

Collaborative approaches are becoming increasingly common in our environment-economy studies. There is no guaranteed formula for success, but a necessary ingredient of success is open and continual communications. Mr. Cowan is particularly adept at meeting this requirement. He has just completed the direction of the development of the Canadian Hazardous Waste Inventory for CCME and Environment Canada. This project required considerable collaboration among industry representatives, provincial and government representatives and other stakeholders. The success of the project was contingent upon securing the cooperation of these groups throughout the country. Mr. Cowan also recently completed a number of studies examining the impacts on industrial competitiveness of environmental assessment regulations in Canada. The successful completion of

these studies required collaboration among groups with strongly conflicting views and interests on the subject. Our reports on the issue have been accepted by all parties and one report has even become recommended reading for industry representatives. Mr. Cowan was invited last year to guide Environment Canada's regulatory review teams on strategic options, and assisted the teams to assess the benefits and costs of the non-regulatory options.

As director of our environmental program review and evaluation practice, Mr. Cowan has considerable experience in directing and facilitating collaborative processes.

During a four-year stint at the Privy Council Office of the Federal government, he organized on-going sets of consultations among industry groups, labour and Cabinet ministers.

Mr. Cowan's technical project direction skills have been developed through over 20 years of practice. He has directed and managed hundreds of complex, multi-disciplinary projects in the public, private and multi-lateral sectors. While at Shell Oil, he presented various project management courses to middle managers throughout the oil industry, emphasizing tools to ensure that quality objectives were achieved while also meeting budget and time constraints. He is very much a "hands-on" project director and will personally undertake a number of the quality assurance/control activities.

Mr. Ken Watson will manage the day-to-day tasks involved with this project. Mr. Watson is the director of our environment-economy services. He has three years experience managing projects of this magnitude. Most of his projects have involved multi-disciplinary, multi-company consulting teams.

Mr. Watson has managed numerous projects for multi-stakeholder clients, including two cross-country committees of the Canadian Council of Ministers of the Environment. His other clients include Environment Canada, the Ontario Ministry of the Environment and Energy, the U.S. Environmental Protection Agency and other public, multilateral and private sector clients.

He has presented research findings at stakeholder consultations and national and international conferences, most recently at the United Nations conference on emissions forecasting held in Copenhagen.

7.2 Contingency Provisions

We foresee no reason that the staff assigned to this project will not be available. However, Apogee Research has a staff of over 60 professional economists, engineers and policy analysts. Many of them have direct experience on similar projects. We anticipate no problems completing the project, even in the unforeseen event that one of the assigned consultants becomes unavailable during the course of the project.

7.3 Cost and Schedule Control

The key to our control of costs is the project budgeting and project cost monitoring system that we have in place.

The first step in the initiation of any Apogee project is the completion of a project cost report, describing the categories of costs (labour, travel, data acquisition, graphics, telecommunications, etc.) and the budget assigned to each. A generic example of a project cost report is presented in Exhibit 7.1. This project cost report is the basis for allocating time to our consultants to contribute to the various research tasks in the project. All consultants participate in the preparation of the cost report, and agree to the budget allocation to the various cost categories for each of the tasks of the project.

All charges to the project are coded with the project number and are accumulated weekly. Consultants, including sub-contractors, fill out time sheets (presented in Exhibit 7.2) on a daily basis. Each Monday morning, the time sheets and direct costs accumulated during the previous week are entered into our computerized project accounting system. Updated project cost reports are produced on Monday afternoon for each project. Project managers then take immediate remedial action if categories of costs are not in line with the work progress.

During the course of the project, we hold weekly project meetings. All staff assigned to a project attend these meetings. The meeting covers, in order: tasks completed; tasks in progress; budgeting; allocation of time next week; and project scheduling.

This system ensures that *potential* cost or scheduling problems are identified before they become *actual* problems. Our project management approach, emphasizing clear communications and open discussion of the budget and schedule, is designed to minimize these difficulties.

7.4 Reporting and Client Review

A key feature of our approach is the close contact we will maintain with the clients, in Montreal and Hull.

There are four components to our approach to reporting and client review. Each is described below.

(i) *Weekly Progress Reports By Telephone*

We will provide weekly progress reports by telephone during the first month of the schedule. Although we will likely be in touch with the client on numerous other occasions during the start-up phase of the project, these calls will be important to continually verify our understanding of the client's needs for the project.

EXHIBIT 7.1

Project Cost Report
392 CEN
Sample Only

Manager: Eric Cowan

Report Number: 1
Period Covered: Jan. 1-7
Date: 17-Jan-95

Fees	Budget Days	Budget $	Rate		Days YTD	Current Days	Current Month	New YTD days	New YTD $
Apogee T.O.		$0.00							$0.00
E. Cowan K. Watson M. Levitt P. Moore									
Apogee U.S.		$0.00	Pay U.S.$	Chrg (C $)					$0.00
Other		$0.00	Pay	Chrg					$0.00
Total Fees		**$0.00**							**$0.00**

Expenses	Budget $	Previous YTD $	This Week	This Month	New YTD $
Travel WP, etc. Courier, phone, etc.					
Total Expenses	**$0.00**	**$0.00**	**0.00**	**$0.00**	**$0.00**
Unallocated	$0.00		Current: Week	Month	
TOTAL $ (Fees & Expenses)		**$0.00**	**0.00**	**$0.00**	**$0.00**

EXHIBIT 7.2

APOGEE RESEARCH **Eric Cowan**

Employee Time Record

JANUARY 1995

Side 1

	Week 1						Week 2						Week 3					
Category	**1 M**	**2 T**	**3 W**	**4 T**	**5 F**	**T**	**8 M**	**9 T**	**10 W**	**11 Th**	**12 F**	**T**	**15 M**	**16 T**	**17 W**	**18 Th**	**19 F**	**T**
Recoverable																		
332 CEN																		
334 CEN																		
369 VAU																		
372 IJC																		
373 CCME																		
375 IC																		
Proposal																		
393																		
Administration																		
Accounting																		
Sick Leave																		
Annual Leave																		
Stat. Holiday																		
Total																		
PERCENT RECOVERABLE																		

Signature

(ii) *Monthly Written Progress Reports*

Each month the client will receive a memorandum outlining the progress made during the month. The memoranda will:

- list the tasks and sub-tasks completed;
- describe any obstacles encountered and the solutions adopted; and
- keep the client informed of whom we are contacting for information and what information is being requested. All dealings with the Québec government will be cleared in advance with the clients.

(iii) *Formal Reports*

Three formal reports will be provided: draft report 1; draft report 2; and a final report. The Work Plan outlines preliminary tables of contents for these reports. The suitability of these tables of contents will be discussed at the project initiation meeting. As the project evolves, changes to the tables of contents may be required. If we identify a need to make a change to a table of contents, we will send the client proposed revisions for comment.

(iv) Project Review Meetings

The Work Plan and Schedule identified one point at which a formal project review meeting is needed. Further meetings can be arranged on an as-needed basis.

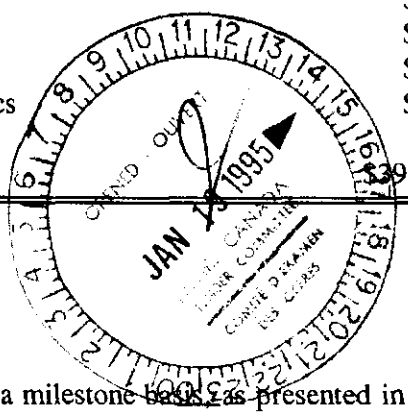
8. PRICE AND PAYMENT PROPOSAL

We propose to conduct the study for a fixed price of $39,650, exclusive of GST. This represents 49 days of consulting effort.

Exhibit 8.1 provides a breakdown of this fixed price. Exhibit 8.2 shows a detailed allocation of consulting efforts by work task.

Exhibit 8.1
Breakdown of Fixed Price

Professional Services	$37,700
Travel	$800
Copying	$250
Telephone, Courier	$500
Wordprocessing, Graphics	$400
Total	$39,650



Payment Schedule

We will invoice Environment Canada on a milestone basis as presented in Exhibit 8.3.

Exhibit 8.3
Milestone Payment Schedule

Milestone	Description	Invoice
1	Submission of Draft Report #1	40%
2	Submission of Draft Report #2	30%
3	Acceptance of Final Report	30%

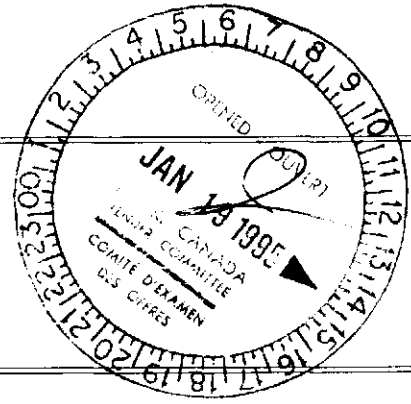
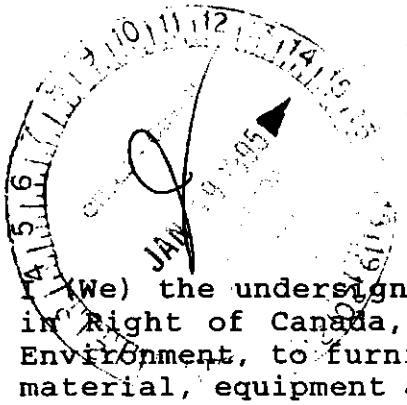


Exhibit 8.2
Budget Allocation By Task

	Days of Consulting Effort						
Consultant	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Total Days**	**Per Diem**	**Professional Fees**
E. Cowan	1	1		1	3	$1,100	$3,300
D. Mudge	1		1		2	$1,100	$2,200
E. Prefontaine	1	2	1	1	5	$1,100	$5,500
K.Watson	7	2	5	4	18	$700	$12,600
P. Nissenbaum	3		2		5	$700	$3,500
A. Gratton	2	6	1	1	10	$700	$7,000
R. Sturges	2	2	2		6	$600	$3,600
Total Days	**17**	**13**	**12**	**7**	**49**	–	–
Total Cost	**$12,900**	**$10,100**	**$9,000**	**$5,700**	–	–	**$37,700**

Appendix "A" OFFER OF SERVICE

1. OFFER SUBMITTED BY: HYPOGEE RESEARCH INTNL. LTD.
144 FRONT ST. WEST - #500
TORONTO, ONT.
M5J-2L7
Print or Type Complete or Business or Corporate Name and Address)



2. I (We) the undersigned hereby offer to Her Majesty the Queen in Right of Canada, as represented by the Minister of the Environment, to furnish all necessary expertise, supervision, material, equipment and other things necessary to complete to the entire satisfaction of the Minister or his authorized representative, the work as described in the Request for Proposal according to the terms and conditions of the Department's Service Contract for the prices:

2.1 **Professional Services and Associated Costs:**

An all-inclusive fixed price of.....$ 38,850.00
Canadian Currency) (Total of 2.1.1 + 2.1.2)

2.1.1 Professional Services: $ 37,700

The following is a breakdown of the above tendered amount for Professional Services (show fee structure all-inclusive of profit and overhead.

Category of Personnel	Per Diem Rates	#of Days Assigned	Total
Project Directors	$ 1100	10	$ 11,000
Managers	$ 700	33	$ 23,100
Seniors	$ 600	6	$ 3,600

Appendix "A"

2.1.2 Associated Costs: #1,150

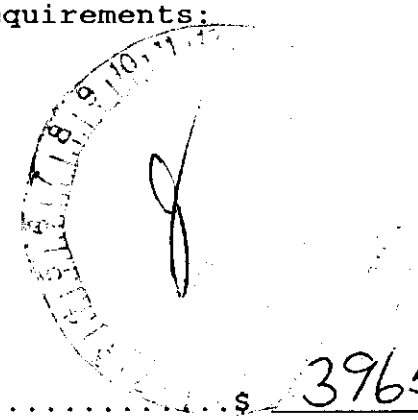
Associated Costs breakdown not included in Fixed price (2.1.1 on page 1 (courier, long distance calls, reproduction, etc..)

- telecomm & courier #500
- w/p, graphics #400
- Copying #250

2.2 **Travel Expenses:**

Reimbursable at cost in accordance with the attached Travel Directive, to a financial limitation .....
$ #800.00

My/Our estimate for travel expenses is based upon the following anticipated travel requirements:



2.3 TOTAL TENDER PRICE.....$ 39650.00
Total of 2.1 + 2.2 above)

+ G.S.T. $ 2775.50

Total $ 42425.50

Appendix "A"

3. I (We) agree that the Offer of Service will remain firm for a period of thirty (30) calendar days after the tender closing date.

4 Payment for Professional Services and Associated Costs will be effected upon completion of each phase, submission of invoices detailing the work completed to date and upon acceptance by the Departmental Representative for services rendered/deliverables received.

Claims for travel and accommodation expenses will be reimbursed at cost, in accordance with the Travel Directive, to be submitted with the aforementioned invoices and supported by receipts, vouchers, or other appropriate documents.

5. I (We) agree to submit herewith the following:

(a) A PROPOSAL to undertake the work, indicated an understanding of the objectives and responsibilities, a methodology and a time schedule as it relates to the requirements;

(b) a CORPORATE RESUME indicating relevant experience, the proposed personnel for the work team including their curriculum vitae;

(c) a list, if applicable, of subcontractors(s) including full names and addresses, portion(s) of work to be subcontracted and relevant experience;

(d) a duly completed OFFER OF SERVICE, (in triplicate.)

6. I(We) hereby undertake to ensure that, to the maximum extent possible, goods and services of Haitian origin are not to be purchased for the purpose of this proposed contract. In the event that goods and services of **HAITIAN** shall be used for the purpose of this contract, I (We) hereby that my (our) proposal/tender, includes a full disclosure of such goods and services.

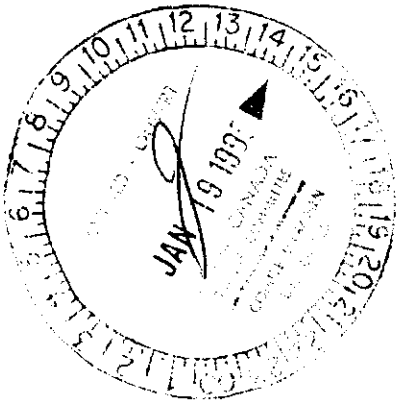
7. It is a condition that during the terms of the contract any persons engaged in the course of carrying out this contract shall conduct themselves in compliance with the principles of the Conflict of Interest and Post-Employment Code for Public Office Holders. Should an interest be acquired or seem to cause a departure from the principles, the Contractor shall declare it immediately to the Departmental Representative.

OFFERS WHICH DO NOT CONTAIN THE ABOVE-MENTIONED DOCUMENTATION OR DEVIATE FROM THE PRESCRIBED COSTING FORMAT MAY BE CONSIDERED INCOMPLETE AND NON-RESPONSIVE

8. Dated this 17th day of January, 1995, at Toronto in the Province of

E. Howa
By: (Signing Officer)

President
Title



APPENDIX A

APOGEE RESEARCH PROJECT DESCRIPTIONS

- Transportation Control Measures
- Economic Instruments
- Emissions Modelling

Economic Instruments for NO_x Emissions from Mobile Sources in Quebec: A Preliminary Investigation

Environment Canada
December 1994

At concentration levels currently experienced in some regions in Canada, ground-level ozone can adversely affect human health and damage crops and forests. The federal and provincial governments, through the Canadian Council of Ministers of the Environment, has created the NO_x/VOCs Management Plan to reduce emissions of ozone precursors. Many control initiatives in the Management Plan are targeted at the transportation sector, a major source of NO_x emissions.

Nonetheless, additional controls will be needed to adequately reduce NO_x emissions. Economic instruments are one policy approach that could encourage cost effective reductions from the transportation sector. Such instruments include emissions-based vehicle registration charges, emissions-based vehicle sales taxes, "feebate" or scrappage programmes, road pricing and parking pricing.

Apogee Research identified and assessed 15 economic instruments to reduce NO_x emissions from the transportation sector. Based on a review of experience with the instruments in other jurisdictions, Apogee evaluated the environmental and cost effectiveness of the instruments. Instruments were then ranked as high, moderate and low priority based on their demonstrated success.

In addition, Apogee provided a preliminary investigation into major issues regarding the application of these instruments in the province of Quebec. Apogee identified the province's existing and planned control options that would complement the economic instruments, evaluated data availability for a detailed study of economic instruments and briefly discussed selected implementation issues.

The study was used as the basis for a more detailed study of implementing economic instruments to reduce NO_x emissions from mobile sources in Quebec.

Transportation Control Measures

- ***TCM Handbook for Local Planners***. For the North Jersey Transportation Planning Authority (the MPO for northern New Jersey), Apogee produced a user-friendly handbook on TCM effectiveness. The handbook includes worksheets for planners to use in calculating emissions impacts of TCMs, including "fill-in-the-blank" forms and simple instructions. This tool was designed to help local officials develop "ballpark" estimates of the potential emissions reductions and evaluate synergistic, institutional, and political effects. The worksheets and handbook package provide information on relative magnitude of air quality impacts and program costs, as well as information on a variety of implementation questions.

- ***Analysis of Transportation Control Measures for St. Louis***. Apogee analyzed the cost-effectiveness of TCMs in helping meet air quality standards for the St. Louis metropolitan region and, with this information, developed a package of TCMs for consideration by the MPO, states, and other officials. This project, conducted for the East West Gateway Coordinating Council—the Metropolitan Planning Organization for the region—built on TCM experience across the country and applied it to the St. Louis region. The results of this TCM analysis fed into the planning process for the State Implementation Plans (SIPs) in Missouri and Illinois.

- ***Cost-Benefit Analysis of Transportation Control Measures***. This study, conducted for the Conservation Law Foundation, examined several TCM strategies, including telecommuting, parking restrictions, employer trip-reduction programs, smog/VMT taxes, and transit improvements. The project involved the quantification of emissions benefits, as well as other key external benefits, and a cost-effectiveness analysis of TCMs. This analysis was designed to assist several state air quality agencies in determining which TCMs (if any) to include in their SIP. The project included the development of a model which estimated travel time savings, user cost reductions, and accident cost savings of various TCMs.

- ***Costs and Effectiveness of Transportation Control Measures***. Apogee conducted a comprehensive review and analysis of the literature on TCMs. The TCMs analyzed ranged from transit and HOV improvements to congestion pricing and parking charges. This analysis included quantitative estimates of the travel impacts (in trip and VMT changes), emissions impacts (in tons of ozone-related pollutant emissions reductions), and cost-effectiveness (in cost per ton of hydrocarbons eliminated). This work was intended to provide local planners with information on nation-wide experience and modeling results to aid them in evaluating TCMs and to identify areas which merit further investigation and analysis. This literature review and analysis, conducted for the National Association of Regional Councils, was summarized in a report distributed to Metropolitan Planning Organizations and others across the country.

- ***Analysis of Role of TCMs***. As part of the Clean Air Act Amendments Transportation Educational Series developed for NCHRP under 20-7(60), Apogee evaluated the role of transportation control measures in meeting air quality requirements. The package provides information on effectiveness and cost-effectiveness for decision-makers who are considering TCMs, or are interested in comparing TCMs with other strategies designed to meet clean air requirements. The package seeks to put these estimates into a policy context and includes suggestions on how regions might evaluate TCMs in the context of clean air and transportation planning.

- ***CMAQ Improvement Program Review and TCM Analysis***. For the Federal Highway Administration, Apogee coordinated program reviews in the ten states which receive the greatest level of CMAQ funding and evaluated the air quality impacts of a sample of TCMs funded by CMAQ in those states. The project included preparation of proceedings papers for each state, a summary review at the national level, and a report on the effectiveness of the sample TCMs. This entailed accompanying FHWA, FTA, and EPA officials to each of the site visits and extensive interaction with state DOT, MPO, local government, and interest group officials involved in the state's CMAQ program. Based on information learned from the site visits, Apogee will assist the FHWA in developing a final report including suggestions to Congress on how to improve the CMAQ program.

Cost-Benefit and Externality Analysis

- ***Highway Benefit-Cost Analysis***. Apogee developed an analytic framework to help assess the net marginal social return on investments in highway improvements (investments brought about by federal-aid program) for the Federal Highway Administration. Because the Highway Economic Requirements System (HERS) model developed by FHWA already provides a good sense of direct effects on users, this effort focused on introducing externalities (including air emissions) and induced demand into the analysis. The goal of this work was to combine existing information with the additional material and to provide a statement about the net marginal social return of highways. The project established the proper framework for comparing social benefits and costs of highway improvement. It also assigned values to benefits and costs, provided qualitative assessments elsewhere, and provided guidance on how to improve the necessary base of information.

- ***Incorporating Externalities into Highway Cost-Benefit Model.*** Apogee has been selected by FHWA to analyze the HERS cost-benefit model and expand it to include external costs and benefits of transportation. The project includes a short-term quantification of air quality impacts, and a longer-term analysis of the full range of external costs and benefits. Apogee will develop a matrix of transportation impacts, analyze the current model, develop analytical procedures, and complete a preliminary design for model expansion.

- ***Analysis of the Full Costs of Transportation.*** This project, for a private client, involved an assessment of the full range of costs of transportation, including environmental and other external costs, as well as costs to users and government. The project included a literature review, the development of an analytic framework for measuring costs, two metropolitan area case studies, and an analysis of the policy implications of these costs. Costs for various modes of transportation in an urban-suburban context, including auto and transit, were

evaluated and quantified using a detailed spreadsheet model. The results include a matrix (of more than 2000 cells) reporting cost estimates from the case studies.

- ***Benefits and Disbenefits of Transit.*** Apogee completed a study for the Transit Cooperative Research Program of the National Academy of Sciences to determine the nature and magnitude of the benefits and disbenefits which accrue from public transit. Impacts analyzed in the study include the effects of transit on mobility and access, the economy, energy supplies and the environment, safety and security, and public references and attitudes. The research will enable state and local decision-makers to consider a range of impacts broader than the traditional methods of direct cost and travel time when making comparisons between transportation modes.

- ***Transit Fare-Pricing Strategy in Regional Intermodal Transportation Systems.*** Apogee is part of a team to devise a methodology and process to structure transit fare-pricing strategies within a regional intermodal system context. This one-year project, for the Transit Cooperative Research Program (TCRP) of the Transportation Research Board, will develop systematic approaches to evaluating and setting transit fares that explicitly consider the impacts on transit demand from decisions and conditions in other transportation modes. The model developed will include factors outside the traditional range of transit-pricing considerations such as auto fuel prices, congestion levels and variations in congestion, the cost of parking at transit stations and at final destinations, HOV policies and infrastructure, and availability and characteristics of alternative transportation (taxis, bicycles, etc.).

- ***Congestion Pricing Grant Application.*** For a state DOT, Apogee prepared an application for an ISTEA Congestion Pricing Pilot Project grant which the state presented to the FHWA. Apogee analyzed the economic, financial, institutional, and technical issues surrounding congestion pricing and designed a program involving peak-hour tolling and the potential use of parking pricing. The project also included the design of a community input process to develop public consensus around a congestion pricing program. Throughout the process, Apogee worked with state and local officials and business executives to identify transportation needs in a major metropolitan area.

Transportation and Air Quality Policy Analysis

- ***Strategic Analysis of the Effectiveness of Regional Air Quality Options.*** For FHWA, Apogee will analyze current air quality conditions and projections of future air quality trends in six or more selected nonattainment areas around the country. Apogee will examine the trend by pollutant (e.g., VOC, NO_x, PM-10) over the appropriate recent time period, consider factors that may have influenced that trend, and analyze how those factors may change over time. Project staff will assess the effectiveness of current emissions control measures and identify which measures are likely to be most effective in the future, in terms of attainment. Apogee will focus, in particular, on the relevance and usefulness of travel changes and conformity requirements for air pollution control in the next two to three decades. Project staff will also identify any federal policy changes that might bring about more effective long-run strategies.

- ***Analysis of Air Quality and Transportation Research for NCHRP.*** As part of a larger study that reviewed the National Cooperative Highway Research Program's research

process (NCHRP 20-37), Apogee completed a case study on air quality and transportation research. We developed a framework for organizing research on air quality and transportation and categorized in-progress and completed research studies from the major research organizations, as well as federal, state, and other agencies. The project identified research gaps and evaluated the implications of past experience in clean air/transportation for the development of future research agendas.

- ***Monitoring Nonattainment Areas***. Apogee is under contract with FHWA to monitor the CAAA/transportation implementation activities in nonattainment areas around the country. We are evaluating the transportation-related strategies being used (such as TCMs), as well as the problems metropolitan areas are facing in efforts to meet CAAA requirements. We will be collecting quantitative and qualitative data from selected nonattainment areas, evaluating the strategies and problems, and analyzing the policy implications. A subsequent phase of this effort would provide ongoing monitoring and evaluation of nonattainment area CAAA/transportation implementation activities.

- ***Evaluation of the CO_2 Emissions Implications of the Intermodal Surface Transportation Act of 1991***. Apogee reviewed ISTEA, identifying those provisions that are most likely to affect CO_2 emissions. After policy relationships between ISTEA and the Clean Air Act requirements were analyzed, causal links between these laws and changes in travel decisions, local planning, and policy decisions were identified. Apogee then estimated the impact on vehicle miles traveled that would result from TCMs, as well as highway and transit investment, and used this figure to estimate the effect on emissions.

- ***Analysis of Regulatory Authority to Reduce Greenhouse Gas Emissions***. For the EPA Office of Policy, Planning and Evaluation, Apogee is conducting an analysis of the ways in which existing authority, granted under ISTEA and other relevant legislation, could be used to reduce greenhouse gas emissions from the transportation sector. After a thorough analysis of ISTEA and other statutes, Apogee will catalogue the areas of discretionary authority and assess the likely greenhouse gas and other implications of exercising that authority. The project also includes the completion of a series of short-turnaround analyses of policy options to reduce carbon emissions.

- ***Feasibility Study and Preliminary Design of Vehicle Retirement Program***. Apogee is currently supporting an association in a feasibility study and preliminary design of an early retirement program for certain motor vehicles as a means of reducing emissions. This effort involves characterizing the existing stock of vehicles—broken down by age, engine type, and ownership—and analyzing various options for vehicle retirement, including exportation and scrappage. Apogee is examining data on markets for these vehicles in various nations as well as projecting likely emissions reductions that would result from different scenarios. Innovative financing options are being considered, including an analysis of the subsidy levels that would be required to ensure buy-back of a target percentage of vehicles (i.e., analysis of the supply curve).

Possible Mitigation Strategies for E-470 Toll Road

Holme, Roberts and Owen
April 1993 - May 1993

E-470 Toll Road Mitigation Strategies. Apogee prepared an analysis of potential emissions mitigation strategies for a new, private toll road in the Denver region -- E-470. Under the Clean Air Act Amendments of 1990 and the Intermodal Surface Transportation Efficiency Act of 1991, the sponsors of E-470 face strong pressures to improve or, at least, maintain regional air quality. Apogee reviewed the effectiveness, cost-effectiveness, and institutional implications of a series of transportation control measures (TCMs), as well as the potential of several stationary source strategies to offset any emissions increases resulting from the proposed highway facility. The analysis covered strategies aimed at travel on the E-470 corridor itself and regional approaches to both mobile and stationary source emissions. The analysis indicated that the most cost-effective methods available to the E-470 sponsors include pricing as an HOV incentive, older vehicle buy-back programs, and capital investment in stationary source controls.

Georgia Transportation Survey

The Road Information Program
January 1993-April 1993

The Road Information Program (TRIP) and its public relations firm, Ketchum Public Relations, contracted with Apogee Research, Inc. to conduct a statewide survey of registered voters in Georgia to determine the reasons behind the defeat of a recent constitutional amendment that would have set-up a Transportation Trust Fund in the state.

Apogee designed a survey instrument that not only identified why voters failed to pass the Transportation Trust Fund amendment but also determined:

- How voters might have voted differently;
- Satisfaction with the transportation system in the state;
- Preferences for transportation improvements;
- Perceptions toward a motor fuel tax increase; and
- Attitudes toward the ability of the General Assembly and State Department of Transportation to spend transportation funds wisely and efficiently.

This information will be used by TRIP and its clients to bring the issue back to the voters in time to meet federal deadlines for the availability of new money under the Intermodal Surface Transportation Efficiency Act (ISTEA).

Market Research Study of Toll Finance

Minnesota Department of Transportation
December 1989 - February 1990

Apogee used market research techniques to help the Minnesota Department of Transportation evaluate the potential for toll financing of road, highway, and bridge projects in Minnesota. To ensure that data adequately represented public opinion in Minnesota, Apogee collected information from two main sources: a broad-based telephone survey of over 900 respondents, approximately evenly divided between residents of the Minneapolis-St. Paul metropolitan region and the rest of the state, and two focus groups composed of particular segments of the business community dependent upon an efficient road transportation system.

Since traditional methods of survey analysis often do not reveal important underlying influences and trade-offs, we used several multivariate statistical techniques such as conjoint analysis, discriminant and factor analysis, and regression analysis to probe survey data for more subtle relationships. The focus group sessions, with bulk shippers and transporters and with more localized special carriers, highlighted the special needs and unique views of these two business groups concerning transportation needs, financing approaches in general, and toll facilities in particular.

The final analysis included not only an evaluation of the general response to toll financing but also a description of demographic characteristics of those residents more supportive of toll financing, factors facilitating toll acceptance, and the approximate value associated with each factor.

Financing Environmental and Transportation Infrastructure in New Jersey

Chase Manhattan Bank
Dec. 1989 - Jan. 1990

Apogee was retained to prepare two policy options for presentation to the transition team of the new governor of New Jersey, James Florio. In one paper, we explored options that address the most pressing environmental problems in New Jersey. We developed a proposal for State Solid Waste Facilities Corporations -- public-private partnerships to provide integrated waste management services. These state-owned solid waste industrial parks would lease or franchise concessions for materials recovery, energy recovery, and landfill of residuals. Several innovative financing options were also proposed and analyzed.

In a comparison paper on transportation finance, Apogee developed new financing options for needed toll roads and rehabilitation of existing highways. New public transit systems were also promoted through public-private arrangements.

Measuring and Valuing Transit Benefits and Disbenefits

Transit Cooperative Research Program, Transportation Research Board
June 1993 - May 1995

Apogee is part of a team undertaking a study for the Transit Cooperative Research Program of the Transportation Research Board (National Academy of Sciences) to determine the nature and magnitude of the benefits and disbenefits which accrue from pubic transit. Impacts analyzed in the study include the effects of transit on mobility and access, the economy, energy supplies and the environment, safety and security, and public preferences and attitudes. The research will enable state and local decision makers to consider a range of impacts broader than the traditional direct cost and travel time effects when making comparisons between transportation modes or options within the same mode, a critical objective if the multimodal principles of the ISTEA are to be implemented in practice.

Assessment of Economic Instruments For Waste Management

Environment Canada
1992

The search for low-cost, effective policy instruments is a critical component of achieving Canada's waste management objectives. The Green Plan target of a 50 percent reduction in waste generation by the year 2000 is highly ambitious. Innovative public policies are necessary to achieve this goal during a period in which great demands are being placed upon government and private financing capabilities. Market-based instruments (MBIs) offer a promising policy option for achieving waste management objectives during a period of low economic growth.

This study for Environment Canada assessed a wide variety of MBIs for waste management. These included weight- and volume-based pricing of disposal services, landfill tipping fees, tradeable permits, tax policies, deposit-refund programs, market development programs and financial incentives. The study emphasized the practical issues involved in applying each instrument to specific waste problems in both the hazardous and solid waste fields. Each instrument was assessed according to criteria such as in terms of environmental effectiveness, cost effectiveness, impacts on international competitiveness and jurisdictional compatibility.

The final report included an inventory and assessment of current MBIs used for waste management in both North America and Europe. Practical recommendations were made on feasible MBIs for selected wastes and implementation plans were developed.

Tool Box and Interventions: Issues for Consideration by the CEPA Review Team

Environment Canada
1993

The Canadian Environmental Protection Act has been the cornerstone of federal environmental policy since 1988. The government has initiated a review of the legislation to ensure that the Act is sufficient to meet Canada's need for environmental protection. Review teams are researching specific issues and formulating recommendations to improve the Act.

Apogee Research provided expert analytical support to the review team assessing the need to broaden the range of policy options authorized by the Act. Apogee Research prepared a background discussion paper that evaluated environmental policy options, including tradeable permits, environmental taxes and liability, deposit-refund systems, financial incentives, technology transfer programs, multi-stakeholder protocols and citizenship programs. For each policy option, Apogee Research:

- evaluated the experience in Canada and other jurisdictions with the policy;
- identified specific applications of the policy option to environmental concerns covered under CEPA;
- assessed the current status of the policy option under CEPA; and
- recommended enforcement tools that would be necessary for the policy option to be most effective.

A Test Case of Economic Instruments for Achieving Environmental Objectives

Water Resources Branch, Ontario Ministry Of Environment
June 1991 - February 1992

The theoretical advantages of economic instruments and market-based incentives over traditional command and control approaches for achieving environmental protection goals, have been recognized for some time. However, successful practical examples are strikingly absent. The purpose of this project was to design a practical test case in applying economic and market-based incentives to remediate and prevent pollution of Ontario's major rural beaches.

The sources of pollution consist of agricultural point and non-point sources, industrial effluents, urban run-off and faulty septic systems in rural and urban areas. In general, the introduction of Best Management Practices (BMPs) is the most cost-effective approach to most of the sources of pollution.

Cross-sector and intra-sectoral incentives and instruments were examined, including tradeable permits, point-non-point trades, charges, fines, and education/demonstration projects. The distinction between economic instruments with economic efficiency objectives and those with revenue generating objectives turned out to be particularly important given the large institutional nature of the sources of pollution (the dairy industry, for example). In the end, a practical set of economic instruments was designed for one particular watershed along with the required implementation plans and organizational/institutional changes.

Use of Economic Incentives for Water Pollution Control

Department of Ecology, State of Washington
1992

Although the theory of economic instruments promises much, there is growing frustration with the lack of progress in implementing practicable economic instruments. "Real world" applications to achieve specific environmental goals remain limited in number despite increasing pressure to increase the cost-effectiveness of environmental protection programs.

This study for the Department of Ecology addressed these issues by designing implementable economic instruments to attain water quality goals in the State of Washington. Criteria for selecting suitable sites were developed and applied to Federal and State water system data bases. Detailed profiles of water bodies suitable for economic instruments were compiled that included source-specific discharge characterizations, financial performance of industrial sources, demographic structure, water use and other relevant information.

The study assessed a wide variety of economic instruments for their applicability to meet water quality objectives for each water system selected. These instruments included effluent charges, marketable permits, taxes, subsidies and deposit-refund systems. Preliminary assessments allowed selection of a limited number of options for detailed design work. The final report provided an implementation guide that examined jurisdictional issues, statutory requirements, complementary programs, institutional structures required, necessary enforcement activities and potential cost savings resulting from the use of economic instruments rather than a traditional regulatory approach.

Assessment of Harmonized Economic Instruments for Used Tires

Canadian Council of Ministers of the Environment
December 1993 - April 1994

Trade liberalization and economic restructuring have focused government and private sector attention on the issue of industrial competitiveness. At the same time, public demand for environmental protection has increased. Government and industry are searching for ways of achieving environmental protection objectives without sacrificing industrial competitiveness.

Economic instruments and policy harmonization are two approaches being considered by the Canadian Council of Ministers of the Environment to achieve environmental objectives without imposing undue costs on industry. This assignment used a case study approach to assess the potential application of harmonized economic instruments in Canada. Given the diverse experience of Canadian provinces with implementing economic instruments for used tire management, used tires were selected for study.

Apogee Research was contracted to evaluate existing economic instruments for used tires, develop alternative models for harmonized economic instruments for used tires, and assess each model in light of the used tire market characteristics. A broad definition of harmonization was adopted, in which market characteristics determined the appropriate level of harmonization. The study concluded with key findings that could be incorporated into a generic framework for harmonized economic instruments.

The User Pay Approach to Stormwater Management and its Potential Application in Ontario

Environment Canada, Canada Centre for Inland Water
January, 1991 to March, 1991

For Environment Canada, Apogee examined the potential applicability of stormwater utilities for financing the management of stormwater runoff pollution. This work reviewed stormwater management practices in the U.S. and Canada, the impacts of runoff pollution, and examined the utility approach to stormwater management for its potential application in Ontario and Canada. Of particular interest was the potential for stormwater utilities to assist in financing the costs of Ontario's 17 remedial action plans (RAP's).

An Assessment of Alternative Economic Policy Options to Control the Production and Consumption of Methyl Bromide

Environment Canada
1993

In December 1992, methyl bromide, a fumigant used to control pests in numerous soil, space and commodity applications, was added to the list of ozone-depleting substances covered by the Montreal Protocol. Canada is committed to freezing methyl bromide production and consumption at 1991 levels by 1995, and further reducing methyl bromide production and consumption by 25% by 1998.

Apogee Research was contracted to conduct a two-phase study to assess policy options to achieve Canada's methyl bromide goals. Phase I evaluated the full spectrum of policy options, including input charges, transferable allowances (permits), product labelling, product charges, structured and unstructured voluntary agreements, and bans. Each policy option was assessed for its environmental effectiveness, cost effectiveness, administrative efficiency, impacts on innovation, and other characteristics. Policy recommendations were presented to industry, government and ENGO representatives at a multi-stakeholder consultation/workshop.

Phase II consisted of a comprehensive assessment of the likely socio-economic impacts of the recommended policy options. Costs, benefits, non-allocative and trade impacts were assessed for transferable allowances used in conjunction with a range of complementary policy options.

Advisory Panel on Alternatives to Command-and-Control Regulations

Environment Canada, Regulatory Review Office
April 1993

In this time of recession and increasingly liberalized trade regimens, industrial competitiveness is a major concern to government. Effects on competitiveness are an increasingly important yardstick for assessing public policies.

Environment Canada undertook a comprehensive review of existing environmental regulations to determine the costs and benefits of these regulations, their impacts on industrial competitiveness and whether alternatives to the regulations are available that would achieve more efficiently the same environmental objectives. Department staff were organized into teams to review clusters of all current regulations promulgated by the Department.

Apogee Research was invited to provide expert advice on alternatives to command-and-control regulations to eight of the regulatory review teams. The advisory role took two forms. First, a one-day workshop provided the teams with: background material on the types of alternatives available; techniques for assessing the viability of using alternatives to replace or supplement each existing regulation; and case studies of applying the assessment techniques.

Second, Apogee consultants met with each regulatory review team to: review each team's progress in assessing alternatives; and suggest avenues of research in cases where the teams had not been able to find alternatives.

The Use of Fees to Support State Environmental Programs

U.S. Environmental Protection Agency, Office of the Comptroller, Resource Management Division
March 1992 - April 1992

For EPA's State Capacity Task Force, chaired by the Deputy Regional Administrator of EPA Region IX (San Francisco), Apogee prepared a series of reports that characterized the states' use of fees to finance environmental programs. Our research covered air, water, hazardous, and solid waste programs and examined permit fees, effluent fees, user fees, and impact fees.

The reports identified trends among states in the use of fees, such as revenues generated, percentage of environmental budgets funded through fees, and activities covered by fee programs. The reports also provided the Task Force with some evidence of both the opportunities and limitations of using fees to pay for state environmental programs.

Key issues included: (1) the extent to which full program costs were recovered or recoverable with fees, (2) the efficiency and equity of using fees to fund state programs, (3) the potential for fees to reduce discharges and consequent effects on revenues, and (4) the effects of fees on different economic sectors, such as households and U.S. industry relative to their international counterparts.

Fee Schedule Recommendations as Required Under the 1991 Clean Air Washington Act

Washington Department of Ecology
June 1992 - November 1992

The 1991 Clean Air Washington Act directed the Department of Ecology to establish a statewide operating permit program consistent with the federal Clean Air Act requirements. The purpose of this project was to assist Ecology in developing an operating permit fee schedule which would provide a long-term source of funding for the permit program.

Apogee's responsibilities on this project were divided into three major tasks. Efforts under the first task were geared toward the development of an emissions inventory estimate to evaluate the size and structure of the permit program that would need to be funded. The results of this task indicated the number and type of emissions sources that are likely to require permits under the Clean Air Washington Act, and became an integral part of permit workforce planning. Under Task 2, Apogee estimated the range of staff time necessary to perform the activities associated with the development and implementation of a federally approved operating permit program. The culmination of the task was the union of Task 1 results and lists of permit workload estimates and activities into forecasts of staffing and permit expense levels. Task 3 involved developing a methodology for tracking the air permit program revenues and expenditures. In reviewing alternative tracking methodologies, Apogee considered compatibility with existing systems, equipment costs, operating costs, administrability, and comparability to methods employed by other permitting programs.

Taxes and Fees to Maintain and Improve Water Quality

National Tax Association
March 1991

Apogee participated in a panel discussion, *Taxes and Fees to Maintain and Improve Water Quality*, part of the National Tax Association's national seminar, "How Should States Tax Business?" The session examined state taxes and fees imposed on solid and hazardous waste disposal, on air emissions, and on water use or water discharges. A survey compiled by the National Governors' Association provided background information on the imposition of such fees by states, including fee schedules and the amount of revenues collected. Panelists discussed the economic theory underlying the use of fees and taxes for environmental improvement, and how that theory was often translated into practice.

Participants offered their perspectives on the use of fees and taxes to create economic incentives to reduce polluting behavior (in addition to or in lieu of regulatory measures), or as a source of revenues for state environmental programs. They also provided insights into the process by which states have arrived at some of the environmental fees and taxes that are being collected today. Finally, panelists addressed the ability of fees and taxes to raise sufficient funds to address the growing demand for financing state and local expenditures for environmental protection and improvement.

Use of Economic Incentives for Water Pollution Control: Evaluation of Fees to Attain Water Quality Goals

Washington State Department of Ecology, Water Quality Program, Alternative Strategies Unit
May 1992 - September 1992

As part of a project to examine the use of economic incentives to control water pollution, Apogee conducted an analysis of the operational, economic, institutional, and administrative applications of fees to reduce pollution or otherwise attain water quality goals. Fees were evaluated in terms of their effectiveness, efficiency, and practical feasibility when applied at each of three levels of economic activity -- inputs to production, production processes, and outputs. Apogee concluded that fees can best serve pollution reduction goals where they generate revenues dedicated to water quality programs. Effectiveness, flexibility, and efficiency tend to increase as fees are assessed further down the production process or where they are more closely linked to the release of pollutants. Apogee concluded that fees imposed on outputs, including products and waste by-products, have the highest potential to reduce pollution. Among output fees, effluent fees show the most promise as incentives for pollution reduction.

Apogee's report, *The Use of Fees As Economic Incentives For Water Pollution Control*, includes a description of fees based on the three stages of economic activity, evaluates the use of fees at each stage, and presents a brief explanation of the theoretical effect of fees applied at each stage. The report provides examples of how fees in that category have been used in practice, identifies the advantages and disadvantages of fees under each category, and assesses the potential for fees to have the intended effects of reducing pollutant volumes and/or toxicity of discharges.

Toxic Air Pollutant Control Strategy Development

Washington State Department of Ecology
July 1990-December 1990

Apogee and Senes are developing a number of strategies to control existing sources of toxic air pollutants in the State of Washington. The purpose of the project is to identify comprehensive, innovative alternatives to achieve efficient, timely and cost effective reductions in toxic air pollutant emissions and potential health risk. Apogee's work will include the following elements:

- Working with Washington's Air Toxics advisory committee to assist their development and evaluation of alternative control measures,
- Identification of toxic air pollutant control measures including at a minimum ambient air quality standards for toxic air pollutants, air pollution source category regulation, pollution taxes, quantitative risk analysis and technology application to residual risk, application of all known reasonable technology to all sources,
- Evaluation of control alternatives using 6 hypothetical case studies and 10 toxic air pollutants based on economic criteria (e.g., cost of inventory & dispersion modelling, process changes & control technology costs, health risk assessment costs, pollution tax costs, costs to individuals, equipment and staff costs),
- Evaluation of legal issues, and
- Submission of final report with recommendation of toxic air pollutant control strategy.

Use of Economic Incentives for Water Pollution Control

Washington Department of Ecology
May 1992 - August 1992

For the Washington Department of Ecology Water Quality Program, Apogee has prepared three reports that examined the effectiveness and efficiency of using economic instruments to control water pollution. The first report explores the detailed operational, economic, institutional, and administrative applications of fees to promote water quality objectives. This report will include extensive sections on: (1) description and "typology" of fees; (2) analysis of administrative, efficiency, equity, effectiveness, and other isues in implementation of fees; (3) profile of state and federal experiences with fees, including numerous case studies; (4) analysis of advantages and disadvantages of different classes of fees under different settings; and (5) an assessment of the potential for fees to have the intended effects of reducing pollutant volumes and/or toxicity of discharges or providing appropriate incentives for proper handling of wastewaters. The second and third reports will explore the detailed applications of other economic instruments and of point/nonpoint source trading for nutrient loading reductions, respectively, to promote water quality objectives and will evaluate their efficiency and effectiveness.

Constructing a Computerized Model to Forecast Emissions of Common Air Pollutants

Environment Canada, Pollution Data Analysis Division
1992-1993

Emissions forecasting models are essential tools in the formulation and evaluation of environmental protection policies and programs. Environment Canada currently forecasts emissions of common air pollutants from point, area and mobile sources by applying yearly macroeconomic growth factors to base year activity and emissions for chosen sectors over the forecast period. Base year parameters, such as existing air pollution control regulations and emissions per unit of activity, are held constant over the forecast period.

The increasing importance of the role of emissions forecasting requires that forecasts capture more complicated determinants of air emissions. This project to conduct such a model was conducted in two phases. Phase I consisted of a thorough analysis of factors that determine levels of air emissions. Primary factors included the level of economic activity, the composition of production and consumption, production technology used, the quality of inputs and the pollution control technology employed. Each primary factor was analyzed for its determinants to discover the underlying factors that influence air emissions. Phase I concluded with an assessment of the relative importance of primary and secondary factors and recommendations on which should be captured by air emission forecasts.

Phase II focused on the construction of a new air emissions forecasting model. The latest innovations in Canadian and U.S. forecasting models were assessed for their impacts on forecasting accuracy and their data requirements. A computerized model was constructed that integrated the Residuals Discharge Inventory System with a disaggregated macroeconometric model. Training workshops, user manuals and a on-line help system provide on-going client support.

Inventory and Review of Economic and Commodity Forecasting Models

Ontario Ministry of the Environment
November, 1991 to February, 1991

Many of the pollutants with which environmental regulators are concerned are emitted during production processes. Environmental regulations may affect emission loadings by changing production levels or by altering the amount of emissions generated per unit of production. Therefore, projections of production activity are required to forecast future emissions.

This assignment undertook the first step in developing an emissions forecasting model for the Ontario economy. An inventory of economic and commodity forecasting models which could be integrated into an emissions forecasting model was developed. The inventory encompassed macroeconomic models and eight of the major regulated industrial sectors, as well as energy, tourism and recreation.

Each model was critically evaluated for its forecasting accuracy, applicability to Ontario-specific production variables, ease of updating and modification, and cost of application. Models which met most closely the Ministry's needs were then selected for in-depth analysis.

An Inventory of Greenhouse Gas Emission Forecasts in Canada

Environment Canada
1992

The makeup of the Earth's atmosphere is being altered due to human activity. Atmospheric concentrations of "greenhouse gases", which trap heat in the atmosphere, have been increasing dramatically over the past 100 years due primarily to industrialization. These gases contribute to an unnatural warming of the Earth's climate. This phenomenon has been labelled "the greenhouse effect" of "global warming".

Recognition of human contributions to global warming has prompted international and national initiatives to reduce the emissions of greenhouse gases. For example, Canada has committed itself to stabilizing emissions of CO_2 at 1990 levels by the year 2000.

To achieve these ambitious reduction targets, national policies designed to reduce the emissions of greenhouse gases are being implemented. Emission forecasts play an essential role in the formulation and evaluation of these policies to control and prevent greenhouse gas emissions.

Apogee Research was contracted by Environment Canada to compile an inventory of the greenhouse gas emission forecasts being produced by various government, research and private agencies throughout Canada. The inventory examined the underlying assumptions which drive the forecasts and analyzed the subsequent forecast results. This analysis provided Environment Canada with an overview of the major greenhouse gas emission forecasts in Canada and a better understanding for the variations in these forecasts.

Washington State Impact Analysis of Alternative Toxic Air Pollutant Control Programs

Washington State Department of Ecology
April 1990 - September 1990

This project involves the analysis of the impact on small businesses in Washington State of proposed regulations aimed at limiting air toxic emissions from industry. The project involves developing a working knowledge of the industrial base in Washington, the toxic air pollutants generated, the relative human health risk of the pollutants in question, and the current air quality protection system. The proposed regulations will then be examined in terms of their potential financial impact on industries, on large and small business within affected industry, and on the regulatory agencies.

The small business economic impact statement resulting from this analysis is developed in order to fulfill the requirements of the state Regulatory Fairness Act. The Regulatory Fairness Act is designed to ensure that the proposed new rules, or rule changes, do not place a differential burden on small businesses in Washington.

The study also includes an estimate of the total cost of compliance with these regulations for all industry in Washington in order to fulfill the requirements of the Economic Policy Act, which specifies that each new rule or rule change adopted in Washington should consider economic factors in the course of its development.

Forecasting Air Pollution through Economic Drivers

Environment Canada
October 1992 - November 1992

Apogee Research Inc., Canada, was recently hired by Environment Canada to create a computerized forecasting model for emissions of common air pollutants. The model will be designed to include any additional air pollutants Environment Canada may wish to add. The forecasting model is based on data contained in an Environment Canada database named the "Residual Discharge Information System" (RDIS). Apogee assisted in an assessment of the factors affecting the emission of air pollutants. Specifically Apogee performed three tasks for this project: (1) a thorough investigation of the literature with regards to factors, or determinants, of emissions of air pollutants; (2) a survey of selected U.S. jurisdictions, including the U.S. EPA, the U.S Department of Energy, and selected state public agencies for information on the factors used in modelling of air emission forecasting; and (3) a review of the major air emission forecasting models in the U.S.

Support for the Development of a Hazardous Air Pollutants Program

Arizona Department of Environmental Quality
October 1992 - October 1993

Apogee is currently assisting the Arizona Department of Environmental Quality (DEQ) in developing a regulatory approach for listing hazardous air pollutants (HAPs), recommending which air pollutants on a specified list meet the requirements for designation as hazardous, developing a list of source categories subject to control under the state program, and preparing economic impact statements for the proposed regulations. Apogee is in the process of presenting risk screening methodology options for listing State HAPs; part of this task has been to balance statutory definitions, toxicological, ambient concentration, and emissions data availability. Apogee also provided estimates of economic costs and health benefits that would result from the proposed regulations.

In addition to reviewing other state and local programs use of toxicological data sources, Apogee investigated numerous relevant data sources in the areas of toxicology-based ambient standards, emissions rates, and ambient concentrations for Arizona's list of potential State HAPs. The HAPs in question are chemicals in addition to those already on the Federal list of HAPs in the Clean Air Act as amended, and therefore presented problems of data availability, since published emissions factors and applicable toxicological standards are rare among these compounds. Apogee has developed options for how these data can be used to determine whether any given substance should be listed as a State HAP and thereby regulated by DEQ.

In conducting this study, Apogee also developed a mechanism that links the emission of HAPs to emissions sources through the use of EPA guidance documents and databases obtained through EPA's Office of Air Quality Planning and Standards Technology Transfer Network.

Apogee also evaluated the economic costs and health benefits of regulating the additional pollutants. To provide these estimates, Apogee designed the necessary models of costs and benefits. Apogee combined economic projections of growth by SIC code with lists of the HAPs emitted by each SIC code to identify the number of affected firms. Costs per firm were then estimated. Benefits were determined with a model of emissions rates, control efficiences, dispersion with distance at a representative, generic source, and population densities.

Congestion and Pollution in Four California Metropolitan Areas

The Road Information Program
March 1990-May 1990

This project consisted in estimating the congestion and the air pollutant level in four metropolitan areas. In the course of this study Apogee used two models: "Freway" and "Mobile4". Freway is a FHWA model which gives congestion level and cost for any section of highway following certain parameters. It relies on the data computed by the Highway Performance Model Study (HPMS) from the FHWA. Mobile4 is a EPA sophisticated computer model which calculates average emission rates in grams per mile for any selected calendar year up to 2020. Based on these two models the Apogee estimated the level of congestion, the cost of congestion, and the level of four air pollutants (Total or non-methane HC, CO, and NOx) for LA, Sacramento, San Diego, and San Francisco.

Forecasting Industrial Hazardous Waste Reduction in Texas

Texas Water Commission
September 1990 - December 1990

Apogee conducted a series of studies to evaluate the extent to which the 200 largest hazardous waste generators in Texas will pursue waste reduction through the year 2000. In the first study, we constructed a database of Texas' annual Waste Minimization Reports for 1987, 1988, and 1989. From these, Apogee calculated actual amounts of waste reduced each year by industry at the 4-digit SIC code level and by type of waste.

In the second study, Apogee conducted a survey of Texas' 200 largest waste generators. The survey was designed to solicit industry's projections of the amounts they plan to reduce through the year 2000. In addition, the survey collected information on industry attitudes towards waste reduction and recycling, management decision making, ways to measure progress toward waste reduction, and barriers to source reduction and recycling.

In the final study, Apogee assembled the results of the previous two analyses in a forecast of waste reduction statewide. These projections were made by industry, type of waste, and year. Results were used to frame the state's waste reduction program and justify regulatory initiatives.

CO_2 Emissions Impacts of the Intermodal Surface Transportation Efficiency Act

U.S. Environmental Protection Agency, Office of Policy, Planning and Evaluation
February 1992

Apogee Research was selected to prepare an estimate of the CO_2 emissions impacts of the Intermodal Surface Transportation Act (ISTEA) of 1991. The one-week project involved three tasks: review of ISTEA and establishment of baseline estimate; analysis of the causal links; and quantification of the travel and emissions changes.

Apogee began the first task by identifying those provisions of ISTEA that are likely to affect CO_2 emissions. This included provisions that affect the following; vehicle miles travelled (VMT), mode split, proportion of auto trips in congested conditions, and other variables. Apogee then examined the relationship between ISTEA and the requirements of the Clean Air Act Amendments (CAAA), particulary the impact of CAAA on the relevant decision-makers under ISTEA. Next, using information provided by EPA, Apogee established baseline estimates for U.S. surface Transportation sector CO_2 emissions in the years 200 and 2010.

In order to complete the second task, Apogee identifies and analyzed the links in the chains of causality that result from various provisions in ISTEA to changes in individual travel decisions. Two links in the chain were established: (1) the effect of ISTEA provisions on state and local Transportation and planning decisions, and (2) the effect of those decisions on travel behaviour. The analysis focused on the state and local decision-making institutions, and in particular Metropolitan Planning Organizations (MPOs) in urban areas of more than 200,000 population, which will be spending a large portion of the funds under ISTEA. Apogee examined such issues as how they will spend the money provided under ISTEA, planning provisions under ISTEA, and differences in short- and long-term behaviour.

APPENDIX B

STRATEM INC.
CORPORATE QUALIFICATIONS

DESCRIPTION DES SERVICES
DE CONSULTATION EN TRANSPORT

STRATEM INC.

Stratem Inc. Consultants
1100 boul. René-Lévesque Ouest
Bureau 1350
Montréal (Québec) Canada
Tel: (514) 393-9088
Fax: (514) 393-3579

EXPERTISE DE STRATEM EN TRANSPORT

Le secteur des transports consitue, pour Stratem, un secteur d'activités priviliégié. Le nombre important d'études réalisées dans ce secteur permet à notre firme d'offrir des services d'expérience à une clientèle variée, pour tous les modes de transport (aérien, routier, ferroviaire et maritime).

L'expertise démontrée par les experts de Stratem en matière des tranports est orientée principalement vers les disciplines suivantes :

- Analyses de faisabilité, de rentabilité et d'impacts économiques et financiers de projets dans le domaine des transports;
- Plans de développement, de modification et d'aménagement des infrastructures en transport;
- Études sur la logistique et la distribution;
- Plans de marketing;
- Stratégies de développement des transports.

ÉTUDES EN TRANSPORT RÉALISÉES PAR STRATEM

Parmi les dossiers et études menés dans le domaine du transport figurent les études suivantes :

- Étude relative à la contribution du transport (terrestre, maritime, aérien et ferroviaire) à l'économie montréalaise. Évaluation de l'ensemble des inter-relations possibles du transport avec les activités économiques et positionnement de l'activité transport dans la CUM par rapport à la province.

- Étude de faisabilité pour l'implantation d'un héliport public à Montréal. Étude réalisée pour le compte des Aéroports de Montréal (ADM).

- Étude des différentes formes d'organisation publique/privée du stationnement à Montreal. Cette etude avait pour but de procéder à une évaluation des différentes formes d'organisation du stationnement en Amérique du Nord et en Europe, recommander sur la base d'objectifs concrets à la Ville de Montréal la forme d'organisation qui correspondait le plus à ses besoins.

- Plan de mise en valeur et de développement de la zone aéroportuaire de Sherbrooke. Étude mandatée par le Comité Administratif de l'Aéroport de Sherbrooke. Cette étude comprend trois volets : un volet développement de l'aéroport, un deuxième sur le développement industriel de la zone aéroportuaire, et le troisième visant l'intégration du développement de la zone au contexte du développement régional.

- Étude relative au transport des marchandises dans la région de Montréal. Étude réalisée pour la Communauté Urbaine de Montréal et le Ministère des Transports du Québec.

- Analyse des conditions d'opération de la compagnie Intair; examen de différents scénarios de redressement de la compagnie et analyse de sensibilité. Partie d'étude réalisée en sous-traitance de Tecsult pour le ministère des Transports du Québec.

- Article consacré au camionnage au Canada intitulé : "Le transport routier à la croisée des chemins" paru dans la revue Forces no 87 sur les transports.

- Analyse de la faisabilité économique et financière relative à l'achat d'un nouveau bateau pour le transport maritime dans le Grand Nord canadien pour la firme Igloolik.

- Élaboration des caractéristiques de l'aéroport de St-Hubert et le potentiel de développement des transports aériens dans la zone aéroportuaire de St-Hubert. Étude réalisée pour les villes de St-Hubert, Longueuil, Boucherville, St-Bruno de Montarville et la Régie des Affaires municipales.

- Étude des impacts socio-économiques et culturels du projet de développement de l'îlot gare Windsor pour la Société Marathon.

- Étude du plan de transport du ministre Marc-Yvan Côté dans la région de Montréal et l'impact des projets de développement en transport en Montérégie pour la Société Montérégienne de Développement.

- Étude de la problématique des transports dans la région de Montréal et du concept d'un plan régional en transport pour les villes de Longueuil et Laval.

- Analyse des aspects économiques et financiers dans l'étude du réaménagement des concessions et services de l'aérogare de Québec pour Transports Canada.

- Étude de faisabilité technique et économique pour l'évaluation du projet d'allongement de la piste d'Alma pour Transports Canada.

- Étude d'évaluation du projet d'allongement de la piste de Blanc-Sablon pour Transports Canada.

- Évaluation du système de contrôle du stationnement de l'aéroport de Dorval. Étude pour Transports Canada.

- Mise à jour des taux de location d'espaces de l'aérogare de Dorval. Étude pour Transports Canada.

- Étude pour le développement commercial de Transports Canada à l'aéroport de Dorval. Étude pour Transports Canada.

- Études de tarification des espaces des aérogares des aéroports de Québec, Val d'Or, Frobisher Bay, Gaspé, Blanc-Sablon, Chevery, Havre Saint-Pierre et Natashquan. Étude pour Transports Canada.

- Étude sur le calcul du prix de revient et de tarification de location d'espaces pour l'aérogare de Dorval, Transports Canada.

- Coordination relative à l'évaluation des impacts économiques d'un train à haute vitesse dans le corridor Québec-Montréal-Ottawa-Toronto

- Étude de faisabilité pour l'allongement de la piste à l'aéroport d'Alma pour Transports Canada

- Direction d'une étude de marketing et de stratégie de développement pour l'aérogare de Québec pour Transports Canada

- Étude sur le calcul du prix de revient du transport du manganèse via le Gabon et via le Congo. Détermination d'une tarification ferroviaire pour le transport du manganèse par le Transgabonais. Projet réalisé pour l'Office des Chemins de fer Transgabonais (OCTRA), Libreville, Gabon

- Étude de marketing pour le développement du trafic passagers et cargo à l'aéroport de Mirabel, Montréal, Canada

- Élaboration d'une politique d'investissement pour la compagnie de transport maritime Canada Steamship Lines, Montréal, Canada

- Étude d'impact des tarifs maritimes des lignes de conférence de l'Atlantique Nord sur le commerce international du Canada

- Analyse avantages-coûts de l'implantation de radars dans trois secteurs situés dans le nord-est du Québec. Modélisation de l'analyse à l'aide du logiciel de simulation aérienne SIMMOD, de D-Base 3+ et de Lotus 1-2-3;

- Analyse de faisabilité d'un héliport-vertiport à Montréal. L'analyse financière a été réalisée sur I.F.P.S. (Interactive Financial Planning System), système informatisé de gestion financière;

- Étude comparative des aéroports de Val d'Or et de Sept-Iles comme points d'escales techniques;

- Évaluation du marché des escales techniques pour l'aéroport de Val d'Or;

- Étude de tarification des espaces locatifs aux aéroports de Dorval, Mirabel, Québec et des aéroports desservant la Basse Côte Nord et Iqaluit sur base Lotus 1-2-3;

- Plan de développement commercial des espaces commerciaux de l'aéroport de Québec. En plus des aspects marketing, cette étude comprenait les aspects architectural, économique et financier relatifs au plan de développement;

- Plan d'aménagement de la zone cargo à l'aéroport de Dorval;

- Stratégies de développement des transports (rail, route et air) pour la région de Montréal;

- Analyse des impacts d'un plan de transport routier pour les régions Nord et Sud de la région de Montréal;

- Étude d'impact d'une gare intermodale rail-autobus-métro dans le centre-ville de Montréal;

- Étude des coûts de transport pour le transport des déchets sur l'île de Montréal et étude d'optimisation par modèle informatique d'un centre de transfert;

- Étude des coûts de tranport pour le transport des résidus de Crustacés de Gaspé.

OUTILS INFORMATIQUES

Afin de réaliser le plus efficacement possible les différents mandats, Stratem utilise régulièrement les logiciels suivants :

- Lotus 1-2-3;
- SPSS
- Harvard Graphics;
- I.F.P.S. Ce logiciel permet de programmmer tous les paramètres initiaux de l'analyse financière et de l'analyse de sensibilité;
- D-Base 3+. Pour monter des banques de données;
- SIMMOD est un modèle élaboré de simulation aérienne, développé par la F.A.A. (Federal Aviation Administration) et CACI Products Company. Ce logiciel peut être efficacement utilisé, à la fois, par le spécialiste en transport aérien, le gestionnaire de l'aviation, l'analyste en transport, le contrôleur aérien et le pilote, car il leur permet de visualiser l'ensemble des séquences et procédures observées lorsqu'un appareil ou un groupe d'appareils traverse un espace aérien contrôlé, décolle et atterrit aux différents aéroports.

  SIMMOD retrace et comptabilise les mouvements par appareil ou par groupe d'appareils alors qu'il parcourt l'espace aérien et détecte les violations potentielles dans les normes de séparation, les procédures de contrôle du trafic aérien. Il identifie les problèmes relatifs à la circulation des appareils sur la ou les pistes et à la gestion des opérations au sol (allocation des portes, départs successifs, stratégies d'attente, etc.).

  SIMMOD fournit également les statistiques de trafic, de retards en vol, au sol et aux différentes portes, de temps de vol pour un appareil ou un groupe d'appareils ou pour un exercice au complet ou selon qu'il s'agit d'arrivée ou de départ, et de consommation de carburant. Ces statisqiues peuvent être obtenues sous forme de tableaux et de graphiques.

APPENDIX C

RESUMES

Eric Cowan, M.Sc.
President
Apogee Research International, Ltd.

EDUCATION

M.Sc. Operations Research, University of South Australia (1969)
B.Sc. (Hons.) Mathematics, University of Ottawa (1965)

Eric Cowan is the President of Apogee Research International Ltd. and the founder of our Canadian environmental practice. He has over 20 years' consulting and operating experience in the private, multi-lateral and government sectors. His environmental economics expertise is in the areas of: strategic options for achieving environmental objectives, the design of practicable economic instruments, innovative financing of environmental infrastructure, industrial competitiveness and environmental protection, regulatory impact analysis and environmental market research and evaluation. His work experience includes four years with the Privy Council Office of the Federal government and five years working in the oil, gas and mining sectors.

We highlight below his project experience relevant to this project on economic instruments for NO_x/VOC reduction in the Quebec corridor.

STRATEGIC OPTIONS AND ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL PROTECTION

- Directed the detailed feasibility assessment for Environment Canada of using three economic instruments (advance disposal fees, waste generation charges, and tradable permits) to deal with hazardous waste streams in the steel, surface finishing and plating sectors.

- Co-facilitated (with two Dutch experts) a set of four workshops on lessons learned from experiments with economic instruments for environmental protection. Participants came from Western and Eastern Europe, Latin America, Asia, the U.S. and Canada, as part of a conference on environmental compliance held in Oaxaca, Mexico sponsored by the U.S. EPA, the Dutch environmental agencies and World Wildlife Fund.

- Directed an assessment of harmonized economic instruments for used tire management, for the Canadian Council of Ministers of the Environment.

- Directed the detailed design of a tradeable allowance scheme to achieve Canada's commitment to reduce the consumption of methyl bromide, an ozone-depleting substance. The structure of the Canadian economy requires that these instruments be carefully designed and implemented.

- Directed the study of the potential applications of economic instruments to achieve CCME's solid waste management objectives. This project assessed 15 economic instruments, ranging from simple curb-side fees, through deposit-refund systems to taxes on virgin materials. The study emphasized the practical issues involved in applying each instrument to four categories of solid wastes.

- Consulted to the nine Environment Canada regulatory review teams on strategic options, emphasizing economic instruments, for achieving the environmental goals of existing regulations. The costs and benefits of the strategic options were identified for the teams.

- Directed the identification of a comprehensive set of economic instruments to achieve water quality goals in an Ontario watershed with agricultural, rural, industrial and municipal sources of pollution.

- Directed the development of a long-term air toxics control strategy for a U.S. state. Eight strategic control options were identified and ranked as to their effects on air emissions, the resultant effects on human health and the consequences of the policies to economic growth in the state. The emphasis in the options analysis was on the potential roles of economic instruments as opposed to command-and-control approaches.

- Directed a review of world-wide approaches to the compensation of communities and individuals for costs incurred due to the locating of industrial and municipal waste management facilities in the area.

AIR EMISSIONS

- Assessment of economic impacts on 12 key Ontario industry sectors of proposed air emissions regulations.

- Development and analysis of alternative long-term control strategies, including economic instruments for air toxics emissions in Washington state.

- Evaluation of environmental benefits and costs of new air emissions regulations for vapour control and new sources.

- Direction of the development for Environment Canada of a model to forecast air emissions throughout Canada resulting from complex scenarios of technology change, new regulations, economic growth etc.

ENVIRONMENTAL ECONOMICS AND FINANCE

- Commissioned to prepare and present a theme paper on "Innovative Financing of Environmental Infrastructure in the NAFTA Partners", at the PRO-ECO environmental conference in Monterrey, Mexico in May 1994.

- Directed a study of strategic options for financing mechanisms available to Ontario municipalities for funding water and wastewater treatment facilities. This study reviewed innovative approaches to water system financing in Canada and the United States and assessed their potential applicability in Ontario. Case studies were carried out on six Ontario municipalities, demonstrating that the "user pay" principle is gaining in popularity as a way of financing these facilities.

- Directed a study of the potential for user-pay approaches to stormwater management and treatment, in particular through stormwater utilities. Experience with over 50 utilities was reviewed and precursors to success were identified. The potential applicability of the approach to Ontario's Remedial Action plans (RAPs) and the separation of combined sewer overflows was assessed.

- Directed the preparation of the long-term strategic plan for the P^3 initiative (Public-Private Partnerships) of the U.S. Environmental Protection Agency. This initiative was established recently by the EPA to explore innovative approaches to financing public purpose environmental protection facilities and services.

- Provided expert advice to the Ontario Ministry of the Environment on the use of economic and financial tests in the determination of BAT-EA effluent limits for the MISA program.

- Directed a comprehensive study of the costs and benefits of restoring to beneficial uses the seventeen Canadian Areas of Concern in the Great Lakes (the RAPs).

ENVIRONMENTAL PROTECTION, TRADE AND INDUSTRIAL COMPETITIVENESS

- Directed a study for CCME on potential barriers to internal Canadian trade arising from categories of environmental protection approaches. A template was developed for determining whether the environmental protection measures were barriers to trade and estimating the likely impacts of the measures.

- Directed a set of seven detailed Canadian industrial case studies on the cost and competitiveness impacts of draft environmental assessment regulations. The case studies covered: pulp/paper mills; forestry and logging; mining; and oil/gas exploration and development in British Columbia, Alberta, Ontario and New Brunswick.

- Directed a study for the Ontario Ministry of the Environment of the comparative impact of air and water environmental regulations on the competitiveness and productivity of Ontario industry, focusing on pulp and paper, iron and steel and petroleum refining.

- Directed a study of the detailed effects on competitiveness for industry investment in facilities of different approaches to environmental assessments.

- Directed a study for Environment Canada/Industry, Science and Technology Canada to quantify the impacts of the New Substances Notification Regulation on Canadian industrial innovation and competitiveness. The regulation imposes reporting requirements before new chemical substances can be introduced into Canada. Industry groups have argued that the regulation will have an adverse impact on competitiveness as it is much more stringent than similar U.S. regulations. A case study approach was used as the primary research tool in measuring the costs and environmental benefits of the regulation.

- Directed the assessment of the costs, productivity/competitiveness consequences to industry and other affected sectors, and the environmental benefits of various proposed regulatory changes:

    - low-sulphur diesel fuel regulation of Environment Canada;
    - the Clean Air Program in Ontario;
    - new source regulations in the state of Washington;
    - gasoline vapour control limits in Washington; and
    - seven alternative approaches to the long-term control of toxic air emissions.

- Directed the formulation of a comprehensive research plan for the U.S. EPA on the impacts of environmental protection regulation on industrial competitiveness and on the development of an "environmental protection" industry.

- Directed the comparison of the air and water environmental protection regulations of Ontario, Quebec, 12 U.S. States and six other OECD countries and the effects of the regulations on affected industries.

HAZARDOUS WASTES MANAGEMENT AND MARKETS

- Directed the assessment of the market in Western Europe for Canadian environmental protection goods and services.

- Directed the technical design and building of the Canadian Hazardous Waste Inventory (CHWI), a comprehensive inventory of industrial and household hazardous waste generation in Canada. The CHWI database is designed to be updated regularly to enable Canada to comply with its international reporting requirements. CHWI draws on a number of hazardous waste generation and management reporting systems in use across the country. A computerized model enables users to forecast the generation of hazardous wastes as a consequence of waste minimization policies and economic variables.

- Directed the follow-on CHWI project for CCME, aimed at ground-truthing the hazardous waste generation estimates by Canadian industry on a regional and provincial basis. The verification sessions have been held with key industry sectors and Provincial agencies, and have led to significant improvements to the original CHWI estimates.

- Directed a hazardous waste inventory and planning model study for the British Columbia Hazardous Waste Management Corporation. Apogee designed the surveys to be sent to 4,000 generators and designed the databases and forecasting models. Proprietary Apogee models were used to identify the priority B.C. sectors. Apogee databases on pollution prevention and waste minimization were used to forecast the likely impacts of such initiatives.

- Directed various hazardous waste market research studies on:

    - the site remediation market in Canada;
    - niche markets for the incineration of hazardous and toxic wastes in the U.S.;
    - the size, sub-markets and entrance requirements of the environmental protection market in Canada;
    - hazardous waste landfill capacity markets in the U.S.

  These studies required the compilation of large databases on hazardous waste generation, characterization, and treatment, then forecasting markets based on economic growth, technological change and other factors.

- Directed a review for a private client of the market forecasting and waste treatment methodologies used in a proposed expansion to the Swan Hills hazardous waste facility in Alberta.

- Directed the review of Canadian and U.S. econometric and commodity forecasting models to determine their usefulness for projecting pollution generation by major industry groupings.

OTHER ENVIRONMENTAL PROJECTS

- Directed the design and construction of a forecasting model for air emissions, based on the RDIS database of Environment Canada. Air emissions were modelled as a function of a set of impacting factors, including government regulations, new technologies, and economic growth.

- Directed the evaluation of the Natural Resources Conservation component of Environment Canada. Both the Inland Waters Directorate and the Canadian Wildlife Service were evaluated.

- Evaluated the likely effectiveness of the Canadian Major Industrial Accident Coordination Committee (MIACC), designed to reduce the likelihood and severity of major industrial environmental accidents such as occurred in Bhopal, India.

- Participated in the development of a business plan and assessment framework for the conversion of a government-owned wastewater technology R&D centre into a GOCO, i.e., a government-owned contractor-operated facility.

- Evaluated, subsequently, the effectiveness of the GOCO experiment in achieving its goals of increasing the rate of commercialization of environmental technology developed and reducing its dependency on government funding.

- Carried out an organizational review of the Ontario Ministry of the Environment.

PARTIAL LIST OF CLIENTS

Agriculture Canada
Association of Canadian Publishers
B.C. Hazardous Waste Management Corporation
Business Council on National Issues
Canada Centre for Inland Waters
Canadian Committee of Ministers of the Environment (CCME)
Canadian International Development Agency
Canadian Steel Industry Association
Centre for the Great Lakes Foundation
Consumer and Corporate Affairs
Department of Communications
Department of Ecology (WA)
Department of Finance
Department of Industry, Trade and Commerce
Department of Regional Industrial Expansion
Dow Chemical (Canada) Ltd.
DuPont Corporation
Environment Canada
External Affairs and International Trade Canada
Federal Business Development Bank
Federal Environmental Assessment Review Office (FEARO)
Health and Welfare Canada
Inter-American Development Bank (IDB)
International Finance Corporation (IFC)
International Joint Commission (IJC)
International Monetary Fund (IMF)
Labour Canada
Metro Toronto
Ministry of Citizenship and Culture
Ministry of Consumer and Commercial Relations
Ontario Clean Water Agency (OCWA)
Ontario Ministry of the Environment
Ministry of Housing
Ministry of Industry, Trade and Technology
Ministry of Treasury and Economics
Ontario Waste Management Corporation
Private legal firms on solid waste issues
Public Works Canada
Solicitor General
Statistics Canada
University of Toronto
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency (EPA)
U.S. Federal Aviation Administration (FAA)
Wastech Corp.
World Bank
World Wildlife Fund
Wastech Corporation

KENNETH J. WATSON
Apogee Research International Ltd.

Education

1991 M.A., Economics
Queen's University

1989 B.Sc., Economics (Quantitative Methods)
University of Toronto

Experience

Mr. Watson is an economist and policy analyst with our Toronto office and Director of our Environment-Economy Services practice. During eight years of employment as a researcher, he has covered a diverse set of policy issues including international trade and investment, national comparative advantage and determinants of labour earnings. His strong background in quantitative analysis has been demonstrated in his contributions to the empirical components of three published books and many published articles. His empirical experience also encompasses hands-on work with a major macroeconometric model, and estimation of consumer demand systems and earnings generation models.

For the last five years, Mr. Watson has focused upon the field of environmental economics, including evaluating market-based instruments, regulatory impacts on industrial competitiveness and trade, and the costs and benefits of environmental policies. Mr. Watson has also developed complex environmental models, including Canada's national emissions forecasting model. A synopsis of his work is provided below.

Economic Instruments for Environmental Protection

- Consultant for a study that designed a set of economic instruments to achieve environmental protection goals in the Upper Thames watershed of southern Ontario. Economic-based policy instruments were tailored to the specific characteristics of the polluters: many non-point agricultural sources; few industrial point sources; urban run-off; and sewage treatment plants. Complex jurisdictional issues between municipal, regional and provincial government agencies and marketing boards limited policy options.

- Task manager on a project designing implementable economic instruments to meet water quality objectives in the State of Washington. In conjunction with the Washington Department of Ecology, a set of water bodies most suitable for economic instruments was developed using Federal and State water body data bases. Additional site selection criteria were developed on the basis of detailed design issues. Three aquatic sites were then selected for intensive analysis of the feasibility of applying economic instruments. The study concluded with an implementation plan for specific economic instruments and an analysis of the instruments' economic and environmental impact.

- Project manager of an assessment of strategic options to freeze and reduce Canadian consumption and production of methyl bromide, an ozone depleting substance. Phase I of the project analyzed the full range of policy options and recommended the use of a system of transferable consumption allowances supplemented by several additional policies. A detailed assessment of industry structure revealed minimal potential for strategic behaviour in allowance markets. Recommendations were also developed regarding alternative design features, including allocation mechanisms, market priming, banking and "use-it-or-lose-it" rules.

- Project manager on a study for Environment Canada to assess and design economic instruments to reduce hazardous waste generation and improve hazardous waste management. The study provided an initial screening of instruments, resulting in the identification of three high potential instruments: hazardous waste generation fees; advance disposal fees; and substance deposit-refund systems. Three test applications were designed for heavy metal sludges from the metal finishing industry and iron and steel mills, and solvents and organic solutions from the paints and coatings industry.

- Project manager of a discussion paper on strategic options used during the federal government's 5-year legislative review of the Canadian Environmental Protection Act. The discussion paper examined the Act's limited authorization of alternatives to command-and-control regulations. Economic instruments, voluntary initiatives and exhortation tools were assessed for their potential use to address CEPA environmental concerns (toxic releases, ocean dumping, cleaning agents and detergents, transboundary air pollution, etc.).

- Project manager of a background feasibility assessment for Environment Canada of using economic instruments to reduce NO_x emissions from mobile sources in Quebec. The study evaluated the use of economic instruments for NO_x emissions in Canada and other O.E.C.D. countries. An inventory of data and information on NO_x emissions, source characteristics and abatement costs was developed and assessed for gaps. Recommendations on the most feasible economic instruments and approaches for detailed design work were provided.

- Project manager of an assessment of alternative models for nation-wide harmonized economic instruments for used tires. This study for the Canadian Council of Ministers

of the Environment reviewed the Canadian and U.S. experiences with used tire management programs. Potential markets for used tire were quantified and each stage of the recycling loop (collection, transportation, processing) was assessed for barriers to increased development. Alternative financing mechanisms and incentive programs were designed to overcome these barriers. Opportunities for policy harmonization were identified for each alternative program. The study's approach was developed into a framework for assessing harmonized economic instruments.

- Project manager of a study of strategic options available to Environment Canada under the Canadian Environmental Protection Act (CEPA) to control the introduction of dioxins and furans from chloranil-derived pigments and dyes into the environment. As a sub-contractor, Apogee undertook three research tasks: (i) development of policy assessment criteria; (ii) a preliminary review and screening of broad range of policy options; and (iii) detailed analysis of the four policy options offering the most potential to achieve Environment Canada's objectives. Policies assessed included monitoring requirements under both 18(1) and 34(1) of CEPA, various command-and-control options and economic instruments such as taxes and tradeable permits.

- Project manager of a study examining economic instruments as one strategic option to achieving the CCME waste management objectives. This project for Environment Canada's Office of Waste Management assessed 15 economic instruments, including variable curb-side fees, landfill tipping fees, landfill surcharges, tradeable recycling credits, virgin material taxes, deposit-refund systems and recycling rebates. The study emphasized the practical issues involved in applying each instrument to four specific waste categories. Each instrument was assessed according to criteria such as environmental effectiveness, cost effectiveness, impacts on international competitiveness, public acceptability, distributional impacts and jurisdictional compatibility.

- Participant on an advisory panel on alternatives assessment during Environment Canada's recent Regulatory Review. The panel provided assistance to the Review Teams on expanding their analyses of market-based instruments and voluntary approaches as alternatives to traditional command-and-control regulations.

Cost-Benefit Analysis

- Project manager for a regulatory impact analysis of Environment Canada's proposed system of transferable allowances for methyl bromide. The value of human health benefits, namely reduced morbidity and mortality largely from skin cancers, were estimated. The literature on additional ecosystem benefits was reviewed and assessed qualitatively. The cost analysis involved developing estimates of the cost per unit of methyl bromide foregone in each of 10 use categories, identifying cost effective reduction

- Project manager on a socio-economic profile of the Canadian metal finishing industry. Developed as part of Environment Canada's first sectoral approach at controlling toxic releases, the report compiled and assessed the complete range of information needed to analyze the full range of policy options and conduct cost-benefit analyses of recommended options. The report covered market structure, financial performance, obstacles to and opportunities for increased material recovery and process trends. The assessment was conducted at both the sectoral and sub-sectoral levels. Given the lack of data on the metal finishing industry, a survey was developed and sent to over 650 metal finishers. Detailed interviews were conducted with over thirty firms.

Regulatory Impacts on Industrial Competitiveness and Trade

- Project manager on a study of internal trade barriers in the environmental protection sector. As part of the Canadian Council of Ministers of the Environment contribution to Canada's Internal Trade Agreement, Apogee evaluated the disputes over environmental measures under the GATT, the EC and the Canada-U.S. Free Trade Agreement. Twenty generic environmental measures were assessed for their potential trade impacts and the conditions under which they may violate the provisions contained in major trade agreements. Interviews were conducted with major industry associations to identify existing environmental measures that may inhibit internal trade.

- Project manager on an assignment for the U.S. Environmental Protection Agency developing a plan for a comprehensive research program on the effects of EPA regulations upon industry. Particular emphasis was placed upon the positive effects of regulatory activity and how government policy may be used to encourage positive economic effects in regulated industries, as well as the environmental protection industry.

- Project manager of an assessment for Transport Canada of the international trade effects of U.S. subsidies for ethanol in fuels. The study involved evaluating the likely impacts on Canadian imports and exports of fuels and ethanol, based on price differentials with and without the U.S. subsidies. Using international case law under the GATT and NAFTA, the potential to apply countervailing duties to offset the U.S. subsidies was investigated.

- Project manager on a study for the Ontario Ministry of the Environment on the impact of environmental regulation upon the productivity and competitiveness of Ontario industry. In addition to an exhaustive review of the most recent empirical research on productivity and environmental regulations, he formulated a wide variety of hypotheses on how both negative and positive effects may be transmitted, tested these hypotheses, and forecasted future effects on the productivity and competitiveness of three key industrial sectors (pulp and paper, iron and steel, and petroleum refining).

Environmental Modelling

- Project manager for an assignment to construct for Environment Canada a computerized model to forecast common air pollutant emissions and simulate the effects of policy options. This work was conducted in two phases: (i) development of a theoretical framework of the determinants of common air pollutant emissions; (ii) construction of the model based on the Residual Discharge Inventory System. A primary objective of the study is to allow the forecasting model to interact with economic forecasting models so as to incorporate environment-economy linkages.

- Project manager for a project to construct a computerized Data Pre-Processor for Environment Canada's emissions forecasting model. The Pre-Processor performed several functions on Canada's inventory of air emissions, a database comprising over 40,000 emission records. The Pre-Processor works interactively with a database of NAPAP emission factors to complete the inventory fields. It subsequently identifies equations suitable for calculating and forecasting emissions from each source in the database.

- Project manager for an assessment of options to link abatement cost databases with Environment Canada's emissions forecasting model. Such linkages would allow the Department to estimate the costs of complying with regulations and the economic and environmental effects of emission taxes and tradeable permits.

- Project manager on an inventory of economic and commodity forecasting models and services for the Ontario Ministry of the Environment. Canadian and U.S. forecasting models at the macroeconomic and industry levels were analyzed for their applicability to the client's interests. Recommendations were made regarding the most suitable models for estimating the impacts of environmental regulations and use in forecasting pollutant emissions.

- Developed a flexible theoretical model to estimate the most efficient levels of recycling activities. Using optimal control maximization techniques, the paper extended traditional models of non-renewable resources to encompass the case of renewable resources with pollution by-products resulting from secondary material production.

Environmental Finance

- Project manager on an assignment to prepare a manual for the U.S. Environmental Protection Agency on assessing the viability of small water systems. The manual summarized various assessment methodologies and provided a critical assessment of financial planning models and aggregate viability tests based on financial ratio analysis.

- Consultant to the Ontario Clean Water Agency analyzing the theoretical and practical issues in establishing net earning targets. After reviewing appropriate definitions of net earnings in the context of a crown corporation, recommendations were based on the effects of net earnings on access to private capital markets and the level-playing field in domestic markets.

Other Research Areas

- Author of an evaluation of Ontario's Municipal-Industrial Strategy for Abatement and the potential for its multi-criteria decision-making framework to produce efficient water effluent standards. He concluded that the multiple decision criteria reflected conflicting objectives of the program and that achieving economic efficiency could be seriously hindered.

- During two years at the Ontario Centre for International Business, Mr. Watson researched the adjustment process of Canadian multinational enterprises to the Canada-U.S. Free Trade Agreement, the use of non-tariff trade barriers as a management strategy of some U.S. firms, and the strategic management of South Korea's *chaebols*.

- Co-authored for a major Canadian management consulting firm a report on subsidies in the U.S. steel industry. This necessitated developing a detailed model of the steel sector disaggregated by type of firm and output destination. Significant subsidies were found to exist though only in forms different from traditional notions of subsidies.

- Provided empirical expertise in large-scale quantitative assessments of the comparative advantages of Thailand, New Zealand and Great Britain.

- Estimated a full earnings generation model of women in the Canadian labour force. Using a modified data set derived from the Canadian Job Mobility Survey, this recursive model predicted education levels, first occupation, labour force experience, and current occupation and earnings as a function of a wide range of socio-economic background variables. In extensions of this work, a smaller model was estimated to compare the effects of dependent variables by immigration status.

Papers Presented

- *Environment Canada's Emissions Forecasting Model.* United Nations Economic Commission for Europe Workshop on Emissions Forecasting, Copenhagen, June 1993.
- *Are Environmental Regulations Bringing Ontario's Competitiveness Down?* Ontario Ministry of the Environment and Energy's Technology Transfer Conference, Toronto, November 1993.

Clients

Canadian Council of Ministers of the Environment
Canadian Pulp and Paper Institute
Environment Canada
Industry Canada
National Cooperative Highways Research Program
Ontario Clean Water Agency
Ontario Ministry of the Environment
Transport Canada
State of Washington Department of Ecology
U.S. Business Round Table
U.S. Environmental Protection Agency
Vaughan C.A.R.E.S.

Richard R. Mudge, Ph.D.

TITLE	President
EDUCATION	Ph.D., Regional Economics, University of Pennsylvania, 1972. M.A., Regional Economics, University of Pennsylvania, 1970. B.A., Economics and Geography, Columbia College, 1968.

Dr. Richard Mudge, a nationally known expert in the economics and financing of transportation and related environmental programs, has more than 20 years of experience in investment and strategic planning, forecasting, policy and budget analysis, and project management. As co-founder and President of Apogee Research, Dr. Mudge directs the firm's work in transportation, applied public finance, strategic planning, and the interactions between transportation and the environment. Dr. Mudge has conducted cost-benefit and cost-effectiveness studies for virtually every type of transportation change ranging from pricing to large-scale capital investments. One of his specialties is the integration of technical analyses into the decision-making process.

ISTEA and Clean Air Act

- Under contract to NCHRP, Dr. Mudge led an Apogee team to provide the state departments of transportation (DOTs) with ongoing analysis of the transportation implications of the Clean Air Act. This effort included a briefing book with monthly updates as well as several information packages. One package provided up-to-date information on the relative and absolute effectiveness of TCMs. This effort provided the definitive information source for each DOT -- and other interested groups -- on the fast-changing analysis and interpretation of the Clean Air Act and the actions taken at the local and state level to implement the act.

- At the local level, Dr. Mudge was part of a team from Apogee which worked with the St. Louis MPO to develop an effective plan for implementing TCMs. Apogee has conducted similar projects in Boston and Providence for the Conservation Law Foundation. Apogee takes a comprehensive approach to this work, adding the expected transportation benefits from TCMs rather than relying solely on emission reductions to justify change.

- A number of Dr. Mudge's current and recent projects focus on the Intermodal Surface Transportation Efficiency Act (ISTEA) and its implications for transportation policy and financing. He prepared two white papers on the financial opportunities for state and local governments created by ISTEA (for a private client). For the U.S. Environmental Protection Agency, the Federal Highway Administration, and the Federal Transit Administration, he is evaluating the implications of new ISTEA legislation and related environmental laws (the Clean Air Act, in particular) for effective decision-making and for the development of cost-effective transportation. Previously, Dr. Mudge developed detailed plans to apply revolving loan fund lessons learned from wastewater treatment experience to other public works, including highways and airports. This approach has since been incorporated into the new ISTEA legislation (for several trade associations).

- At the state level, Dr. Mudge is developing plans for the application of congestion pricing to urban transportation in the United States. This work covers financial planning, institutional issues, and the development of a public consensus for action (for a state DOT). For the New Jersey Department of Transportation, Dr. Mudge helped develop a five-year business plan covering strategic issues and financial implications. This work covered implications of recent changes in social and economic structure, and the new environmental rules and regulations.

Finance

- Dr. Mudge is directing a two-year study on how to reduce or eliminate barriers to public private partnerships to finance and operate roads and bridges. This multi-disciplinary effort covers legal, administrative, financial, and operational issues (for the FHWA). He is also working with several state DOTs on innovative ideas to finance a range of major new transportation projects including a $400 million new bridge, a $1 billion rehabilitation of urban freeways, and a $2 billion multi-modal urban transportation corridor.

- Dr. Mudge's work on financing transportation infrastructure also includes the development of a detailed, multi-year, highway trust fund simulation model which analyzes options for structural and financial changes to improve the functioning of current federal trust funds (for a confidential client); preparation of a detailed financial simulation model which assesses the pros and cons of "partial" privatization -- ownership of plant and equipment by a central authority, for example, with leases to local agencies; and direction of the development of a series of case studies on institutional and political reasons for the success or failure of proposed private toll roads and public-private partnerships (for a Japanese financial institution). For the U.S. Congress, Dr. Mudge made a comprehensive assessment of U.S. policy on toll roads over the previous half century -- what worked, what did not, and what options made sense for the 1980s and 1990s.

- Dr. Mudge also directed a series of studies on the financing of infrastructure by state and local governments through the private bond markets. All modes of transportation were included, emphasizing the integration of public and private sources of funds. In addition to research studies, Dr. Mudge has served as a financial advisor to investment groups (confidential clients) seeking to develop water supply facilities, highways, and airports that would be part private, part public.

- Dr. Mudge's work for FHWA also includes the development of a revenue forecasting system. This study required evaluating FHWA's current model, proposing a new system of equations, and fitting the new equations. All revenue sources were considered, including forecasts for underlying economic data such as VMT, miles per gallon, and the allocation of revenue across more than 30 vehicle types. Results were used to help develop new legislation, to evaluate program structure, and for detailed planning.

- Dr. Mudge co-authored a handbook on the use of public-private partnerships in financing public programs. This book of case studies (published by the National League of Cities as *Financing Infrastructure*) focuses on where these new techniques work best and on what technical (data bases, for example) and political forces are needed to implement these new methods. The book is now in its third printing. Building on the issues addressed in the handbook, Dr. Mudge helped lead training sessions on innovative financing techniques for local public works projects (for the National League of Cities).

Economics

- Dr. Mudge directed a benefit-cost analysis of highway investments, for the Federal Highway Administration (FHWA), quantifying the benefits and costs of highway investments to determine the net marginal social return.

- Dr. Mudge was part of the Apogee team that analyzed the internal and external costs of transportation, including a review of transportation cost literature, development of an analytic framework for measuring costs, two case studies of metropolitan areas, and an analysis of the policy implications of these costs.

- For the next two years, Dr. Mudge will play an integral role in Apogee's project to manage, coordinate, and provide technical support to a federal inter-agency effort examining planned federal infrastructure investments, their relationship to productivity, and the U.S. standard of living. He has also directed studies for FHWA and AASHTO that developed case studies demonstrating the links between transportation infrastructure and economic productivity.

- Dr. Mudge directed a comprehensive critical review for FHWA of the existing literature on transportation and economic development, including recommendations on which techniques are most appropriate for specific types of problems. For the Transportation Systems Center and FHWA, he developed technical approaches to measure long-term economic interaction between public works, economic development, and other social goals. Previously, he prepared a White Paper for FHWA analyzing the effect on the demand for transportation services resulting from the nation's change from an industrial base to a service economy, including suggestions for future research. He also directed original research on the firm-level productivity gains of a wide range of transportation improvements. This work identified the process(es) by which productivity gains occur at the plant level (for FHWA and AASHTO).

- Dr. Mudge helped direct a series of more than forty policy and economic studies for the National Council on Public Works Improvement. This work was directly incorporated into the Council's report to the President and the Congress, *Fragile Foundations*. The project included development of a general framework to assess the performance of public works in the United States and to evaluate alternative means to finance and manage public works in the future, as well as the development of a data base and analytical system to measure the overall performance and cost-effectiveness of public works.

Communications and Outreach

- In addition to having written numerous publications, Dr. Mudge has spoken on numerous occasions before local, state, and national organizations including the White House Conference on Global Climate Change, Airport Operators Council International, American Association of State Highway and Transportation Officials, Transportation Research Board, National Association of Counties, and National League of Cities.

- He is a member of several technical committees sponsored by the National Academy of Sciences: Taxation, Financing and Pricing; Aviation Economics; and Truck Size and Weights. He was past Chair of the Subcommittee on Non-Traditional Financing Techniques.

- Dr. Mudge has made more than two dozen testimonies before Congressional committees, including the House Committee on Public Works and the Senate Committee on Environment and Public Works.

- He has also organized several national and regional seminars and workshops, most targeted to local government officials or researchers.

EMPLOYMENT HISTORY

Apogee Research, Bethesda, MD, President (1986-Present).

Congressional Budget Office, Chief of the Public Investment Unit (1975-1986).

New York City-Rand Institute, Program Leader for Economic Development Studies (1972-1975).

Wharton School, University of Pennsylvania, Research Associate (1970-1972).

PUBLICATIONS

"Cost and Effectiveness of Transportation Control Measures: Review and Analysis of the Literature," prepared for the National Association of Regional Councils (April 1993).

"Research Agenda on the Economic Value of Urban Public Transportation," with Arlee Reno, prepared for the Transportation Research Board (May 1991).

"The Economics of Selected Toll Road Projects," Apogee Research, for the Japanese Toll Road Co. (April 1991).

The New Highway Revenue Forecasting Model, Apogee Research and R.D. Mingo, for the Federal Highway Administration (April 1991).

Case Studies of the Link Between Transportation and Economic Productivity, Apogee Research, for the Federal Highway Administration (January 1991).

Transportation: Key to a Better Future, The Relationship of Transportation Investments to Economic Growth, Apogee Research, for the American Association of Highway and Transportation Officials (December 1990).

Using Market Research to Improve Management of Transportation Systems, Apogee Research, for National Cooperative Highway Research Program 20-24 (1) (August 1990).

Enhancing U.S. Competitiveness Through Highway Investment: A Strategy for Economic Growth, with Dr. David Aschauer, for the American Road Builders Association (June 1990).

"Freight Transportation and Economic Development: A Research Agenda," Apogee Research for National Cooperative Highway Research Program (2-17 (2)) (April 1990).

Market Research on Highway Finance Options in Minnesota, Apogee Research, for the Minnesota Department of Transportation (February 1990).

"A Strategic Plan for the Nation's Airport System," Apogee Research, for the Federal Aviation Administration (January 1990).

"Research Program Design for Chief Administrative Officers," Apogee Research with John Clements, for National Cooperative Highway Research Program 20-24 (August 1989).

"A Multi-Year Management, Financial, and Administrative Research Program for the Chief Administrative Officers of State DOTs," Apogee Research, prepared for the National Cooperative Highway Research Program (October 1988).

Financing Infrastructure: Tools for the Future, with Kenneth Rubin and Roger Feldman, published by Executive Enterprises (1988).

Financing Infrastructure: What Works at the Local Level, with Susan Jakubiak, Apogee Research, published by the National League of Cities (December 1987).

Consolidated Performance Report for the Nation's Public Works, Apogee Research, prepared for the National Council on Public Works Improvement (August 1987).

Airports and Airways, Apogee Research, prepared for National Council on Public Works Improvement (May 1987).

"The National Economic Importance of No Highway Funding," Apogee Research, prepared for The Road Information Program (January 1987).

"Urban Infrastructure: Problems and Solutions," with Kenneth Rubin, in Urban Change and Poverty, published by the National Academy of Sciences (January 1988).

The Uses and Misuses of Infrastructure Needs and Inventories, Apogee Research, prepared for the National Council on Public Works Improvement (October 1986).

Infrastructure Issues, Problems and General Solutions, Apogee Research, prepared for the National Council on Public Works Improvement (October 1986).

Financing U.S. Toll Roads in the 1980s, Congressional Budget Office (December 1985).

The Federal Budget for Public Works Infrastructure, Congressional Budget Office (July 1985).

Paul Nissenbaum

TITLE	Manager
EDUCATION	M.P.P., concentration in Urban and Regional Economic Development and Planning, Harvard University, 1991. B.A., graduated with *High Honors* in Soviet Studies, Wesleyan University, 1985.

Mr. Nissenbaum specializes in transportation and environmental economics, finance, and policy. His project experience covers all levels of government and the private sector, with a focus on urban transportation and air quality problems. He has conducted extensive analysis of the Intermodal Surface Transportation Efficiency Act (ISTEA) and the Clean Air Act Amendments of 1990 (CAAA), including examination of the planning, institutional, and financial implications of these acts.

Economic Analysis

- Conducted benefit-cost analysis of highway investments, for the Federal Highway Administration (FHWA), quantifying the benefits and costs of highway investments to determine the net marginal social return.

- Analyzed the internal and external costs of transportation. Managed the project, including a review of transportation cost literature, development of an analytic framework for measuring costs, two case studies of metropolitan areas, and an analysis of the policy implications of these costs.

- Analyzed the effectiveness of transportation control measures (TCMs)—in terms of both emissions reductions and cost effectiveness—including a review of existing literature and a quantification of TCM effectiveness.

- Conducted a cost-benefit analysis of TCMs. Managed the project and helped quantify the emissions benefits (as well as other key external benefits of TCMs) and the cost-effectiveness of the TCMs in order to assist several state air quality agencies in determining which TCMs (if any) to include in their State Implementation Plans (SIPs).

- Analyzed the implications of the Clean Air Act Amendments of 1990 (CAAA) for state DOT officials. Provided information and analysis to state DOTs and other transportation officials on the CAAA and transportation, including conformity, metropolitan planning, TCMs, federal sanctions, SIPs, and interest group positions.

Financial and Policy Analysis

- Developing CMAQ funding guide, an information document for state, local, and private officials interested in innovative uses of CMAQ funds, including an analysis of 12 exemplary uses of CMAQ funds.

- Developed a guide for state DOTs on ISTEA financing options. Analyzed the financial opportunities created by ISTEA and prepared a user-friendly guide for state and local agencies to assist them in using ISTEA to increase their transportation funding options.

- Developed an application for a federal Congestion Pricing Pilot Program for two metropolitan regions, including an analysis of current congestion conditions and the identification of appropriate pricing strategies for dealing with those conditions.

- Analyzed the key provisions of ISTEA and developed an action plan for Amtrak to become involved in the ISTEA planning and decision-making process.

- Conducted a survey and analysis of the intelligent vehicle highway system (IVHS) market among state departments of transportation (DOTs), toll authorities, and MPOs. Collected and analyzed data including plans for IVHS, technology development, privatization, and overall project planning.

- Provided analytic and logistic support for an expert panel and conference on transportation and the environment, particularly ISTEA and the CAAA, for the Environmental Protection Agency, FHWA, and Federal Transit Administration. Managed this project, including analyzing the links between the two acts, providing briefing materials for participants in the expert panel and conference, and developing an action plan to follow up and assist MPOs, states, and transit agencies in meeting the requirements of the CAAA.

From 1986 through 1989, Mr. Nissenbaum worked for U.S. Senator John F. Kerry, in both his Washington and his Massachusetts offices. He specialized in economic policy, including transportation, business, trade, and budget issues. He developed legislative positions for the Senator's Commerce, Science and Transportation Committee work, including the Airport Improvement Program as well as highway and transit projects. In Massachusetts, Mr. Nissenbaum was Senator Kerry's point-person on economic issues, acting as his liaison to the business and transportation communities. In addition to developing policy positions on these issues, his work included speaking on behalf of the Senator, directing policy-advisory groups and coordinating field hearings. Mr. Nissenbaum also drafted Senate floor statements and articles on transportation and economic policy.

EMPLOYMENT HISTORY

Manager/Transportation Economist, Apogee Research, Inc., Bethesda, MD (1/92 - present).

Teaching Assistant for Microeconomics and Applied Microeconomics, Harvard University's John F. Kennedy School of Government, Cambridge, MA (9/90 - 5/91).

Harbor Planning and Development Intern, Boston Redevelopment Authority
Boston, MA (6/90 - 8/90).

Commerce and Small Business Liaison, U.S. Senator John F. Kerry
Boston, MA (11/87 - 9/89).

Legislative Correspondent/Research Assistant, U.S. Senator John F. Kerry
Washington, DC (3/86 - 11/87).

Richard A. Sturges
Apogee Research, Inc.
Project Manager

EDUCATION

M.P.P.M. Masters in Public and Private Management, Economic Analysis, Yale University, 1993.

B.E.S. Electrical Engineering, Johns Hopkins University, 1985.

EXPERIENCE

Mr. Sturges, a Project Manager with Apogee Research, has over five years experience in economic, financial, and management analysis of environmental policies and programs and infrastructure investments. Mr. Sturges has developed financial models and economic evaluation methodologies, and performed a variety of quantitative analyses, strategic planning studies, management reviews, and policy evaluations. Mr. Sturges has worked for a number of international and U.S. clients on economic instruments for industrial discharge, water and wastewater, hazardous and solid waste, and other environmental issues. Prior to joining Apogee, Mr. Sturges worked as an economic analyst in the Investment Development Department at the Overseas Private Investment Corporation (OPIC) in Washington, D.C. Mr. Sturges has worked in Bujumbura, Burundi for the United States Agency for International Development (USAID), the U.S. Peace Corps, and the United Nations Development Program (UNDP). His recent project work is summarized below.

- For the United States Agency for International Development (USAID) and the Government of Morocco, Mr. Sturges is developing an industrial effluent discharge fee system for two pilot cities in the Kingdom of Morocco. Mr. Sturges interviewed government and industry representatives in the Moroccan cities of Rabat and Safi, and collected data on industry economics and wastewater discharges in the chemical, food-processing, textiles, and agricultural sectors. Mr. Sturges is using the data as well as information on the environmental impacts of industrial pollution on health and natural resources to develop alternative effluent discharge fee systems for discussion and eventual implementation by the Moroccan government's newly formed sub-Ministry of the environment. The alternatives will encompass aspects of traditional "command and control" approaches to environmental protection with volume- and concentration-based permitting and fee systems.

- For EPA's Office of Enforcement, Mr. Sturges prepared an international workshop and background materials on designing, implementing, and financing programs to promote pollution prevention and pollution minimization in the mining sector. The workshop, used at the Third International Conference on International Enforcement in Oaxaca, Mexico, detailed the major environmental problems associated with open-pit and sub-surface mining and presented a series of interactive exercises for participants to design and measure the financial and other impacts on government, industry, and residents of command and control regulations, technological solutions, economic instruments, and voluntary compliance approaches.

- For the Asia Pacific Economic Cooperation (APEC) organization, Mr. Sturges is evaluating management and technological approaches to minimize environmental damage from the tourism industry in the Pacific Rim. Mr. Sturges is helping to develop a framework for assessing economic

development-ecological tradeoffs in the tourism industry and is exploring management approaches, technological alternatives, and economic instruments to minimize damage to coastlines, beaches, coral reefs, inland waterways, and other ecosystems at risk from intensive tourism. The results of the study will be presented at a symposium of APEC members next year in New Zealand.

- For the Aspen Global Forum, a consortium of U.S. and Mexican government officials, investment banks, and industry leaders, Mr. Sturges wrote an extensive study on the past and potential future investor response to the use of sub-sovereign debt on international capital markets to finance environmental infrastructure in Mexico. Mr. Sturges examined the structure (interest rates, maturities, and risk allocation mechanisms) and market response to past Mexican stand-alone project financings that accessed international debt capital, described the classes of risk inherent in these types of transactions, evaluated mechanisms for allocating these risks appropriately (including currency hedging and other derivatives, letters of credit, contingency reserves, and development bank guarantees), and assessed the critical success factors for future market acceptance of these issues. The study was used to guide discussion of Senior U.S. and Mexican representatives at the Third Aspen Global Forum in May, 1994.

- Mr. Sturges is currently working on and has completed a number of in-depth studies on water and wastewater system financing, rate setting, and privatization for the U.S. Army Corps of Engineers. Mr. Sturges developed wastewater treatment needs projections, evaluated political and economic factors, and assessed the cost-savings potential of contract operations and maintenance for an existing wastewater treatment facility. Mr. Sturges also developed a complex financial planning spreadsheet to assess the financial implications on a local government and its residents of a variety of public-private partnership scenarios for the development and operation of three wastewater treatment systems to serve rural areas. Mr. Sturges is currently developing a financial plan, user fee and impact fee schedule, and an economic impact model for privatization, renovation, and consolidation for an existing system of nine wastewater treatment plants.

- Mr. Sturges is currently working with EPA's Office of Groundwater and Drinking Water and the States of Montana and Pennsylvania on policy alternatives to assess and ensure the financial viability of drinking water systems. Mr. Sturges is analyzing existing viability assessment methodologies, including aggregate level statistical analysis of water system financial statements and individual full-cost pricing estimation models, and is assessing the impacts on water system financial viability of impending legislation. Mr. Sturges is evaluating regulatory approaches, including requirements for viability screening, performance bonding, insurance policies, and letters of credit, that will encourage private developers to design financially viable water systems and ensure their commitment to continued viable operation after new housing units are sold.

- For an industry association, Mr. Sturges organized and helped facilitate a roundtable discussion on alternative approaches to hazardous waste cleanup management. The workshop brought together senior policy experts from the public, private, and non-profit sectors to discuss alternatives to the current federally-focused Superfund management structure in the U.S. Mr. Sturges prepared background materials on Superfund and analyzed strategies to improve cleanup efficiency and reduce costs of the Superfund program. He wrote the widely circulated discussion brief: *Hazardous Waste Site Cleanup: Towards New, More Efficient Management Models*. Mr. Sturges then organized a series of regional workshops with state and local leaders to discuss their views on implementing a state-led Superfund program. Mr. Sturges collected and analyzed the policy alternatives presented

by workshop participants into a policy briefing paper: *Superfund Reform: Views from Beyond the Beltway*.

- For a private client, Mr. Sturges evaluated the economic effects of a class of solid waste disposal regulations, known as destinating flow controls, on consumers. This study analyzed the potential monopoly-producing effects of flow controls and their impact on landfill disposal costs and environmental quality. Mr. Sturges conducted in-depth interviews with municipal landfill and incinerator operators in Rhode Island, Utah, Minnesota, and North Carolina. Mr. Sturges' paper and additional background research were used in state and federal legislative debates and court cases on flow control legislation.

- At OPIC, Mr. Sturges evaluated the economic, political, and environmental effects of fifteen proposed U.S. investment projects in Eastern Europe, Latin America, and Africa that totaled $155 million. He estimated project impacts on employment and balance of payments in the U.S. and host countries. Project analysis included an examination of industry structure, pricing, and growth trends, host country regulatory environments, political stability, environmental impacts, and company financial projections. Projects included debt refinancings, privatizations, loan guarantees, and political risk insurance policies and encompassed canning operations in East Africa, food processing in the Caribbean, mining in Central Africa, and black fly eradication operations in West Africa.

- Mr. Sturges was employed as a Private Sector Analyst at USAID, where he performed the first detailed study of Burundi's business sector to provide information for a $20 million USAID private sector development program. He supervised a census of businesses in Bujumbura (population 600,000) and co-developed a 40-page demographic and financial questionnaire in French. Mr. Sturges conducted in-depth financial interviews with Burundi businessmen and government officials in French. He wrote project background memos on Burundi industry, regulatory structure, economic climate, and capital markets, analyzed survey data, and edited and produced the project report. The study provided the first assessment of the private sector's importance in the Burundi economy and included estimates of private sector contribution to GNP, exports, and taxes.

- While working for the Burundi Government Training Center (a UNDP funded project) and the U.S. Peace Corps, Mr. Sturges provided a variety of survey support, census, interview, and analysis services to USAID, FAO, UNDP, and other lenders for studies of the Burundi household economy, informal business sector, education system, and agricultural sector. Mr. Sturges also designed curricula and taught more than 20 courses on management information systems to mid- and high-level government officials.

- Prior to working in Burundi, Mr. Sturges worked as a group leader in the Customer Equipment Services Division of Eastman Kodak. He managed service engineering and customer technical support activities for a group of 25 engineers and technicians.

RENSEIGNEMENTS PERSONNELS

Naissance 1948
Langues Français, anglais

ÉTUDES ET DIPLÔMES

1980	Maîtrise en administration des affaires (M.B.A.) Marketing, gestion internationale	École des Hautes Études Commerciales, Université de Montréal, Québec, Canada
1975-77	Spécialisation en sciences économiques (B.Sc.)	Université d'Ottawa, Ontario, Canada
1975	Scolarité de maîtrise (M.A.), Développement régional	Université d'Ottawa, Ontario, Canada
1972	Baccalauréat spécialisé (B.Sp.), (géographie)	Université du Québec à Montréal, Montréal, Québec, Canada
1969	Diplôme d'études collégiales (D.E.C.)	Collège Bois-de-Boulogne, Montréal, Québec, Canada

CARRIÈRE EN BREF

1986 à ce jour — **STRATEM INC.**, Consultants stratégies, études économiques et marketing, Président et Directeur de projets en études de faisabilité, marketing et planification stratégique, Montréal, Québec, Canada

1980 - 1986 — **LAVALIN - Econosult Inc.**, Montréal, Québec, Canada

1985 - 1986 — Vice-président - Directeur des divisions d'études économiques et de gestion

Responsable de l'administration, de la direction de projets d'études en économie et en gestion regroupant 35 professionnels. Responsable de la négociation de contrats et du marketing. Préparation et supervision des budgets de la direction dans le domaine des études économiques et de gestion.

1984 — Directeur - Division formation et études organisationnelles

Directeur d'une équipe de personnes spécialisées dans le domaine de la formation et des études organisationnelles, responsable de l'administration, de la planification et de la coordination des projets se rattachant à ce secteur ainsi que de l'élaboration des offres de

services. Liaisons suivies avec les différentes agences gouvernementales et institutions financières (ACDI et Banque mondiale).

1982-84 Directeur de projet - division études de gestion

1980-82 Consultant en études économiques et de gestion, Montréal, Québec, Canada

1979-80 **École des Hautes Études Commerciales**, Service du marketing, Université de Montréal, Québec, Canada,

1975-79 **Ministère des Affaires indiennes et du Nord**, direction de la planification économique du Nord, Ottawa, Ontario, Canada.

1976-79 Analyste senior de projets de transport

1975-76 Économiste en transport

1972-75 **Université d'Ottawa**, Département de géographie et de développement régional, Ottawa, Ontario, Canada
Boursier en recherche - programme de maîtrise
Commission scolaire de Gatineau
Professeur de géographie

1972 **Agence canadienne de développement international (ACDI), Ottawa, Ontario, Canada.**
Adjoint au directeur administratif, section des Antilles (emploi d'été)

1971 **Societa des Plasmon S.P.A.** (Heinz-Italia), Milan, Italie
Stagiaire AIESEC (Association internationale des étudiants en sciences économiques et commerciales, emploi d'été)

1970 **Automobile Association**, Londres, Angleterre
Stagiaire AIESEC (Association internationale des étudiants en sciences économiques et commerciales) Section comptabilité (empoi d'été)

EXPÉRIENCES PROFESSIONNELLES INTERNATIONALES

- Étude de viabilité pour la mise en place d'un partenariat entre Halong Fiscom au Vietnam et une entreprise de transformation de crevettes du Nouveau-Brunswick.

- Coordonnateur d'une étude d'avant-projet architectural et de transport ainsi que du montage financier pour la construction d'une gare ferroviaire à Libreville, Gabon pour l'Office des Chemins de fer Transgabonais (OCTRA), Libreville, Gabon.

- Directeur d'une étude sur le calcul du prix de revient du transport du manganèse via le Gabon et via le Congo. Détermination d'une tarification ferroviaire pour le transport du manganèse par le Transgabonais. Projet réalisé pour l'Office des Chemins de fer Transgabonais (OCTRA), Libreville, Gabon.

- Étude de plan marketing de cinq (5) entreprises vietnamiennes à Hanoi dans la fabrication de meuble, l'import export, pisciculture, fabrication de vêtements et fabrication de textiles.

- Coordonnateur d'une mission d'évaluation visant la mise sur pied d'un partenariat entre des entreprises canadiennes et des entreprises vietnamiennes.

- Coordonnateur d'une mission France-Canada de création de partenariat entre des entreprises françaises et canadiennes et de transferts de technologie possibles. Mandat réalisé pour le Ministère de l'industrie des sciences et de la technologie avec la collaboration de l'Ambassade du Canada en France.

- Direction d'une étude d'approvisionnement reliée à l'implantation d'une usine de fabrication de panneaux particules pour une entreprise espagnole et la Corporation de développement économique de la région de Mégantic.

- Co-direction, avec Samson Bélair et le Groupe Conseil SM, d'une étude de faisabilité pour un projet pilote d'incubateurs d'entreprises de type PME à Douala au Cameroun, pour l'Agence Canadienne de Développement International, Hull, Québec.

- Responsable d'une mission d'évaluation en vue d'un programme de privatisation d'usines de pâtes et papiers et de scieries pour le State Planning Organization, Ankara, Turquie.

- Administrateur d'une étude d'implantation de systèmes budgétaires et de rationalisation des dépenses pour l'Office de Météorologie du Niger sous la direction du Club de Sahel de l'OCDE, en sous-contrat avec le Harvard International Development Institute, Cambridge, Massachusetts, É.-U.

- Responsable des négociations et directeur d'un projet de formation d'entretien mécanique pour les ateliers centraux de la Compagnie des Phosphates de Gafsa en Tunisie, projet financé par la Banque mondiale.

- Participation à titre d'administrateur au projet de formation de spécialistes du meuble dans le cadre du projet Sena Meubles, Medellin, Colombie, projet financé par l'Agence canadienne de développement international.

- Directeur d'un projet de formation et de gestion du ministère des Travaux publics du Togo. Projet financé par la Banque mondiale.

- Directeur d'une étude sur la formation des prix des matériaux de construction au Cameroun et en Côte d'Ivoire. Élaboration de recommandations en matière de distribution commerciale et de réglementation sur le contrôle des prix des matériaux de construction. Projet réalisé pour le gouvernement du Cameroun, Yaoundé, Cameroun dans le cadre du 5ième plan du Cameroun.

- Analyse de rentabilité financière et étude de flux monétaires prévisionnels pour un organisme de gestion d'un marché public à Port-au-Prince, Haïti, pour le compte de Daniel Arbour et Associés, Lavalin dans le cadre d'un projet financé par la Banque mondiale.

- Mise sur pied du cadre organisationnel et opérationnel pour une société autonome de gestion des marchés à Port-au-Prince, Haïti, pour le compte de Daniel Arbour et Associés, dans le cadre d'un projet financé par la Banque mondiale.

- Participation à l'élaboration de projets de développement dans plusieurs pays des Antilles (Ste-Lucie, Antigua, Barbade, Trinidad Tobago, St. Kitts-Nevis).

- Participation à la planification budgétaire de la division de la planification de projets de développement aux Antilles.

- Analyse de marché pour l'exportation de produits alimentaires dans les pays de la Communauté économique européenne.

- Participation à une étude de localisation d'une usine agro-alimentaire en Italie méridionale.

- Direction d'une étude de faisabilité pour l'extension d'une installation d'équipements de transformation en République Dominicaine dans le cadre d'un financement par la Société d'Expansion des Exportations.

- Participant et conseiller avec le groupe Conseil SM à une étude de pré-faisabilité sur les produits dérivés de la canne à sucre en Haïti pour l'Agence canadienne de développement international.

- Responsable d'une étude de faisabilité économique, financière et institutionnelle portant sur un projet d'aménagement d'un marché d'alimentation de gros et de détail à Port-au-Prince, Haïti; projet financé par la Banque mondiale.

- Direction d'une étude de pré-faisabilité pour la transformation des résidus de crabe en chitine/chitosan en vue d'échanges technologiques avec des entreprises japonaises.

EXPÉRIENCES PROFESSIONNELLES AU CANADA

Transport

- Directeur d'une étude d'évaluation des divers systèmes de gestion des stationnements pour la Ville de Montréal.
- Directeur d'une étude des avantages comparatifs des aéroports de Sept-Iles et de Val d'Or comme points d'escale technique pour Transports Canada.
- Directeur de projet dans l'étude de faisabilité pour l'implantation d'un héliport public à Montréal. Étude réalisée pour le Conseil des Aéroports de Montréal.
- Coordination relative à l'évaluation des impacts économiques d'un train à haute vitesse dans le corridor Québec-Montréal-Ottawa-Toronto.
- Conseiller principal dans l'étude de rationalisation et de redressement de la compagnie aérienne Intair. Étude réalisée pour le ministère des Transports du Québec.
- Direction d'une étude de faisabilité pour l'allongement de la piste à l'aéroport d'Alma pour Transports Canada.
- Direction d'une étude de marché relative aux activités de transport aérien pour le développement de la zone aéroportuaire de St-Hubert pour les villes de Longueuil, Boucherville, St Hubert, St-Bruno et le ministère des Affaires municipales, en sous-traitance de Pluram.
- Direction d'une étude de marketing et de stratégie de développement pour l'aérogare de Québec pour Transports Canada.
- Direction de l'étude de faisabilité concernant l'allongement de la piste de Blanc-Sablon, Côte-Nord. Étude pour Transports Canada.
- Direction d'une étude sur le calcul du prix de revient et la tarification de location d'espaces pour l'aéroport de Dorval, Transports Canada.
- Étude de marketing pour le développement commercial de Transports Canada à l'aéroport de Dorval.
- Étude de planification stratégique pour le développement des transports à Montréal pour le Secrétariat du Comité ministériel sur le développement économique de la région de Montréal (Rapport Picard).
- Directeur d'une étude portant sur l'élaboration d'un plan de développement des infrastructures aéroportuaires pour l'aéroport de Pabos - Chandler, Québec, Canada pour le ministère des Transports du gouvernement fédéral, Ottawa, Canada.

Transport (suite)

- Chargé d'une étude de marketing pour le développement du trafic passagers et cargo à l'aéroport de Mirabel, Montréal, Canada.
- Élaboration d'une politique d'investissement et de stratégie de marketing pour la compagnie de transport maritime, Canada Steamship Lines, Montréal, Canada.
- Rédaction d'un mémoire ministériel pour la Commission canadienne des transports sur le service de transport par eau du Grand Lac de l'Ours, Territoire du Nord-Ouest, Canada.
- Rédaction d'un mémoire sur l'impact de la construction du gazoduc sur les transports pour la Commission d'enquête Berger, Yellowknife, Territoires du Nord-Ouest, Canada.
- Analyse "coût-efficacité" de routes logistiques pour l'approvisionnement des communautés et des mines; recommandations pour rationaliser les opérations de la société de transport NTCL dans le but de réduire les subventions gouvernementales dans le grand nord canadien.

Développement économique

- Direction d'une étude de diagnostic et de stratégies de développement de l'industrie du génie-conseil au Québec pour l'Association des ingénieurs-conseils du Québec.
- Direction d'une étude de stratégie de développement pour la région du Sud-Ouest de Montréal pour le Comité de relance pour le Sud-Ouest de Montréal (CREESOM).
- Direction d'une étude de faisabilité portant sur la rationalisation du système de distribution et d'entreposage pour la SAQ.
- Participation à l'élaboration d'un plan stratégique pour le développement d'un parc de haute technologie et de télécommunications (CITEC) à Ville St-Laurent.
- Participation à une étude de positionnement-marketing et de stratégie pour sept produits de Postes Canada en collaboration avec la firme de Publicité Martin.
- Direction d'une étude économique et de positionnement sur les sociétés d'ingénierie au Québec. Étude pour l'Association des ingénieurs-conseils du Québec.
- Recherche sur l'industrie de l'électronique et des télécommunications en vue de l'élaboration d'une stratégie de positionnement de l'industrie.
- Président d'un comité ministériel du Commerce extérieur du Gouvernement du Québec pour la détermination de programmes à l'exportation pour PME.

Développement économique (suite)

- Étude de marché pour la revitalisation d'un secteur de Ville Saint-Laurent.
- Étude de financement pour l'implantation d'une usine de fabrication d'appareils médicaux au Canada.
- Administrateur et directeur d'une étude de faisabilité pour l'usine d'assemblage d'autos Hyundai au Canada et étude comparative de site au Québec et en Ontario pour la compagnie Hyundai Canada Inc.
- Administrateur d'une étude des coûts de distribution de pièces automobiles AMC-Renault au Québec et en Ontario pour le ministère de l'Industrie et du Commerce, Gouvernement du Québec.
- Administrateur d'une étude de faisabilité et de marché pour une entreprise de fabrication de freins pour la compagnie de Construction de Matériel de Friction.
- Administrateur d'un projet d'étude de planification stratégique pour un organisme du ministère des Affaires sociales du Québec.
- Responsable d'une étude de faisabilité pour l'aménagement d'un centre culturel et de centres d'information d'affaires pour une municipalité de la région de Montréal.
- Directeur d'une étude pour la présentation d'éléments traitant des conditions de travail dans le secteur de la construction au Québec en vue d'une stratégie de négociation avec les syndicats de la construction.
- Responsable d'une étude sur les maisons de commerce et étude de faisabilité pour la création d'un Trading house pour la région de Montréal, pour Lavalin Inc.
- Direction d'une étude de marché et de stratégies de marketing pour la vente de produits de laboratoires de santé pour la Société générale de financement, Montréal, Québec, Canada.
- Analyse de rentabilité financière d'une usine de traitement d'anhydride sulfurique relié aux activités de traitement du cuivre pour plusieurs options d'investissement. Projet réalisé pour les ministères de l'Environnement du Québec et du Canada.
- Élaboration d'une stratégie de développement commercial pour la revitalisation d'une artère commerciale d'une municipalité de la région de Montréal, en association avec Daniel Arbour et Associés.
- Direction et consultant d'une entreprise de distribution de produits destinés au marché canadien et à l'exportation pour l'organisation et l'élaboration de stratégies d'entreprises, stratégies de mise en marché et de distribution, gestion du personnel de vente et contrôle budgétaire.

Développement économique (suite)

- Révision de politiques de développement et formulation des objectifs de développement pour un ministère fédéral, Ottawa, Canada, pour le compte d'Econosult inc., division de Lavalin.
- Analyse du réseau de transport aérien et de l'accessibilité des communautés du Nouveau-Québec, Québec, Canada.
- Élaboration de modèles de prévision de demande pour le transport aérien, appliqués au réseau de transport du Nouveau-Québec, Québec, Canada.

Énergie - Efficacité énergétique

- Direction de l'étude intitulée "Evaluation of Financial Incentives Options for the Implementation of an Energy Efficient Mortgage Program". Étude pour l'Association Canadienne des Industries Solaires.
- Direction d'une étude relative à un plan d'entreprise pour l'implantation d'une usine pour la production de chauffe-eau bi-énergiques destinés au marché canadien et américain pour une entreprise de produits de chauffage et d'énergie solaire.
- Réalisation d'une stratégie d'établissement d'un programme d'information et de formation pour la maîtrise d'énergie pour un réseau d'énergie mondial d'énergie des pays francophones.
- Responsable de l'élaboration d'une structure corporative pour la création d'une société para-gouvernementale orientée sur le développement des ressources énergétiques, Nouvelle-Écosse, Canada.

Environnement

- Directeur de projet pour une étude sur le rechapage de pneus pour Recyc-Québec.
- Validation des orientations de gestion intégrée des déchets dans le cadre de l'opération Défi Déchets pour la Ville de Montréal.
- Direction d'une étude de pré-faisabilité pour un centre de transbordement de déchets domestiques.
- Conseiller dans une étude exploratoire du projet d'un centre de tri à Cowansville.
- Directeur du projet d'évaluation de la nature environnementale des emballages d'un important fabricant de biscuits.
- Directeur de projet pour l'élaboration d'un plan de gestion intégrée des déchets de la Ville de Montréal à partir de 19 tables rondes sur tous les éléments affectant la gestion des déchets soit le recyclage, le tri, les marchés et les méthodes de traitement.

Environnement (suite)

- Direction d'une étude de marché et de positionnement pour une entreprise de traitement de déchets domestiques dans le cadre du projet de déchets de la Régie intermunicipale des déchets de l'île de Montréal.

- Direction d'une étude de localisation entre Montréal et Toronto pour une entreprise de recyclage de déchets liquides industriels.

- Conseiller relativement à la méthodologie et les études de marché dans le cadre d'une étude de faisabilité sur la gestion des déchets sur l'île de Montréal auprès de la firme Lavalin pour la Régie intermunicipale de la gestion des déchets sur l'île de Montréal.

- Étude de planification stratégique pour une entreprise spécialisée dans la fabrication de produits métalliques des technologies de l'environnement et de traitement de déchets.

- Administrateur d'un projet d'étude sur la gestion des déchets pour 19 municipalités de l'île de Montréal pour la Régie intermunicipale des déchets.

Agro-alimentaire

- Directeur d'études de prix de revient et de marketing de produits alimentaires français sur le marché canadien et américain.

- Directeur du projet d'expérimentation pour la mise en valeur de produits agro-alimentaires par l'exportation de produits en France.

- Direction d'une étude d'impact financier d'un changement de prix de certains produits laitiers (beurre et poudre de lait) sur les entreprises canadiennes de transformation laitière pour la Commission Canadienne du Lait, Ottawa, Ontario.

- Direction d'une étude sur l'opportunité de l'octroi du droit de Premier Receveur sur les contingents supplémentaires américains. Étude réalisée pour l'Office Canadien de Commercialisation des Poulets.

Pêcheries

- Directeur d'une étude de faisabilité pour la production de coquilles St-Jacques et de stratégie de mise en marché pour une entreprise du Nouveau-Brunswick.

- Directeur d'une étude de positionnement des produits marins au niveau du marché de détail et institutionnel au Québec et en Ontario, pour le ministère de l'Industrie, des Sciences et Technologie.

Pêcherie (suite)

- Directeur d'une étude de faisabilité sur la commercialisation de crabe pour la firme Crustacés de Gaspé.
- Directeur de l'étude portant sur les implications du marché unique de l'Europe 92 sur les produits de la pêche. Étude réalisée en co-participation avec Raymond Chabot International, pour le compte du ministère des Affaires extérieures du Canada.
- Membre du comité de sélection des offres d'achat de Madelipêche Inc. dans le cadre de la privatisation de Madelipêche, Gouvernement du Québec, Québec.
- Coordonnateur d'une étude diagnostic et d'évaluation d'options stratégiques relatives à la privatisation de Madelipêche Inc., pour le Comité conjoint du ministère des Finances et du ministère de l'Agriculture, Alimentation et Pêcheries, Gouvernement du Québec.
- Directeur d'un projet d'étude organisationnelle pour la formation d'une société de pêcheurs du Québec, ministère des Pêches et Océans Canada. Rencontre de plus de 400 intervenants de la pêche de toutes les régions du Québec et implantation de "l'Alliance des pêcheurs du Québec".
- Directeur d'une étude pour établir une stratégie de commercialisation et de distribution des produits de la pêche maritime du Québec pour Pêches et Océans Canada. Recherches concernant divers projets préliminaires de localisation d'usines et de développement de nouveaux produits de la pêche au Canada.

FORMATION ACADÉMIQUE

1978	B.A.A., économie appliquée	École des Hautes Etudes Commerciales, Université de Montréal
1979	Cours à la Maîtrise en Sciences de la gestion	École des Hautes Etudes Commerciales, Université de Montréal
1988-1992	Cours en publicité, en merchandising et en techniques de vente	

EXPERIENCE PROFESSIONNELLE

Depuis 1993 **Stratem Inc.**
Économiste senior

- Étude d'impact économique de l'implantation des compteurs d'eau dans les municipalités pour Hydro-Québec;
- Analyse coût-bénéfice de l'implantation de mesures d'économies d'énergie dans les municipalités pour Hydro-Québec;
- Étude de localisation pour une usine de pneus recyclés et analyse de transport.

1985-1993 **Analyste senior en études économiques et marketing**

Réalisation d'études de marché, d'études de faisabilité, d'études économiques, pour différentes firmes de consultation telles que Lavalin, Raymond Chabot Martin Paré, Stratem, etc.

- Étude de flux d'achats de marchandises;
- Étude de marché sur l'offre et la demande des marchés primaire et secondaire relié au commerce de détail;
- Plans d'affaires;
- Étude de localisation d'entreprises;
- Projet d'analyse de l'industrie de gestion du transport maritime;

- Étude de faisabilité d'un centre civique à Campbellton, Nouveau-Brunswick. Évaluation du marché potentiel. Détermination des coûts et des revenus pour l'analyse financière. Calcul de l'impact économique aux niveaux provincial et régional;
- Étude des politiques tarifaires applicables à un service de navette;
- Étude de marché et d'impact socio économique d'un train touristique Hull-Wakefield;
- Étude sommaire sur la géomatique. Évaluation du marché mondial des applications de la géomatique par une approche de scénarios;
- Étude des possibilités d'échanges entre le Québec et la Wallonie (Belgique) dans le secteur agro-alimentaire et dans le domaine des biotechnologies;
- Étude de développement du secteur route C/petit golf à l'aéroport de Dorval pour Transports Canada;
- Étude de stratégies de développement des transports pour la région de Montréal;
- Étude de marché sur la silice dans l'est du Canada pour le Ministère de l'Energie et des Ressources du Québec;
- Étude d'opportunité et d'impact socio-économique d'un lien maritime inter-rives reliant l'île d'Anticosti, pour divers ministères du gouvernement du Québec.

1983-1985 **Société du Port de Montréal**
Analyste à la Direction de la planification

- Chargée de nombreuses études de marché (flux de transport, intermodalité, coûts bout en bout, relevé statistiques);
- Chargée de l'analyse des rapports mensuels de statistiques et des prévisions de trafic pour les différentes catégories de produits au Port;
- Chargée de l'élaboration de l'annuaire des services maritimes du port;
- Participation à une étude de coûts de transport (coûts terrestres, coûts maritimes, coûts portuaires) sur la route de l'Atlantique-Nord;
- Élaboration des stratégies de marketing suivant l'évolution des différents marchés;
- Rédaction d'articles pour le Bulletin du port.

1979-1983 **Économiste**
LAVALIN - Econosult Inc.

Réalisation d'études économiques et de marché pour divers intervenants: gouvernements, industries privées, sociétés para-gouvernementales, filiales internes.

- Études de marché;
- Études sur les facteurs de localisation des certaines industries;
- Études de pré faisabilité;
- Élaboration de plans directeurs;
- Études de faisabilité;
- Étude de structure de demande d'énergie;
- Études d'évaluation socio-économiques;
- Calculs économiques;
- Étude coûts-bénéfices pour la localisation de bureaux;
- Analyse de la situation de l'industrie nucléaire;
- Recherche et élaboration de dossiers socio-économiques.

1978-1979 **Stagiaire en économie**
École des Hautes Études Commerciales, Montréal