

Clean Air Research Fund

Status Report - 2000

Clean Air Research Fund Steering Committee

November 2001

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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. From 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*” of July 2000 provided a summary of the activities supported by the fund from the beginning to the end of the year 1999. This report summarizes the projects funded from the CAR Fund in the year 2000. It provides brief descriptions and the status of the BC Scrap-It program and various research proposals considered for funding during this period.

2. Clean Air Research Fund History

In December 1995, the Canadian Petroleum Products Institute (CPPI) and BC Ministry of Environment, Lands and Parks (MELP) signed an agreement on CPPI funding for the old, high-polluting motor vehicle scrapping program and for clean air research program. The agreement was for a total annual contribution of \$500,000 for 5 years by CPPI 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. 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) *. 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 is being managed by a Steering Committee consisting of one representative from each of CPPI, MELP and GVRD.

[In March 2001, the Parties agreed to extend the agreement until the total amount is spent or committed.]*

3. Clean Air Research Fund Program Achievements in 2000

As in previous years, the CAR Fund was used to support both the BC Scrap-It Program and a number of research projects in 2000. 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 BC Environment in the Lower Mainland and Victoria. The program partners have included the CPPI, BC Hydro, Vancouver and Victoria Regional Transit Commissions and BC Automotive Dealers Association (BCADA). BC Environment, GVRD, and AirCare have been providing 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. The vehicle owners were offered incentives, such as transit pass and cash toward the purchase of lower-emitting new or post-1988 used vehicles, to have their vehicles scrapped and recycled.

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. For 1999 and 2000, the program is now funded by the CPPI, Translink, Insurance Corporation of B. C. and the BCADA. BC Environment, GVRD, and AirCare (now Pacific Vehicle Testing Technologies) have continued their support for the program. The choice of incentives for the vehicle owners participating in the program was also widened to include cash payments towards purchase of new natural gas vehicle, bicycle and van-pooling. More than 400 vehicles were scrapped between November 26, 1998 and December 31, 1999. Over 550 vehicles were approved for scrapping and nearly 400 scrapped during the year 2000. The vehicle owners opted for: 158 transit passes, 10 West Coast Express passes, cash for 159 new and used less-polluting vehicles and 42 bicycles.

The CPPI paid \$100,000 towards the program in the year 2000, which brought the total CPPI contributions to the Scrap-It since 1996 to \$538,550.

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 and replacement of old vehicles during the pilot and expanded phases of the program are provided below. These estimates are based on the findings 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 '99	73	20	711	4,297
January '00 - December '00	70	19	543	3,465

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

Source: *Scrap-It Program Administration Office, May 10, 2000 and May 01, 2001.*

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 (HC + NO_x + CO/7). The cost-effectiveness of greenhouse gas reduction was estimated to be \$130/t of CO₂, indicating that the program is not currently cost-effective when considered only in terms of these gases.

3.2 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. 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.

A total of 12 new proposals for financial support from the CAR Fund were received in 2000, bringing the total proposals received since 1997 to 30. These proposals included two from government agencies, eight from industry and two from universities. Nine of these new proposals have been either approved or approved-in-principle, two are presently on-hold or deferred, one proposal has not been approved. One proposal approved-in-principle in 1999 is now considered to be inactive, because to date the proponent has failed to pursue it further.

As shown in Table 1, 6 projects were completed during the year 2000. Three of these completed projects were approved in 1999, and the remaining three were approved in 2000. By the end of 2000, 5 projects are still in-progress, of which two were either approved or approved-in-principle in 1999 and the other three were approved in 2000. The status of (i) completed projects, (ii) projects in-progress, (iii) projects approved-in-principle, (iv) proposals not approved, and (v) proposals deferred or inactive at the end of 2000 is summarized in Tables 2 to 4, and outlined in Section 4.

Table 1: Projects Completed in 2000
(Completed projects during 1997-2000 in parenthesis)

Project Proponent	Project Type				
	Basic Research	Applied Research (Study & Assessment)	Planning	Pilot Demonstration Program	Other
University - Academic - Student	(2)	(1)	1 (1)		
Business and Industry		2 (3)			
Government agencies		2 (5)	1 (2)		
Non-governmental Organizations					

In the year 2000, about \$80,000 was allocated from the CAR Fund towards the completed and on-going projects. This amounted to nearly \$250,000 contributions from the CAR Fund to various projects during 1997-2000. 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.

The following describes some of the key findings from those projects completed in 2000.

- An assessment of appropriate emission standards for light-duty vehicles in the Lower Fraser Valley indicated that implementation of the US Environmental Protection Agency's Tier 2 equivalent standards for model year 2004 onwards will lower emissions considerably by the year 2020 and bring larger reductions than California Low Emission Vehicle II standards implementation in the early

years following 2004. Through implementation of such standards, NO_x and VOC emissions from light-duty gasoline vehicles will be substantially reduced by 2020, compared to other regional sources. The cost-effectiveness of the implementation of the Tier 2 emission standards for light-duty vehicles compares favourably with that of the current Scrap-It program.

CAR Fund contribution - \$15,000 Total project value - \$90,000.

- A *Master Sustainable Transportation and Land Use Planning Framework (Planning Framework)* has been developed to investigate transportation and land use policies and transportation demand management strategies. It has been used to assess the anticipated growth in the proposed Burnaby Mountain Community Development. The results indicate that through implementation of certain policies and strategies a minimum of 20% reduction in single-occupant vehicle trips to and from Simon Fraser University is achievable. The *Planning Framework* can be used as a template for similar purposes in other communities.

CAR Fund contribution - \$5,000 Total project value - \$34,000.

- Tests with Canadian synthetic diesel fuels showed reduced emissions of particulates and nitrogen oxides, but increased emissions of hydrocarbons and carbon monoxide, as compared to the average emissions from the reference conventional diesel fuel. The specific fuel consumption of synthetic fuels was also less than that of the reference fuel.

CAR Fund contribution - \$15,000 Total project value - \$60,000.

- The AirCare research facilities were utilized to measure emissions of fine particulate matter PM_{2.5} (particulate matter of diameter 2.5 micron and smaller) species, as well as non-carbon dioxide greenhouse gases, namely nitrous oxide and methane from in-use motor vehicles of different ages. The results showed that PM_{2.5} emission varied from 0.25 to 100 mg/mile, and on average about two-thirds of the PM_{2.5} consisted of carbon and the remainder was composed of ammonium sulphate and metals, mainly iron and manganese. Emissions of methane and nitrous oxide were of similar magnitude and ranged from 1 to 300 mg/mile.

CAR Fund contribution - \$12,000 Total project value - \$187,000.

- A survey was done in the City of Kelowna of its residents to obtain information on their travel pattern and use of transportation mode, and their concern about the effects of motor vehicle use on air pollution and health effects, traffic congestions, and accidents. The results of the survey are to be used to develop transportation demand management strategies in the region.

CAR Fund contribution - \$2,900 Total project value - \$42,500.

- An on-board instrument was tested in motor vehicles to determine the driving behaviour of commuters in the Lower Fraser Valley and its effect on emissions. The limited number of tests indicate that the local driving cycle is different from that considered in the US Federal Test Procedure and consequently the mass emissions of air pollutants are also different. Another series of tests showed that fuel consumption during "cold start" is about 19% higher than the average fuel

use and approximately of the same order of magnitude as was observed in earlier studies.

CAR Fund contribution - \$17,000

Total project value - \$47,000.

**TABLE 2: Clean Air Research Fund
Research Projects - Completed In 2000**

Project Title	Project Proponent/ Sponsor	CAR Fund Project Manager	Project Application Date and Schedule			Project Funding (\$)					Project Progress Status		Comments	
			Application Date	Project Start Date	Project Completion Date	Total Proposed	CAR Funding Requested, Approved and Paid			Other Partner Funding Partner Fund (\$)	Interim Report	Final report		
							Requested	Approved	Paid					
Completed Projects														
1 Clean Transportation Analysis	GVRD and BC Env.	GVRD	June 1999	June 1999	January 2000	90,000 (Original - \$50,000)	15,000 (Original - \$10,000)	15,000 (Original - \$10,000)	10,000 in December 1999 and 5,000 in February 2000	BC Env. - 10,000 GVRD - 20,000 Env. Can. - 10,000 Translink 10,000 CVMA ¹ - 10,000 AIAMC ³ - 10,000 FVRD ³ - 5,000		January 2000	CAR Fund was approved in June 1999.	
<i>Notes: 1 - Canadian Vehicle Manufacturers Association, 2 - Association of International Automobile Manufacturers of Canada, 3 - Fraser Valley Regional District</i>														
2 Sustainable Transportation Planning at Simon Fraser University	R. MacDonald, School of Resource and Environmental Management, Simon Fraser University	GVRD	February 1999	January 1999	February 2000	34,000	15,000 - 20,000	5,000	3,000 in May 1999 and 2,000 in March 2000	TC ¹ - 5,000 BC MMA ² - 6,000 SFU ³ - 5,000 TAC ⁴ - 4,000 BMCC ⁵ - 1,000 BC Hydro - 1,000 BCAA ⁶ - 1,000	August 1999	February 2000	The project is for R. MacDonald's Master's Thesis. He financed the balance of the budget himself. The thesis was presented in February 2000.	
<i>Notes: 1 - Transport Canada, 2 - BC Ministry of Municipal Affairs, 3 - Simon Fraser University, 4 - Transport Assoc. of Canada, 5 - Burnaby Mountain Community Corp., 6 - B. C. Automobile Association</i>														
3 Synthetic Diesel Fuel Emissions Testing	CPPI	CPPI	August 1999	October 1999	April 2000	60,000	15,000	15,000	15,000 in September 2000	NRC - 30,000; CPPI - 5,000; Syn crude - 5,000; Suncor - 5,000	March 2000	April 2000	A Project Overview of the Phase 2 was submitted in June '00.	
4 Light-Duty Vehicle Fine Particulates Emission	Env. Can.	CPPI	July 1999	September 1999	June 2000	187,000	12,000	12,000	2,005 in September 1999 and 10,000 in April 2000	Env. Can. - 75,000 Prog. for Energy Res. & Dev. - 100,000	March 2000	June 2000	CAR Fund of \$12,000 included \$2,000 worth of gas coupons for test vehicle owners.	
5 Okanagan Air Quality Management -2000 Summer Program	City of Kelowna	BC Env.	February 2000	May 2000	August 2000	42,500	7,000	5,000	\$2,900 Invoiced. Paid in October 2000	35,500 (in-kind and cash) from City of Kelowna/Regional Dist. Of Central Okanagan and Okanagan University College		September 2000	\$5,000 was approved for 2 projects (Transportation Survey, Statistical Study of Vehicle Volumes and Air Quality). Only Transportation Survey was undertaken and completed. An invoice of \$2,900 was submitted for the completed project.	
6 Assessment of 'Cold Transient' Vehicle Operations and Driving Pattern on Greenhouse Gas Emissions	Instrumental Solutions, Ont. and AirCare Research Centre	CPPI	March 1999	December 1999	November 2000	47,000	17,000	17,000	17,000 in December 2000	Env. Can. - 30,000	April 2000	November 2000	Funding was approved in Jan. '00. Project complete and invoice paid.	

**TABLE 3: Clean Air Research Fund
Research Projects - Approved and In-Progress at the end of 2000**

Project Title	Project Proponent/ Sponsor	CAR Fund Project	Project Application Date and Schedule			Project Funding (\$)					Project Progress Status		Comments
			Application Date	Project Start Date	Project Completion Date	Total Proposed	CAR Funding Requested, Approved and Paid			Other Partner Funding	Interim Report	Final report	
							Requested	Approved	Paid	Partner Fund (\$)			
<i>Projects Approved and In-Progress</i> 1 Development of a Fine Particulates Model for Lower Fraser valley - Phase II	Environment Canada	GVRD	February 1998	Fall 1997		150,000	50,000	50,000	45,000 in September 1999	GVRD - 50,000 Env. Can. - 50,000	January and June 1999		CAR Fund amount is used primarily for Phase II. Project delayed and \$5,000 is withheld pending completion.
2 Ethanol BC - Process Development Program	The University of B. C.	CPPI BC Env.	March 1999			7.4 million over 5 yrs.	100,000 at 20,000/yr. for 5 yrs.	20,000/yr for 5 yrs.	20,000 in May '00	Various amounts from federal and provincial governments and several private sectors.	November 2000		The project is currently an initiative of the provincial Green Economy Secretariat. Capital cost of \$2.5 million and operating cost of \$4.9 million. A Steering Committee is formed and \$84,630 has been approved for 2 projects - Woodlands Incineration and UBC Faculty of Forestry Ethanol Process Development Unit.
3 Canadian Synthetic Diesel Fuel Testing Project - Phase 2	CPPI	CPPI (Shell Canada)	June 2000	Late 2000	May continue till 2002	635,000 (in 2000- 2001)	15,000 in 2000-2001			7 potential partners will contribute.			CAR funding was approved in the 4th Quarter. The project is on-going.
4 Ambient and Personal Exposure Levels of Fine Particulate Matter (PM _{2.5}) Throughout the Prince George Airshed	The University of Northern B. C.	BC Env.	October 2000	September - October 2000	Summer 2002	55,000	10,000	10,000		Various amounts from federal and provincial governments and several universities in cash and in-kind.			CAR funding was approved in December 2000. The project is on-going.
5 Improving Behavioural Parameters in Transportation Modelling in B. C. and Canada	Simon Fraser University	BC Env.	November 2000	November 2000	May 2001	24,000	8,000	8,000		MELP - 6,000, MoTH 4,000 and EC - 6,000			CAR funding was approved in November 2000. The project is on-going.

TABLE 4: Clean Air Research Fund
Research Proposals - Approved-in-Principle, Considered and Deferred or Inactive in 2000

Project Title	Project Proponent/ Sponsor	CAR Fund Project Manager	Project Application Date and			Total Proposed	Project Funding (\$)			Project Progress Status		Comments	
			Application Date	Project Start Date	Project Completi on Date		CAR Funding Requested, Approved and Paid			Other Partner Funding	Interim Report		Final report
							Requested	Approved	Paid				
Proposals Approved-in-Principle													
1 Tailpipe Emissions of Greenhouse Gases from In-Use Gasoline, Diesel and Alternative Fuelled Vehicles	CPPI	CPPI and AirCare	June 2000	September 2000		60,000	7,500 (if all partners contribute equally)			8 potential partners identified.		The project was approved-in-principle at the June 2000 meeting, and CPPI was requested to prepare a Project Proposal and hold discussions with potential funding partners. CPPI would discuss with AirCare about emissions data availability and with BC Env. about partial funding from Climate Change Fund.	
2 Cost-effectiveness of Alternative Transportation Fuels	CPPI	GVRD	June 2000	July 2000		100,000	10,000 (if all partners contribute equally)			9 potential partners identified.		CPPI would be working with GVRD to prepare a revised Project Proposal.	
Proposals Considered													
1 Mitigating Climate Change Through Rideshare	Commuter Connections	BC Env.	June 1999			181,000	Part of 25% of the total			Fed. Govt. may pay 75% of the total. Others have been requested.		In January, the proposal was considered as low priority. The proponent requested a CAR funding of \$20,000 - \$25,000 in June. The proponent was advised to discuss with Translink for a potential joint project; otherwise it would not meet CARF eligibility criteria. A reminder has been sent to the proponent.	
2 Control Strategy for 1, 3 Butadiene Emission from Mobile Sources	CPPI											At the June 2000 meeting CPPI had indicated its interest in a project an emission inventory of 1, 3 Butadiene, a toxic substance under CEPA. CPPI was requested to submit a Project Overview and to solicit other funding partners. No further information has been received from CPPI.	
Proposals Deferred or Inactive													
1 Georgia Basin Impacts and Adaptation to Greenhouse Gases: Biological Indicators and a Comprehensive Air Quality Profile	Katherine Enns, Royal Road University	BC Env.	May 1999			81,000	Part of the total			Several partners proposed.		In January it was considered as low priority; and in June it was decided to request the proponent for a project status. As there has been no response from the proponent, it is considered to be inactive.	
2 Emission Inventory of Mobile Sources	CPPI	CPPI, GVRD, BC Env.	June 2000	September 2000		100,000	10,000 - 35,000			9 potential partners identified		In view of the current inventory activities at the national, provincial and regional levels, CPPI has suggested that the proposal for a CAR- funded project for B. C. should be put on hold for the time being.	
3 Fine Particulates Emissions and Secondary Aerosol Formation Characteristics of Low Sulphur Fuels in New Technology Vehicles	Env. Can.	CPPI	June 2000			176,000	59,000			Env. Can. - 82,000 Prog. for Ener. & Res. Dev. - 35,000		The Project Overview from Env. Can. was submitted at the June 2000 meeting. The project was regarded as low priority and the requested amount exceeded the CAR funding limit. Env. Can. was advised accordingly. As no further response has been received from Env. Can., the proposal is considered inactive.	

4. Summary of CAR Funded Proposals Received in 2000

Summaries of eleven proposals received and considered by the Steering Committee are provided below in five categories identified in Section 3.2. Those projects approved in 1999 but completed or still in-progress in 2000 are also listed. Key findings of all completed projects in 2000 are included in the summaries.

4.1 Projects Approved and Completed During 2000

1. “Clean Transportation Analysis”

The project was awarded by the GVRD in June 1999 in cooperation with five other partners to assess both direct and indirect air quality benefits of several recent initiatives related to transportation in the Lower Fraser Valley. A primary objective of the study was to assess the cost-effectiveness of the US Environmental Protection Agency’s Tier 2 and California Low Emission Vehicle II emission standards for motor vehicles in order to support the impending Provincial Government decision on the appropriate BC emission standards for motor vehicles for the 2004 – 2020 period. The scope of the study included customization of the MOBILE 5B-Tier 2 evaporative emission model to Canadian conditions, analysis of the impacts of the heavy-duty vehicle smoke testing program (ACORP), and additional evaluation of the cost-effectiveness of the proposed US Federal and California motor vehicle emissions standards for the period 2004-2020.

The original study budget of \$50,000 was later increased to \$90,000 to commensurate with the amended scope of the project. The Steering Committee had approved the original request for \$10,000 from the CAR Fund, and subsequently increased it to \$15,000 due to expanded scope of the project. Additional funding was contributed by two new partners. Altogether eight funding partners contributed to the project as follows: (i) GVRD - \$20,000, (ii) BC Environment - \$10,000, (iii) Environment Canada - \$10,000, (iv) CAR Fund - \$15,000, (v) Canadian Vehicle Manufacturers’ Association - \$10,000, (vi) Association of International Automobile Manufacturers of Canada - \$10,000, (vii) Translink - \$10,000, and (viii) Fraser Valley Regional District - \$5,000.

The project was completed in January 2000. The major conclusions from the study are that: (i) implementation of the US Environmental Protection Agency’s Tier 2 equivalent emission standards for light-duty vehicles of model year 2004 onwards will lower emissions considerably by the year 2020, whereas California Low Emission Vehicle II standards will accrue little incremental benefits, (ii) by 2020 the light-duty gasoline vehicles will be relatively minor contributors of NO_x and VOC emissions compared to other regional sources, and (iii) the cost-effectiveness of the implementation of the Tier 2 emission standards for light-duty vehicles compares favourably with that of the current Scrap-It program.

It is to be noted that the CAR Fund was not used in “estimating health and other benefits associated with the air quality improvements”, and that CPPI’s position on the above cost-benefit estimates has been recognized in the Disclaimer and in an Appendix to the final report issued in January 2000.

2. *“Sustainable Transportation Planning at Simon Fraser University: Analysis, Design and Recommendations”*

In view of the anticipated growth in the next few years in the proposed Burnaby Mountain Community Development, it appears that commuting to and from the Simon Fraser University campus will be primarily by single occupant vehicles. The subject project was proposed by Robert MacDonald, a student of the Simon Fraser University, as the topic for his Master’s thesis. In February 1999, a request for partial funding of an amount between \$15,000 and \$20,000 was submitted to the Steering Committee. The total cost of the project was estimated to be approximately \$34,000. Subsequently, the proponent received commitments from the following six other funding partners: (i) Transport Canada - \$5,000, (ii) BC Ministry of Municipal Affairs - \$6,000, (iii) Simon Fraser University - \$5,000, (iv) Transport Association of Canada - \$4,000, (v) Burnaby Mountain Community Corp., and (vi) BC Hydro - \$1,000. In view of these commitments, the CAR Fund Steering Committee approved \$5,000 in March 1999 with a condition that 60% of this amount would be paid in advance and the remaining 40% after the delivery of the final product. The balance of the total budget is to be made up by Mr. MacDonald from his teaching assistantship.

The project was started in January 1999 with funding from the Simon Fraser University. An advanced payment of \$3,000 from the CAR Fund was made in May 1999. An interim progress report was submitted in August 1999. Robert MacDonald defended his thesis and made a public presentation on February 1st 2000. A final report was submitted to the Steering Committee in February 2000, and the final payment of \$2,000 was made in March 2000.

After reviewing the information on the transportation and land use system, a *Master Sustainable Transportation and Land Use Planning Framework* has been developed and used to investigate a number of transportation and land use policies and transportation demand management strategies. The study results indicate that a minimum of 20% reduction in single-occupant vehicle trips to and from Simon Fraser University is achievable through implementation of the recommended policies and strategies. The *Master Sustainable Transportation and Land Use Planning Framework* can also be used as a template for other communities and local governments for similar purposes.

3. *“Synthetic Diesel Fuel Emissions Testing”*

In August 1999, a proposal for partial funding from CAR Fund was submitted by CPPI for the Phase I of a two-phase project. The overall objectives of the project are to compare: (i) emissions from diesel fuels derived from synthetic crude stock with those from conventional diesel, and (ii) emissions from engines tested by Natural Resources Canada (NRCAN) and Environment Canada and those from a prototype advanced design engine. The Southwest Research Institute, San Antonio, Texas was contracted for \$60,000 to carry out the tests under Phase I of the project.

The Phase I work consisted of collection of emissions data from testing of fuels derived from synthetic crude oils using a current technology diesel engine. Three types of fuels were tested in a prototype engine equipped with exhaust gas recirculation. The work began in October 1999 using contributions from other

partners, namely CPPI, Natural Resources Canada, Syncrude and Suncor. A CAR funding of \$15,000 was approved by the Steering Committee in January 2000.

The key findings in the final report, submitted to CPPI in April 2000, are as follows: The reference fuel selected for the program provides a good basis for comparison of the effects of three test fuels. All three test fuels resulted in reduced emissions of particulates and nitrogen oxides, but increased emissions of hydrocarbons and carbon monoxide, as compared to the average emissions from reference fuels. The specific fuel consumption was also reduced with each test fuel in comparison to that with the reference fuel.

4. *“Light Duty Vehicle Fine Particulate Matter Emission”*

The CAR funding for the project was approved in August 1999 to the amount of \$10,000 for sampling and analysis of emissions and \$2,000 in gasoline coupons to procure test vehicles. Other cash contributions of \$100,000 and \$65,000 were received from PERD and Atmospheric Environment Services, Pacific and Yukon Region respectively. During September - October 1999, Environment Canada, in partnership with AirCare, tested 75 in-use light duty gasoline vehicles on a chassis dynamometer for measurement and detailed analysis of fine particulates and other emissions from light-duty vehicles in the Lower Fraser Valley. The test vehicles ranged from 1978 to 1998 model years, and included both AirCare-passed and -failed vehicles in proportion to represent the vehicle fleet.

The final report was submitted in June 2000. The test results showed that PM_{2.5} (particulate matter of diameter 2.5 micron and smaller) emission varied from 0.25 to 100 mg/mile. On average about two-thirds of the PM_{2.5} consisted of carbon and the remainder was composed of ammonium sulphate and metals, mainly iron and manganese. Nearly half of the manganese was soluble in water. The emissions of ammonia and sulphur dioxide were similar in magnitude, and it ranged from 1 to 300 mg/mile. Emissions of non-methane hydrocarbons and vapour phase organic acids were of similar magnitude. Emissions of non-carbon dioxide greenhouse gases, namely nitrous oxide and methane, were also of similar magnitude and ranged from 1 to 300 mg/mile.

5. *“Okanagan Air Quality Management – Transportation Initiatives for 2000”*

CAR funding of \$5,000 towards two initiatives, Transportation Use Survey and a Statistical Study of Traffic Volumes and Air Quality Monitoring Data, proposed by the City of Kelowna and Central Okanagan Regional District was approved-in-principle by the Steering Committee in April 2000. Only the project on Transportation Use Survey was completed, and an invoice of \$2,900 has been submitted with the final report in September 2000.

The survey of the local residents’ travel pattern was conducted by a consultant, and the results were analyzed by the City of Kelowna staff. A random sample of 400 residents were surveyed by telephone (150) and personal interviews (250). The survey results are considered to be representative of the area’s total population within at least +/- 5%, 19 times out of 20.

The survey provided information on: (1) motor vehicle and bicycle ownership per household, (2) average vehicle kilometres travelled per year, (3) number of trips per week by different mode of travel, (4) trip origin and destination, (5) walking,

bicycling and transit use pattern, and (6) respondents' concern about the effects of motor vehicle use on air pollution and health effects, traffic congestions, and accidents. The respondents also provided their opinions on willingness to change their travel mode and behaviour, their preferences to alternative travel modes, and extent of support of action on transportation demand management by local government.

6. *“Assessment of the Impact of ‘Cold Transient’ Vehicle Operations and Driving Pattern on GHG Emissions from In-use Personal Vehicles”*

In January 2000, the Steering Committee approved CAR funding of \$17,000 towards the total cost of \$47,000 for a project proposed by Instrumental Solutions of Woodlawn, Ontario and AirCare. The scope of the study is to develop a commuter driving behaviour pattern in the Lower Fraser Valley and to determine the effects of cold transient operations of vehicles on fuel use and emissions.

The work on the project started in January 2000, and the final report was submitted in November 2000. The key findings of the study are as follows: (i) limited number of tests indicate that the driving behaviour in the Lower Fraser Valley is different from that considered in the US Federal Test Procedure and consequently the mass emissions of air pollutants are also different; (ii) “the average commute pattern shows higher speeds, more aggressive acceleration and more frequent stop and go traffic than is represented by the EPA 75 test.”, and (iii) the energy use of the vehicles during “cold start” is about 19% higher than average fuel consumption and approximately of the same order of magnitude as was observed in earlier studies.

4.2 Projects In-progress by Year End 2000

1. *“Development of a Fine Particulates Modelling for the Lower Fraser Valley”- Phase II*

Environment Canada, Pacific and Yukon Region is the sponsor of this two-phase project on the development of a regional air quality model for fine particulates in the Lower Fraser Valley. The primary goal of the project is to incorporate a particulate matter module to an existing ground level ozone model (UAM-V) for an integrated assessment of multi-pollutant effects on the air quality. The project was approved by the Steering Committee for an amount of \$50,000. The total budget for the project is \$150,000 and is shared equally among Greater Vancouver Regional District, Environment Canada and CAR Fund.

Phase I of the project, completed in September 1998, recommended the use of the existing Urban Airshed Model-Variable Grid (UAM-V) for ground level ozone for application to fine particulate matter, and to develop a modified UAM-VPM model. The objective of Phase II is to develop and implement the selected model to describe the fine particulates concentration and deposition. The existing air quality monitoring and meteorological data and emission inventory during Pacific '93 field program, and other recent information are being used to test the performance of the UAM-VPM model. The work is continuing with some delays due to problems with the meteorological model. Two interim progress reports on Phase II were submitted in January and June 1999, and a workshop was held in March 1999. Environment Canada has been in discussions with the consultants to resolve problems with the model development.

2. *“Ethanol BC”*

A Steering Committee of stakeholders has been formed. Funding of \$300,000 from the provincial government and \$20,000 Clean Air Research Fund have been received to date. Additional funds from Environment Canada and sawmill beehive burner operators are expected in the near future.

During the fourth quarter no work started on any of the projects under this initiative. The Ethanol BC Steering Committee has approved funding of \$33,600 to Woodlands Incineration to demonstrate a woodwaste gasifier to produce syngas for subsequent conversion to ethanol using bacteria.

3. *“Canadian Synthetic Diesel Fuel Testing Project –Phase 2”*

A detailed proposal for the 2nd Phase of the synthetic diesel fuel study was approved in October 2000. This phase of the study is a continuation of the 1st Phase, completed in April 2000, to test synthetic diesel fuel in an advanced engine to be installed and operated at the National Research Council facility in Ottawa. These emissions will be compared to those from the same engine fuelled by conventional diesel fuel derived from petroleum stock.

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

A proposal was submitted in October 2000 from an M.Sc. student from the Department of Natural Resources and Environmental Studies, University of Northern B. C. for a study 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. An amount of \$10,000 from the CARF was requested towards a total project budget of \$55,000 to be contributed by other partners in cash and in-kind. As the project was approved in December 2000, the first progress report should be submitted in the first Quarter of 2001.

5. *“Improving Behavioural Parameters in transportation Modelling in B. C. and Canada”*

The proposal was received in November 2000 from a graduate student at the Simon Fraser University for a research project to develop better estimates of vehicle driver response to transportation demand management (TDM) measures. A quantitative survey method will be used to address key data gaps in estimating driver response, and the results are expected to aid in policy makers' abilities to evaluate TDM measures for air pollution reduction. The requested amount from CAR fund is \$8,000 towards the total estimated budget of \$24,000; two B. C. Ministries and Environment Canada are to contribute the remainder. The project is to start in November 2000 for a completion date of May 31, 2001.

A decision on this proposal was deferred by the Committee in January 2000, pending submission of further information on the project status by the proponent. As there has been no response from the proponent to date, the proposal is considered to be as inactive.

2. *“Transport Emissions – Inventory and Forecast”*

The proposal was submitted by CPPI in June 2000, and had been discussed with several agencies and other potential partners. However, as GVRD, BC Environment and Environment Canada are preparing the year 2000 emission inventories, it is decided to put this project on hold until the outcome of the discussions on the formation of a CPPI-proposed National Network of Centres of Excellence for the development and maintenance of emission estimation models for mobile sources is known.

3. *“Fine Particulate Matter Emissions and Secondary Aerosol Formation Characteristics of Low Sulphur Fuels in New Technology Vehicles”*

This proposal from Environment Canada was submitted in June 2000. It was considered to be of low priority since it was felt to be national in scope and the amount requested exceeded the CARF limit. The proponent has been advised accordingly, and to date no further action has been taken.

5. **Future Outlook of CAR Fund**

Under the Scrap-It program nearly 1,760 old vehicles have been scrapped during the period March 1996 to December 2000, and the CPPI contribution to the program to December 2000 has been about \$538,550. 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.

From August 1997 to the end of 2000 nearly \$250,000 from the CAR Fund has been contributed towards a number of research projects. In the year 2000, the contribution amounted to about \$80,000. During 1997-2000 the total value of all projects funded by various partners is nearly \$1.2 million. The projects funded to date consisted of basic and applied research, including pilot demonstration of technology, and collection of information for planning purposes. 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, and
- transportation demand management.

Continued financial support from the CAR Fund for research on air quality issues related to transportation and fuels 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.