

Clean Air Research Fund

Status Report - 2003

Clean Air Research Fund Steering Committee

April 2004

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1. Introduction

Since the inception of the BC Clean Air Research (CAR) Fund at the end of 1995, the fund has been utilized for two programs, BC Scrap-It and Clean Air Research. From the outset half of the fund has been used to start the BC Scrap-It pilot program for retirement of old high-polluting motor vehicles. Since 1997 contributions have been made from the fund to a number of research projects on air quality in the Lower Fraser Valley and other areas of the province. The “*Clean Air Research Fund Status Report - 1997-1999*”, July 2000, and subsequent annual reports provided summaries of the activities supported by the fund from the beginning to the end of the year 2002. This report summarizes the projects funded from the CAR Fund in the year 2003. It provides brief descriptions and the status of the BC Scrap-It program and various research proposals considered for funding during this period.

All Clean Air Research Fund Status Reports are currently being made available at the following web site of the B. C. Ministry of Water, Land and Air Protection:

<http://wlapwww.gov.bc.ca/air/airquality/carf/index.html>

2. Clean Air Research Fund History

In December 1995, the Canadian Petroleum Products Institute (CPPI) and BC Ministry of Water, Lands and Air protection (WLAP, formerly Ministry of Environment, Lands and Parks), signed an agreement on CPPI funding for two specific programs. While the BC Scrap-It Program is an old, high-polluting motor vehicle scrapping program, the Clean Air Research Program is for research projects on air quality issues in the Province with a particular focus on transportation and fuels. Under the agreement, CPPI is committed to contribute up to a maximum of \$500,000 per year for a total of \$2.5 million over the 5-year period (1996-2001), and the total annual amount is to be split between the two programs. The agreement was amended in December 1997 to include the Greater Vancouver Regional District (GVRD) as another party to the agreement. The CPPI funding members are Chevron Canada, Husky Oil, Imperial Oil, Petro-Canada and Shell Canada. Unless otherwise agreed by the Parties, \$250,000 per year will be dedicated to support clean air research on air quality issues during the 1997-2001 period. The Clean Air Research Fund (CARF) is being managed by a Steering Committee consisting of one representative from each of CPPI, WLAP and GVRD.

As the original CARF was due to expire at the end of 2001, the Parties agreed in March 2001, to continue the Agreement until “... *the full commitment of \$2.5 million has been expended or committed.*” Hence the Fund is still used for air quality research projects and the BC Scrap-It Program beyond the year 2001.

3. Clean Air Research Fund Program Achievements in 2003

As in previous years, the CAR Fund was used to support both the BC Scrap-It Program and a number of research projects in 2003. The achievements of these financial contributions are described in the following sections.

3.1 BC Scrap-It Program

The BC Scrap-It Program was launched as a pilot project for retirement of old high-emitting vehicles in 1996 by WLAP in the Lower Mainland and Victoria. The program partners included the CPPI, BC Hydro, Vancouver and Victoria Regional Transit Commissions and BC Automotive Dealers Association (BCADA). WLAP, GVRD, and AirCare provided additional in-kind support to the program. The pilot program was operated from April 1996 to November 1998, and 955 vehicles of 1983 or older high-polluting vehicles were scrapped.

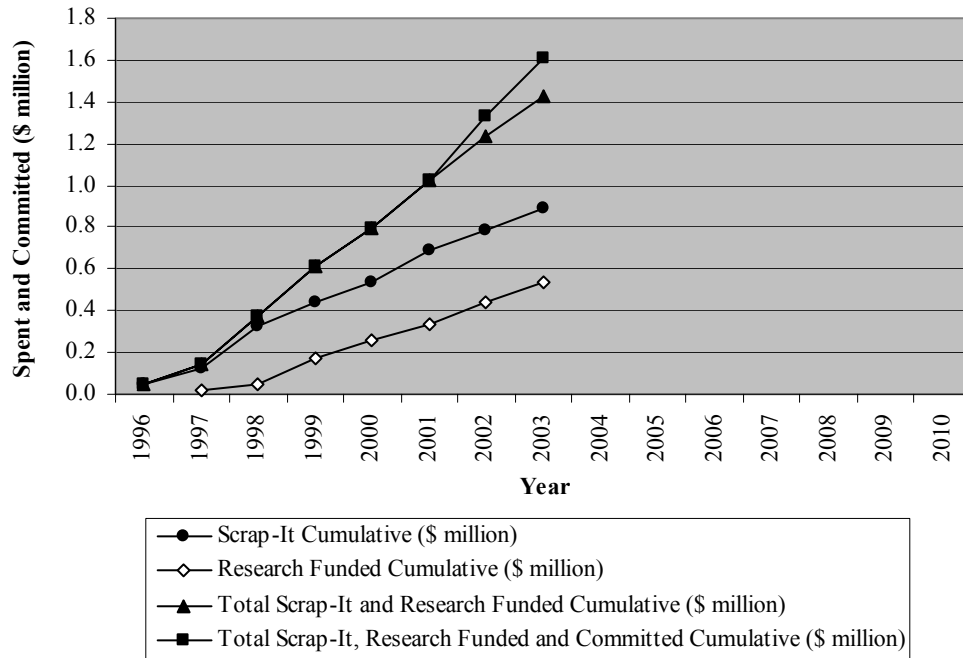
Based on the experience of the pilot program, in November 1998 the Scrap-It program was expanded to the owners of 1987 or older vehicles. Since 1999 the program has been funded by the CPPI, Translink, Insurance Corporation of B. C. and the BCADA. WLAP, GVRD, and AirCare (now Pacific Vehicle Testing Technologies) have continued their support for the program. Environment Canada supported the program with an annual contribution of \$60,000 in fiscal years 2001-2002 and 2002-2003. Presently, the Scrap-It Program Steering Committee looking into the creation of a charitable society to manage the program.

The choice of incentives for the vehicle owners participating in the program has also been widened in subsequent years. The incentives presently offered to vehicle owners include: (i) varying amounts of cash toward the purchase of a new natural gas vehicle, a new vehicle, used 1994 or later model year vehicle, (ii) bicycle, (iii) money towards vanpooling or carpooling, and (iv) a choice of transit or West Coast Express pass.

Nearly 1,600 vehicles were scrapped between November 26, 1998 and December 31, 2002. In the year 2003 a total of 540 vehicles were approved for scrapping and 409 vehicles were scrapped. The vehicle owners opted for a total of 356 incentives: 180 transit passes, 2 West Coast Express passes, cash for 144 new and used less-polluting vehicles, and 30 bicycles.

The CPPI contributions to the Scrap-It program are illustrated in Figure 1. A total of \$100,000 was paid towards the program in the year 2003, which brought the total CPPI contributions to the Scrap-It since 1996 to \$888,550.

Figure 1. Clean Air Research Fund Status



The major benefits accrued from the Scrap-It program have been a cost-effective reduction in vehicular emissions and an increased public awareness about alternatives to the use of old high-polluting vehicles. The estimated reductions in emissions of hydrocarbons (HC), nitrogen oxides (NO_x), carbon monoxide (CO) and carbon dioxide (CO₂) from recycling of vehicles for which incentives were granted during the pilot and expanded phases of the program are provided below. These estimates are based on the methodology developed in the August 1997 study, “*Evaluation of the Scrap-It Pilot Program*”, one of the projects funded from CAR Fund.

Estimated Emission Reduction Benefits of the Scrap-It Program

Program Phase	Reduction in Contaminant and Greenhouse Gas Emission, tonnes			
	HC	NO _x	CO	CO ₂
Pilot	164	43	1,173	7,691
November '96 - December '02	276	75	2,231	14,418
January '02 – December '02	53	14	393	3,077

Note: Assuming 13,010 km/yr distance driven for 3 years, the remaining life of the scrapped vehicle.

Source: *CAR Fund Status Report – Year 2001, March 2002 and Scrap-It Program Administration Office, January 15, 2003.*

On the basis of the pilot program evaluation, the Scrap-It program has been found to be cost-effective, about \$2, 177 per tonne of ‘emission’ reduced. The ‘emission’ in this context

refers to the contaminants with smog-forming potential, and calculated as $(\text{HC} + \text{NO}_x + \text{CO}/7)$. The cost-effectiveness of greenhouse gas reduction was estimated to be \$130/t of CO_2 , indicating that the program is not currently cost-effective when considered only in terms of these gases.

3.2 Clean Air Research Fund Contributions

In the year 2003, about \$83,500 was paid from the CAR Fund towards the completed and on-going projects. This amounted to nearly \$540,000 contributions from the CAR Fund to various projects and the fees paid to the CAR Fund coordinator during 1997-2003. The funding committed towards remaining on-going projects and proposals approved-in-principle by the end of 2003 amounts to about \$182,300. The estimated total value of all projects co-funded from the CAR Fund is approximately \$11.5 million, which includes the budgets for three major projects namely Ethanol BC (\$7.4 million), Pacific 2001 (\$1.4 million) and Canadian Synthetic Diesel Fuel Testing (\$1.6 million including about \$0.5 million for the latest phase of the study started in December 2003). The total value of all other projects is estimated to be about \$1.5 million. The history of the CAR Fund contributions made and committed to date towards all research projects which are complete and in-progress till the end of 2003 is shown graphically in Figure 1.

3.3 Clean Air Research Program Achievement

Proposals submitted to the Steering Committee for CAR funding are required to meet the following eligibility criteria:

- (1) research projects should be on air quality issues relevant in B. C. and in particular on issues related to transportation and fuels;
- (2) in general, funds will not be available solely for capital equipment purchases, on-going programs or staff salaries and benefits;
- (3) generally the funding will be limited to a maximum of one-third of the total project cost, with an annual maximum of \$50,000 or 20% of the fund for any single project;
- (4) payments will be made either in installments according to approved project deliverables or in full upon project completion and acceptance of the final report.

Typically no projects will be funded in advance, and all three Steering Committee members must approve a project. Preference will be given to projects of immediate priority and to those co-funded by other partners.

Thirteen new proposals for financial support from the CAR Fund were received in 2003, bringing the total proposals received since 1997 to 56. By the year-end, out of 13 proposals considered during the year, the funding was fully approved and approved-in-principle for 10, 1 remained under consideration and 2 were refused. Another proposal received in 2002 was also rejected and three proposals submitted in previous years were withdrawn in the year 2003. Only one project was completed in 2003. At the end of the year, 11 projects are still in-progress, and 6 proposals received in 2003 still remain as approved-in-principle.

As shown in Table 1, one applied research type project, *Canadian Synthetic Diesel Fuel Testing Project – Phase 2*, was completed in 2003.

Table 1: Projects Completed in 2003
(Completed projects during 1997-2002 in parenthesis)

Project Proponent	Project Type				
	Basic Research	Applied Research (Study & Assessment)	Planning	Pilot Demonstration Program	Other
University - Academic - Student	(4)	(1)	(3)		
Business and Industry		1 (3)			
Government agencies		(9)	(2)		(1*)
Non-governmental Organizations					

* Training session on a new model (MOBILE 6) for estimation of on-road motor vehicle emission factors.

The completed project along with their key findings is described in Section 3.4. The projects in-progress, projects approved-in-principle and new proposals under consideration, and proposals withdrawn and those refused for funding are summarized in Tables 2, 3 and 4 respectively, and described briefly in Section 4.

**TABLE 2: Clean Air Research Fund
Research Projects - In-Progress at the end of 2003**

Project/Proposal Title	Project Proponent/ Sponsor	CARF Steering Committee Contact	Project Application Date and Schedule			Total Proposed	Project Funding (\$)			Other Partner Funding	Project Progress Status		Comments	
			Application Date	Project Start Date	Project Completion Date		CAR Funding Requested, Approved and Paid				Partner Fund (\$)	Interim Report		Final Report
							Requested	Approved	Paid					
Projects Approved and In-progress at the end of 2003														
1 Ethanol BC - Process Development Program	The University of B. C.	BC WLAP	March 1999	March 2000	March 2005	\$7.4 million over 5 yrs.	\$100,000 at \$20,000/year for 5 years.	\$20,000/yr for 5 yrs.	\$20,000 in May '00, April '01, May '02 and July '03.	Various amounts from federal and provincial governments and several private sectors.	Quarterly progress reports.		Capital cost is \$2.5 million, and operating cost is \$4.9 million. The project Steering Committee has to date approved about \$165,000 for 3 projects.	
2 Ambient and Personal Exposure Levels of Fine Particulate Matter (PM _{2.5}) Throughout the Prince George Airshed	The University of Northern B. C.	BC WLAP	October 2000	September - October 2000	Summer 2002. See comments.	\$55,000	\$10,000	\$10,000	\$10,000 in April '01	Various amounts from federal and provincial governments and several universities in cash and in-kind.	April '01, September '01, February '02, June '02.		CAR funding was approved in December 2000. Field and laboratory work is complete, and the final thesis is being written now after some delays. It is anticipated to be complete by April 2004.	
3 Tunnel Study Pacific 2001 - Effects of Fuel and Lubricant Quality on Vehicle Emissions. Fuel Analysis.	Env. Can. (undertaken by Lisa Graham)	CPPI	January 2001	August 2001	Summer 2002. See comments	(Total budget for Pacific 2001 research projects is \$1.4 million)	Approx. \$12,000 (for this proposal only)	\$12,534	\$12,574 in February '02.	None for this particular project; but a number of partners are contributing towards the total cost of Pacific 2001.	Quarterly progress reports.		A joint project of CPPI and Env. Can. as a part of Pacific 2001 intensive air quality monitoring program in the LFV in August-September 2001. Fuel analysis part of the project was completed in November 2001. The project is delayed as additional analysis of samples and vehicle fleet data is being done.	
4 Marine Vessels Air Emissions in the Georgia Coast Cascade Air Basin and Coastal Areas for the Year 2000	Environment Canada, GVRD	GVRD	June 2002	October 2001	March 2003. See comments.	\$30,000.00	\$9,000.00	\$9,000.00	\$8,411.21 in July '03	Env. Can. - \$22,000 and GVRD - \$9,000 (in-kind)	March 2003 (Preliminary Draft)		The project title has been revised since the 4th Quarter 2002 Report, as the project scope was amended to include a backcast and forecast of marine vessel emissions within the expanded area. The final report is expected by the end of 2003.	
5 FIXIT Program Pilot Project	AirCare	CPPI	October 2002	December 2002	April/May 2003. See comments.	\$76,000.00	\$16,000.00	\$16,000.00		AirCare will be responsible for the remainder.	December 2003 draft final report.		The proponent has been delayed. The draft final report submitted in December 2003 will be revised.	
6 Canadian Synthetic Diesel Fuel Testing Project - Phase 3	CPPI	CPPI	October 2002	October 2002	See comments.	\$490,000.00	\$15,000.00	\$15,000.00		\$475,000 in cash and in-kind from various partners.	Quarterly progress reports.		This project is a continuation of the multi-partner funded project on the testing of emissions from synthetic diesel fuel burning. Phase 1 and Phase 2 partially funded from the CARF are complete. Phase 3 was approved and started in October 2002.	
7 M. A. Turbo - Water Injection Emission Reduction System	Environment Canada	CPPI	October 2002	December 2002	February 2003	\$18,700.00	\$3,500.00	\$3,500.00		Env. Can. - \$6,500 and M. A. Turbo/Engine Ltd. - \$8,700.	Quarterly progress reports.		The project was started in December 2002. The water injection system has been designed, and engine testing is expected to start in Jan. 2004.	
8 Emissions Reduction Options Study for HDV/Fleet in the LFV	GVRD	GVRD	April 2003	June 2003	December 2003/January 2004. (see comments)	\$123,000.00	\$41,000.00	\$41,000.00		GVRD - \$32,000, Env. Can. - \$20,000, WLAP - \$15,000, each of GVTA, FVRD and Clean Energy - \$5,000.			Contract awarded to Levelton Engrg. and others on June 27, 2003. The project completion date is now scheduled for December 2003 or early January 2004 due to delay in procuring vehicle fleet data.	
9 Application of Automated Correlation-based Synoptic Map Classification for Establishing a Climatological Link with Air Quality Episodes in Prince George, British Columbia	Paul F. Willis	WLAP	January 2003	see comments.	July 2004	\$5,700 (not including tuition fees)	\$3,600	Upto a max. of \$6,000.			4th Quarter 2003 progress report.		The proposal is for doing research for a M.Sc. degree at the UNBC. The work is on-going and is expected to be completed by July 2004. A detailed proposal was submitted in July 2003 and approved for funding in August 2003. The requested amount will be confirmed.	
10 Testing of Continuous Water Injection System on one of the two Main Engines onboard the MV Queen of New Westminster	M. A. Turbo/Engine Ltd.	Env. Can.	June 2003	November 2003	March 2004	\$55,500	One-third of the total cost.	\$18,500		\$18,500 - Env. Can. and BC Ferries - \$18,500			This is the second phase of a test project completed in 2002 on an auxiliary engine on the BC Ferry <i>Queen of New Westminster</i> . All fundings were approved by the end of 2003. Testing will start soon.	
11 ISOPART Model Application to the LFV	S. Pryor, Indiana University	WLAP	February 2003	December 2003	December 2004	\$84,809	Approx. one-third of the total cost.	\$30,000		WLAP - \$15,000, Env. Can. - \$25,000, FVRD - \$10,000 and GVRD - \$5,000.			A revised proposal with a new budget was submitted in February 2003. CARF funding of one-third of the total budget was approved, the remainder is funded by WLAP, Env. Can., GVRD and FVRD. The work is due to start in December 2003.	

TABLE 3: Clean Air Research Fund
Research Projects and Proposals - Approved-in-Principle and New Proposals Under Consideration at the end of 2003

Project/Proposal Title	Project Proponent/ Sponsor	CARF Steering Committee Contact	Project Application Date and Schedule			Project Funding (\$)				Comments
			Application Date	Project Start Date	Project Completion Date	Total Proposed	CAR Funding Requested and Approved		Other Partner Funding	
							Requested	Approved	Partner Fund (\$)	
Proposals Remaining as Approved-in-Principle at the end of 2003										
1 Vehicle Emissions Inspections and Maintenance - Effects on CO ₂ Emissions and Fuel Consumption	PVTT (AirCare)	CPPI	Sept. 2003	see comments.	see comments.	\$26,300 plus in-kind. See comments.	\$6,300	\$6,300	Env. Can. - \$20,000. PVTT - In-kind.	The project funded by Env. Can. is complete. The CARF funding request for the costs of publication and presentation of the study findings has been approved-in-principle, if Env. Can. does not provide this funding.
2 Vehicle Emissions Inspections and Maintenance - Effects on CO ₂ Emissions and Fuel Consumption. Phase 2	PVTT (AirCare)	CPPI	Sept. 2003	see comments.	see comments.	see comments	see comments			The proposal has been approved-in-principle, subject to submission of a revised proposal addressing the comments provided by the Committee members, as well as the estimated budget, CAR fund requested, project schedule and deliverables.
3 FIX-IT Program - Phase 2	PVTT (AirCare)	CPPI	Dec. 2003	Upon funding approval.	6 months from start date.	\$46,000	\$16,000	\$16,000	PVTT - \$30,000 (in-kind)	The project has been approved-in-principle, subject to submission of a revised final report on the Phase 1 Pilot Project.
4 Reduction of Nonroad Diesel Emissions in the Lower Fraser Valley of BC	Genesis Engineering	GVRD	Nov. 2003	Upon funding approval.	6 months from start date.	\$18,000	\$18,000	\$6,000	GVRD - \$7,000, FVRD - \$5,000	The project has been approved-in-principle, subject to FVRD funding approval.
5 Updating the Lower Fraser Valley Source-Receptor Air Quality Model	RWDI West Inc.	WLAP	March 2003	see comments.	6 months from start date.	\$43,700 + GST	\$15,000-\$20,000	up to \$20,000	Potential partners: Env. Can., WLAP, GVRD and FVRD.	The proposal has been approved-in-principle, subject to evaluation of AQ modelling only and CPPI's input into the selection of case studies.
6 Mapping Roles and Responsibilities for Energy and Greenhouse Gas Management in Greater Vancouver	Consultants to be selected by GVRD.	GVRD	November 2003	Soon after contract award.	March 2004	\$20,000	A portion of the total cost.	up to \$6,667	GVRD - the remainder.	The proposal has been approved-in-principle, subject to addressing the concerns of the CPPI members and on the understanding that the project should be considered as an exception to the CAR funding eligibility criteria.
New Proposals Under Consideration at the end of 2003										
1 Canadian Synthetic Diesel Fuel Testing Project - Phase 4	CPPI	CPPI	December 2003	sometime in 2004.	see comments.	\$400,000-\$500,000 per fiscal year.	\$15,000.00		The remainder in cash and in-kind from various partners.	This project will be a continuation of the multi-partner funded project on the testing of emissions from synthetic diesel fuel burning. Phases 1, 2 and 3 partially funded from the CARF are complete.

**TABLE 4: Clean Air Research Fund
Research Proposals Withdrawn and Refused for Funding in 2003**

Project/Proposal Title	Project Proponent/ Sponsor	CARF Steering Committee Contact	Project Application Date and Schedule			Project Funding (\$)			Comments
			Application Date	Project Start Date	Project Completion Date	Total Proposed	CAR Funding Requested	Other Partner Funding	
Proposals Withdrawn in 2003									
1 Tailpipe Emissions of Greenhouse Gases from In-Use Gasoline, Diesel and Alternative Fuelled Vehicles	CPPI	CPPI	June 2000	see comments.	see comments.	see comments.		no information provided.	The project was withdrawn in February 2003.
2 Cost-effectiveness of Alternative Transportation Fuels	CPPI	GVRD	June 2000	see comments.	see comments.	see comments.		no information provided.	The project was withdrawn in February 2003.
3 GVRD Lawn Mower Scrappage Program.	GVRD	GVRD	June 2002	see comments.	see comments.	see comments.		no information provided.	The project was withdrawn in February 2003.
Funding Refused for Proposals in 2003									
1 Application of the CMAQ-MC2 Air Quality Model to the Lower Fraser Valley/Southern BC	RWDI West Inc.	GVRD	March 2003	see comments	see comments	\$40,000 - \$100,000	50% of the total budget.	Potential partners suggested - WLAP, GVRD, FVRD and Env. Can.	The funding for the proposal was refused in June 2003, as it appeared to overlap with work planned by Env. Can.
2 Climate Change Mitigation, Greenhouse Gas Emissions Reduction and Fuel Consumption Benefits of Promoting Two wheeled Vehicle Use as an Alternative to Larger Vehicles	AirCare	CPPI	February 2003	see comments.	see comments.	see comments.	see comments.		A 3-Phase study is proposed. No budget, requested CAR funding and schedule for any of the Phases are submitted. Any funding was denied in July 2003.
3 Measurement and Modelling of Traffic-related Air Pollution in the B. C. Lower Mainland for use in Health Risk Assessment and Epidemiological Analysis	M. Brauer, Univ. of BC	WLAP/GVRD	October 2002	Pilot work already started	2-year project	\$71,400	\$30,000 to \$40,000 in two fiscal years.	Health Canada	The funding for the proposal was refused as it did not meet the overall support of the Committee.

3.4 Project Completed in 2003

"Canadian Synthetic Diesel Fuel Testing Project – Phase 2"

Project Lead/Sponsor

Shell Canada Products Ltd. on behalf of CPPI is leader of this two-phase project, and CPPI is CAR Fund Steering Committee Contact.

Project Goal and Objectives

The primary objective of the project is to install and operate an advanced single cylinder diesel engine to test diesel fuels produced from oil-sands and conventional crude oil. Emissions from burning of these fuels will be measured to determine the effects of an exhaust gas recirculation (EGR) system, as well as the effects of fuel sulphur content on particulate matter emissions.

Project Funding

CAR Fund –\$15,000 approved for Phase 2.

Other Partners – National Research Council, Syncrude, CPPI, Suncor, Imperial Oil, Environment Canada, and US Dept. of Energy.

Total - \$635,000 in cash and in-kind for Phase 2.

Contractor

National Research Council, Ottawa.

Approval Date

Phase 2 of the project was approved by the Steering Committee in October 2000.

Completion Date and Status

A Caterpillar single cylinder engine was equipped with an exhaust gas recirculation (EGR) system and debugged earlier in the year. It was further tested to optimize the EGR rates to generate the desired NO_x emission level and the injection timing was adjusted to prevent overheating during one of the engine test modes. EGR rates were varied from 5 to 50%, averaging 16.5 % over the 8 test modes used. Fuel samples from Canadian refineries for the Cycloparaffin study were sent to laboratory for analysis. Based on the fuel analysis results, a proper fuel matrix has been developed. A study on the effect of fuel sulphur content on PM emission was determined. The fuel sulphur content was varied by blending various amounts of sulphur dopants with low-sulphur base fuel. Some quantity of Di tert Butyl peroxide Cetane Improver has been sent to National Research Council (NRC) for use in Cetane response tests. A quantity of the base fuel has also been sent to NRC for testing on a new European Light-duty Diesel vehicle. The report on this Phase of the work was issued in the 1st Quarter of 2003, and the next phase of the project was started soon afterwards. A Management Committee has been formed to assist in the collaborative research program.

4. Status of CAR Funded Projects and Proposals till the end of 2003

Summaries of the year-end 2003 status of the projects and proposals under three different categories are provided below. These projects and proposals include those received in 2003, as well as those received during 1998-2002 but are still in-progress or remain as approved-in-principle and under consideration in 2003. The proposals which were withdrawn and those for which CAR funding was refused are mentioned briefly in Section 4.5.

4.1 Projects In-progress at the end of 2003

1. "Ethanol BC"

Project Lead/Sponsor

The University of British Columbia (UBC) leads this multi-stakeholder sponsored project under a stakeholder Steering Committee. WLAP is CAR Fund Steering Committee Contact.

Project Goal and Objectives

The primary goals of the project are to promote development and demonstration of technologies for production of ethanol, electricity and other products from softwood residues, and a commercial ethanol facility in B. C. by the year 2005. The ethanol project has three major objectives – process development demonstration, development of policy recommendations and preparation of a business plan for commercialization of the process.

Project Funding

CAR Fund –\$100,000 over a 5-year period with an annual contribution of \$20,000. Other Partners – Province of B. C. - \$300,000, and various amounts of cash and in-kind contributions from Federal Government Agencies, UBC and the private sector. By the end of 2001, Environment Canada contributed \$20,000 from its Georgia Basin Ecosystems Initiative – Clean Air Action Plan, and \$120,000 from the forest products industry (Canfor, West Fraser, Weldwood and Slocan) by taking advantage of the provincial beehive burner fee rebate program. The estimated revenue available for 2003 from the latter program is about \$230,000. Environment Canada has indicated that it will potentially provide an additional \$20,000 for the fiscal year 2003-04, subject to a “contractual link to the provincial government”.

Total estimated cost - \$7.4 million for the 5-year project duration.

(Funding Notes – CARF payment to date has been \$60,000 for the years 2000, 2001 and 2002.)

Contractor

UBC Faculty of Forestry is the primary contractor. Several sub-contractors are also to be retained for ancillary work.

Approval Date

The project was approved by the Steering Committee in July 1999.

Completion Date and Status

This is a 5-year project consisting of several components. The work on the Ethanol Process Development Unit (PDU) at UBC Faculty of Forestry is continuing. Some success has been reported in the selection of yeast for conversion of glucose sugar to ethanol. Under a contract from Ethanol BC, Nexterra (formerly EthoPower) has successfully characterized syngas generated from woodwaste and completed several small scale commercial thermal projects. The syngas is planned as a feedstock for ethanol production. The company has now built its pilot plant at Kamloops, instead of at BC Research as originally planned. Nexterra is also preparing project proposals for using the syngas for lumber dry kilns for several industry clients. The company's application for a \$75,000 grant for this project has been approved by Ethanol BC. The project is co-funded by NRCan and NRC has approved funding for this project. DynaMotive Energy has successfully produced BioOil from woodwaste and

demonstrated it as a substitute for natural gas in a lumber kiln operation. The pulp mill lime kiln trial run with BioOil has started at the UBC. DynaMotive is negotiating with Erie Flooring in southern Ontario to install a 3.5 MW gas turbine power and heat demonstration plant to be fuelled by BioOil. The project is being pursued by several partners with the support of Sustainable Development Technology Canada, Ontario Power Generation and Orenda Turbine. Lignol Innovations are continuing the testing of their lignin as well as from softwood residue as a substitute for phenol formaldehyde. Entropic Power is currently seeking partners in the forest industry and discussing with BC Hydro for a demonstration project of its small power generation system. It held an initial meeting with Ethanol BC for potential funding for such a project.

2. *“Ambient and Personal Exposure Levels of Fine Particulate Matter (PM_{2.5}) Throughout the Prince George Airshed”*

Project Lead/Sponsor

Faculty of Natural Resources and Environmental Studies, University of Northern B. C. is the sponsor of the project, and WLAP is CAR Fund Steering Committee Contact.

Project Goal and Objectives

The objective of the project is to develop a detailed understanding of the relationship between ambient PM_{2.5} concentrations and actual personal exposure levels and to determine the spatial variation of these parameters within the Prince George airshed.

Project Funding

CAR Fund –\$10,000 approved.

Other Partners – National Sciences and Engineering Research Council, Science Council of B.C., Harvard School of Public Health, Univ. of B.C., WLAP, Environment Canada, Conor Pacific, Canfor and Univ. of Northern B.C..

Total - \$55,000 in cash and in-kind.

(Funding Note – CAR Funding of \$10,000 was paid in April 2001.)

Contractor

Melanie Noullett, Graduate Student, University of Northern B.C..

Approval Date

Project was approved by the Steering Committee in October 2000.

Completion Date and Status

The field component of the study and laboratory analysis of samples collected was completed by May 2001. The data were analyzed to determine spatial variations in ambient and personal exposure levels of particulate matter within the airshed. Two papers summarizing the study were presented at the Graduate Student ASI Conference in Vancouver in March 2002, and at the International Society of Exposure Analysis conference in August 2002. The writing of the thesis is underway, after a delay due to illness of the contractor. The student is now back to write the final thesis, and good progress is being made. It is scheduled for completion by April 2004.

3. *“Tunnel Study Pacific 2001 – Effects of Fuel and Lubricant Quality on Vehicle Emissions. Fuel Analysis.”*

Project Lead/Sponsor

Env. Can. is the leader and sponsor of this proposal and CPPI is CAR Fund Steering Committee Contact.

Project Goal and Objectives

The objective of the project was to characterize gasoline and diesel fuels and lubricants used in vehicles during the period of the Cassiar Tunnel Testing. This information on the fuel and lubrication oil quality would be input data to assess their potential impacts on motor vehicle emissions during the Cassiar Tunnel Testing. This fuel and lubricant analysis is a part of a larger project (Tunnel Study) of Environment Canada. CPPI worked on a revised proposal with Environment Canada and Alberta Research Council to sample and analyze gasoline, diesel and lubricants in use in GVRD at the time of the Tunnel Study for measurement of motor vehicle emissions scheduled during August-September 2001 Pacific 2001 intensive air quality monitoring program.

Project Funding

Total - \$12,000 (approximate)

CAR Fund approved was \$12,000, taking into consideration that the total cost of Pacific 2001 research projects would amount to about \$1.4 million.

Contractor

Alberta Research Council is to carry out fuel sampling and analysis, and Environment Canada is the principal investigator for the entire project.

Approval Date

Project was approved-in-principle by the Steering Committee in January 2001, provided it constitutes a part of a larger Environment Canada study mentioned above

Completion Date and Status

Field experiments, measurements and collection of fuel samples were done during August 9-15, 2001. Two sets of instruments for sampling and monitoring of various contaminants and gases emitted from motor vehicles were located at the entrance and exit of the Cassiar Tunnel. Gasoline, diesel and motor oil samples were also collected during the same period for subsequent analysis. Alberta Research Council submitted its report on fuel and lubricant analysis in November 2001, and so the CAR funded portion of the study has been completed. The remaining part of the expanded study is now being done by Environment Canada. The chemical analysis of collected samples of vehicle emissions is nearly complete. The analytical data and the remote sensing measurements done during the study period are being examined. One set of samples remains outstanding as a number of target organic compounds are analyzed for use in source-apportionment studies. Samples have also been sent to two additional laboratories for C, S and O isotope and platinum group elemental analysis. The fleet characterization information from AirCare and ICBC is being extracted to estimate vehicle emission rates for the tunnel study. Preliminary mass emission rate calculation results were presented at the Pacific 2001 Workshops in Toronto and Vancouver in April and May 2002 respectively, as well as to the GVRD staff.

4. *“Marine Vessel Air Emissions in the Georgia Coast Cascade Air Basin and Coastal Areas for the Year 2000.”* (formerly titled: *“Marine Vessels Emission Inventory for LFV, B. C. outside LFV and Washington State for 2000. Phase 3 – Backcasts and Forecasts”*)

Project Lead/Sponsor

Environment Canada is leader of this three-phase project with the sponsorship of GVRD. GVRD is CAR Fund Steering Committee Contact.

Project Goal and Objectives

The primary goal of the project is to prepare an emission inventory of marine vessels for the Georgia Coast Cascade Air Basin for the year 2000, as well as to do forecasts of emissions from marine vessels in the Air Basin to 2025. The 3-Phase project was initiated in October 2001 starting with Phase 1 (marine vessels emission inventory for the Core Area [GVRD and Fraser Valley Regional District] for 2000) and Phase 2 (marine vessels emission inventory for the Expanded Area [B. C. outside LFV and Washington Coast, including Whatcom County and Puget Sound] for 2000). The Phase 3 work consists of backcasts and forecasts of marine vessels emissions for both Core and Expanded Areas. The year 2000 emission inventory is used as the baseline for backcasting emission estimates to 1985 and forecasting future emissions to the year 2025.

Project Funding

Phase 3 of the project is being funded by: Environment Canada (\$22,000), CAR Fund (\$9,000) and GVRD (\$9,000 in-kind).

Contractor

Levelton Engineering Ltd., Richmond, B. C.

Approval Date

Phase 3 of the project was approved by the Steering Committee in October 2002.

Completion Date and Status

The contract for Phase 3 was awarded in November 2002. The draft report was submitted by and comments on the report were sent for consideration by the consultants. The final report is delayed and now expected in January 2004.

5. *“FIXIT Program Pilot Project”*

Project Lead/Sponsor

AirCare is the sponsor/leader of the project, and CPPI is CAR Fund Steering Committee Contact.

Project Goal and Objectives

The goal of the project is to develop a new initiative to reduce vehicle exhaust emissions of pre-1992 light-duty vehicles. A working model of the proposed FIXIT program has been designed, and the objective of this project is to evaluate the operational procedures and potential benefits of the FIXIT program

Project Funding

CAR Fund –\$16,000 approved in October 2002.

AirCare is to contribute the remainder (about \$60,000) as in-kind contribution.

Total - \$76,000 in cash and in-kind.

Contractor

AirCare Program Administration.

Approval Date

The project was approved by the Steering Committee in November 2002.

Completion Date and Status

The project was started in December 2002. Because of a slow build-up of interest from possible participants and the rescheduling of diagnoses, tests, repairs and data assessment, the project was delayed. The proponent submitted a final report in December 2003; however, the Steering Committee has requested some revisions and rearrangement of data presentation.

6. *"Canadian Synthetic Diesel Fuel Testing Project – Phase 3"*

Project Lead/Sponsor

CPPI is both the sponsor of this proposal and CAR Fund Steering Committee Contact.

Project Goal and Objectives

CPPI advised the Steering Committee that the Phase 3 of the project would be a continuation of the Phase 1 and 2 of the Canadian Synthetic Diesel Fuel Testing Project, and it started in October 2002 upon completion of Phase 2. CAR Fund has been provided during both Phases 1 and 2, and the Steering Committee approved the requested amount of \$15,000 for Phase 3.

Project Funding

A total of \$490,000 has been budgeted for Phase 3 work. Besides the CARF contribution, the remainder is being provided in cash and in-kind by other project partners (National Research Council, Syncrude, CPPI, Shell, Suncor, Imperial Oil, Environment Canada, Natural Resources Canada and US Dept. of Energy).

Contractor

National Research Council of Canada, Ottawa.

Approval Date

Project was approved by the Steering Committee in October 2002.

Completion Date and Status

The project started in the 4th Quarter of 2002, and its completion date is not available. A Management Committee has been formed to assist in the collaborative research program. To date a set of fuel samples from several Canadian refineries has been analyzed for cycloparaffin content and type. After a delay due to the recent major power failure in Ontario and resultant equipment failures, testing with high cetane fuel blending was completed in December 2003. The test data are being analyzed. Study results to date were presented to CPPI and several federal government agencies in October and November 2003. The representatives of the International Truck and Engine Corp. visited the test facilities in December. Planning for the next Phase of the work has also been completed.

7. *"M. A. Turbo – Water Injection Emission Reduction System"*

Project Lead/Sponsor

Environment Canada on behalf of M. A. Turbo/Engine Ltd. is the sponsor, and CPPI is CAR Fund Steering Committee Contact.

Project Goal and Objectives

The primary objective of the project is to test the effectiveness of water injection in marine vessel diesel engines in reducing nitrogen oxides emission.

Project Funding

CAR Fund –\$3,500 approved in October 2002.

Other Partners: Environment Canada - \$6,500 and M. A. Turbo/Engine Ltd. - \$8,700.

Total - \$18,700.

Contractor

M. A. Turbo/Engine Ltd..

Approval Date

The project was approved by the Steering Committee in October 2002.

Completion Date and Status

The project was started in December 2002. It is scheduled for completion in 3 months. In December 2002, the design work for the water injection system for about 30% water/fuel ratio for relatively low quality water was completed. The designed emission reductions without affecting engine performance are: NO_x – up to 35% and PM – up to 20%. The detailed engineering work is completed. The water injection system has been installed at the US Navy test facilities, and engine tests are scheduled for February 2004.

8. *“Emissions Reduction Options Study for Heavy-Duty Vehicles/Fleet in the Lower Fraser Valley”*

Project Lead/Sponsor

Greater Vancouver Regional District is both the sponsor and the CAR Fund Steering Committee Contact.

Project Goal and Objectives

The project goal is to promote social, environmental and economic sustainability in the Lower Mainland region of B. C.. The primary objectives of the study are to provide guidance to the GVRD, its member municipalities, the Greater Vancouver Transportation Authority and others on the options to reduce emissions from their existing heavy-duty diesel vehicles and future purchases of vehicles and engines and fuels.

Project Funding

Total cost - \$123,000. Contributors: CAR Fund –\$41,000, GVRD - \$32,000, Environment Canada - \$20,000, WLAP - \$15,000, and FVRD, GVTA and Clean Energy - \$15,000 (\$5,000 each).

Contractor

Levelton Engineering Ltd. and Others.

Approval Date

The project was approved by the Steering Committee in April 2003.

Completion Date and Status

The contract for the study project was awarded and the work started in the last week of June, 2003. The scope of work has been finalized following the contract award. Preliminary information from the consultants indicates that progress is being made on: (i) work on HDV fleet characterization and emission calculations by using MOBILE6.2C for the baseline year (2000) and for the forecast period (2025). The existing GVRD input data files have been used to run the model. After prolonged negotiation between GVRD and ICBC on the release of the vehicle registration information, it is anticipated that a formal disclosure and confidentiality agreement will be signed by the end of January 2004. The lack of ICBC vehicle registration data has impacted on the progress of the work. However, progress has been made with respect to other aspects of the study, e.g. fuel quality changes, fuel blends, alternative fuels, alternative propulsion systems and modified engine and control systems. The costs analysis part of the work will be done after ICBC vehicle registration data become available. Several additional tasks, at a cost of another \$10,000 – 12,000, have been identified to improve the study results. Because of the delay in procuring the vehicle registration information from ICBC, the study completion date is now scheduled for the end of March 2004.

9. *“Application of Automated Correlation-based Synoptic Map Classification for Establishing a Climatological Link with Air Quality Episodes in Prince George, British Columbia”*

Project Lead/Sponsor

Paul F. Willis is the sponsor of this proposal with his advisor Dr. Peter Jackson of the Faculty of Natural Resources and Environmental Studies, University of Northern B. C.. WLAP is the CAR Fund Steering Committee Contact.

Project Goal and Objectives

The objective of the project is to develop a recurring and representative map pattern of circulation associated with meteorology favourable to air quality in Prince George. This will include the stages of the development, beginning and decay of any air pollution episode. The research will be the basis of the thesis for a M. Sc. Degree in Environmental Studies at the University of Northern B. C..

Project Funding

The revised project budget is estimated to be \$7,070 of which \$3,600 is requested from the CAR Fund.

Contractor

Not applicable.

Approval Date

After considering a revised proposal submitted at the request of the Steering Committee, a funding of a maximum of \$6,000 was approved by the Steering Committee in August 2003.

Completion Date and Status

The pilot study was completed in September 2003. A new computing environment including a new computer and FORTRAN programs has been developed for data analysis. Tests have been done and verified against manual calculations. Further work is being done to establish an efficient computing environment. The project is being delayed due to proponent's professional workload. However, it is planned to do several weeks of rigorous data analysis in March 2004. An interim report on the project will be submitted in May 2004, and the final thesis is to be defended in July 2004.

10. *“Testing of Continuous Water Injection System on one of the two Main Engines on board the MV Queen of New Westminster”*

Project Lead/Sponsor

M. A. Turbo/Engine Ltd. is the sponsor, and Environment Canada on behalf of CAR Fund Steering Committee is the Contact.

Project Goal and Objectives

The primary objective of the project is to test the effectiveness of water injection in reducing nitrogen oxides emission from one of the two main diesel engines onboard the MV Queen of New Westminster of the BC Ferry Services Inc.. This is the Phase 2 of an earlier project completed in 2002.

Project Funding

Total budget is \$53,500 of which \$18,500 is to be contributed from the CAR Fund. Other funding partners are Environment Canada - \$18,500 and BC Ferry Services Inc. - \$18,500.

Contractor

M. A. Turbo/Engine Ltd..

Approval Date

The project was approved by the Steering Committee in July 2003, and the final agreement between the contractor and BC Ferry Services Inc. was signed in November 2003.

Completion Date and Status

The project which started in December 2003 is scheduled for completion by March 2004. All systems and equipment are being installed for actual testing of the engine.

11. *“ISOPART Model Application to the LFV”*

Project Lead/Sponsor

Ms. S. Pryor of Indiana University is the sponsor, and CPPI is the CAR Fund Steering Committee is the Contact.

Project Goal and Objectives

The project is a follow-up of an earlier study, partially funded by CAR, on the application of ISOPART air quality trajectory model undertaken during Pacific 2001 intensive study in Lower Fraser Valley of B. C.. The primary objectives of the present project are to run a modified ISOPART model using output from meteorological model simulations for receptors in three regions within the LFV. The results will be

presented for each of the four seasons as a chemical/air quality climatology for these regions and chemical sensitivities to sea spray and ammonia burdens.

Project Funding

Total budget is \$84,809 of which \$30,000 is to be contributed from the CAR Fund. Other funding partners are Environment Canada - \$25,000 and WLAP - \$15,000, FVRD - \$10,000 and GVRD - \$5,000.

Contractor

Ms. S. Pryor, Indian University.

Approval Date

The project was approved by the CARF Steering Committee in November 2003, and other partner contributions were confirmed soon afterwards.

Completion Date and Status

The project which started in December 2003 is scheduled for completion by December 2004.

4.2 Projects Approved-in-Principle by the end of 2003

By the year end six proposals received between March and December 2003 remain as approved-in-principle for CAR funding. These proposals are listed in Table 3, and briefly described below.

1. *“Vehicle Emissions Inspection and Maintenance – Effects on CO₂ Emissions and Fuel Consumption.”*

This project was completed by Pacific Vehicle Testing Technologies Ltd. (PVTT) in March 2003 under a contract from Environment Canada. The proponent submitted the proposal in September 2003 for CAR funding of \$6,300 to meet the costs of publication of the study results in a journal and to make a presentation of the same at a conference.

2. *“Vehicle Emissions Inspection and Maintenance – Effects on CO₂ Emissions and Fuel Consumption – Phase 2.”*

This proposal is for the next phase of the study 1. above. An Overview of the project was submitted by PVTT in September 2003. It has been approved-in-principle for some funding; however, the proponent has been advised to submit a revised proposal after taking into account the comments of the Committee members on the Overview, as well as to provide a budget, the project schedule and deliverables.

3. *“FIX-IT Program 2nd Pilot Project.”*

The proposal submitted by PVTT in December 2003 is to continue a recently completed similar project with CAR funding. The budget for the current proposal is \$46,000 of which \$16,000 has been requested from CARF. After approving in-principle, the Committee has advised the proponent to submit a revised proposal based on the comments of the members.

4. *“Reduction of Nonroad Diesel Emissions in the Lower Fraser Valley of BC.”*

The proposal was submitted by Genesis Engineering in November 2003, and received approval-in-principle by the Committee for CAR funding of a maximum of one-third of the

total budget of \$18,000. However, the Committee subsequently advised the proponent to submit a new proposal by expanding the study area to the entire Province of B. C. and to provide new project budget and schedule.

5. *“Updating the Lower Fraser Valley Source-Receptor Air Quality Model.”*

RWDI West Inc. submitted the proposal in March 2003 to revise and update the existing source-receptor model for air quality in the Lower Fraser Valley by incorporating the current emission inventory and meteorological data and the knowledge about atmospheric chemical transformation processes. The budget for the project was estimated to be in the range of \$30,000-\$60,000. In December 2003 after discussing with the proponent, the Committee members approved the proposal in-principle for a maximum of \$20,000 from CARF.

6. *“Mapping Roles and Responsibilities for Energy and Greenhouse Gas Management in Greater Vancouver.”*

In November 2003 the Greater Vancouver Regional District (GVRD) submitted the draft Terms of Reference (ToR) for the proposed study to be undertaken by consultants. As there were a few comments on the draft ToR from the Committee members, the proposal was approved-in-principle for CAR funding of one-third of the total budget of \$20,000, subject to revision of the draft ToR as suggested by the members.

4.3 New Proposals Under Consideration in 2003

As listed in Table 3, a new proposal, *Canadian Synthetic Diesel Fuel Testing Project - Phase 4*, was received in December 2003. The proposal is for the next phase of an ongoing multi-partner funded project to be started in early 2004. As the requested CAR funding \$15,000 out of the total budget of about \$400,000-\$500,000 for the Phase 4 is similar to that approved from CARF for each of the first three phases of the study, the proposal has been approved-in-principle.

4.4 Proposals Withdrawn and Refused for Funding in 2003

As listed in Table 4, the following three proposals received in previous years were withdrawn by the proponents in 2003.

1. *“Tailpipe Emissions of Greenhouse Gases from In-use Gasoline, Diesel and Alternative Fuel Vehicles”* – The proposal was submitted in June 2000 by Canadian Petroleum Products Institute (CPPI) and was withdrawn in February 2003.
2. *“Cost-effectiveness of Alternative Transportation Fuels”* - The proposal was submitted in June 2000 by Canadian Petroleum Products Institute (CPPI) and was withdrawn in February 2003.
3. *“GVRD Lawn Mower Scrappage Program”* – The proposal was submitted by the Greater Vancouver Regional District (GVRD) in June 2002, and was withdrawn in February 2003.

During the year 2003 the following three proposals, received at various times since October 2002, were refused funding as the eligibility criteria for CAR funding were not met. These proposals are also listed in Table 4.

1. *Application of the CMAQ-MC2 Air Quality Model to the Lower Fraser Valley/Southern BC*
2. *Climate Change Mitigation, Greenhouse Gas Emissions Reduction and Fuel Consumption Benefits of Promoting Two-wheeled Vehicle Use as an Alternative to Larger Vehicles*
3. *“Measurement and Modelling of Traffic-related Air Pollution in the B. C. Lower Mainland for use in Health Risk Assessment and Epidemiological Analysis”.*

5. Future Outlook of CAR Fund

Under the Scrap-It program nearly 3,000 old vehicles have been scrapped during the period March 1996 to December 2003, and the CPPI contribution to the program to December 2003 has been about \$888,550. The present resources allow scrapping of about 500 vehicles per year. Although the number of scrapped vehicles is relatively low, compared to the total number of vehicles used in the region, the cumulative effect of retirement of high-polluting old vehicles over the years has resulted in cost-effective incremental emission reduction in the Lower Fraser Valley. The participation in the Scrap-It program appears to depend on the types of incentives available to the owners of old vehicles and the level of public awareness. Adequate funding for attractive incentives to vehicle owners' participation is also a key to the success of the Scrap-It program. Presently, The Scrap-It Program Steering Committee is exploring the possibility of creating a charitable society to manage the program.

From August 1997 to the end of 2003 nearly \$539,000 from the CAR Fund has been contributed towards a number of research projects. During the 2000- 2003 period a total of about \$182,000 from the CAR Fund has been committed towards projects that are still in-progress and approved-in-principle. Since 1997 the total value of all projects already funded and committed for funding by various partners is nearly \$13 million. This amount includes the budgets for three major projects namely Ethanol BC (\$7.4 million over a 5-year period), Pacific 2001 (\$1.4 million) and Canadian Synthetic Diesel Fuel Testing – \$1.6 million (including \$0.5 million for the Phase 3). The total value of all other projects which have been completed, in-progress and approved-in-principle amounts to approximately \$1.5 million.

The projects funded to date consisted of basic and applied research, including pilot demonstration of technology, collection of information for planning purposes, and training program for agency personnel, industry and consultants. The study proponents ranged from academic and students to industry and government agencies. The type of projects included:

- analysis of air quality, emissions and meteorological data,
- air quality model development,
- enhancement of emission estimation methods,
- computer model development for greenhouse gas emission assessment,
- projects to improve AirCare testing and vehicle repair diagnosis,
- transportation demand management, and
- training of personnel from agencies, industry and consultants.

Research projects undertaken with full or partial CAR funding have resulted in significant scientific advances through improved understanding of key air quality issues, filling of important data gaps, and development of modeling tools to better forecast impacts of emission reduction measures on future air quality. Continued financial support from the CAR Fund for research on air quality issues will lead to improved understanding of the science, and development or enhancement of models and tools for data gathering and analysis. These are necessary prerequisites for formulation of appropriate air quality management strategies and policies.