

# On- and Off-Highway Vehicle Technology at Red River College



## Overview

Manitoba's presence as a major transportation hub is growing, and Red River College (RRC) is fueling that growth with the development of on- and off-highway vehicle technologies. RRC is working with national and international manufacturers on product development, the use of renewable fuels, improving the fuel efficiency of fleets, and demonstrations/evaluations - with an emphasis on extreme weather conditions. The College's new and existing capabilities and expertise are helping to introduce new vehicle technologies through applied research, and train the next generation of skilled workers.

## Capabilities and Expertise

### Advanced Transportation & Energy Centre

The Advanced Transportation & Energy Centre's (ATEC's) 3,000-square-foot research facility at RRC will address the issues of emissions reduction and the integration of alternative, renewable sources of fuels for the transportation sector. Three of Canada's ten largest employers in the for-hire trucking industry are headquartered in Winnipeg, and Winnipeg is home to two of North America's largest bus manufacturers. Applied research efforts have been focused upon the end-user, including: vehicle cold-weather testing; vehicle-emissions testing; optimization of fuel economy and emissions; and alternative and renewable fuels utilization and implementation. ATEC's research infrastructure will ultimately include: a drive-in environmental chamber large enough to accommodate a highway bus; a 1,000-HP chassis and a 1,000-HP engine dynamometer; and a multi-fuel station (hydrogen, bio-diesel, electricity and ethanol).

### Electric Vehicle Technology & Education Centre

RRC developed the Electric Vehicle Technology & Education Centre (EVTEC) with the support of the Province of Manitoba to help raise awareness of electric vehicle technology, test and demonstrate electric vehicle technologies, provide access to industry publications and other resources, and allow the College to enhance its applied research and training programs. Catalyzing this initiative has been the Province's collaboration with Mitsubishi Heavy Industries, New Flyer Industries, Manitoba Hydro, and RRC on the \$3-million, three-year project to develop an all-electric transit bus and charging system.

### Centre for Applied Research in Sustainable Infrastructure

The Centre for Applied Research in Sustainable Infrastructure (CARSI) is a state-of-the-art, 10,000-square-foot research facility that incorporates all sustainable-infrastructure applied research into a single building. CARSI's research infrastructure includes two environmental control chambers, one of which is large enough to accommodate a small electric vehicle; -40°C to +40°C (-40°F to 104°F) capabilities with additive humidity control; each side with interior dimensions of 10'10" Wide x 15'2" Deep x 13'7" High.



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## Project Summaries

### All-Electric Transit Bus

In 2011, RRC announced, along with the Province of Manitoba, Mitsubishi Heavy Industries, New Flyer Industries and Manitoba Hydro, the \$3 million, three-year All- Electric Bus - the first of its kind in Canada. After a year in development, the All-Electric Bus prototype made its debut outside the Manitoba Legislative Building on June 1, 2012. Partners were on hand to show off the prototype bus, take attendees for a ride, and explain the technology behind a transit vehicle with zero emissions and no tail pipes. The event marked the beginning of the next phase of the project, which includes on-road testing in Winnipeg through 2014. RRC's contribution to the project is assisting in the development of a charging station for the bus, battery assembly, performance data analysis, and prototype demonstration/evaluation. Video of the bus is available at <http://vimeo.com/61570502> (password: batterybus).

### Mitsubishi Heavy Industries Battery-Pack Integration and Monitoring

In October 2012, Mitsubishi Heavy Industries approached RRC to work together to integrate its battery pack design into New Flyer Industries' Excelsior bus. The work entails developing a structural protective enclosure that will allow six battery packs for the vehicle. RRC will provide technical services (design, 3D modeling, strength and air-flow analysis), as well as fabrication and assembly of the battery packs. RRC will also develop a battery diagnostics program using LabView to test the assembled packs. The battery packs will be complete by the end of July 2013, and battery monitoring and data collection will continue until 2017.

### Plug-in Hybrid Electric Vehicle Fleet Demonstration and Evaluation

As part of one of the largest demonstrations of its kind in Canada, RRC modified nine Toyota Prius vehicles using Hymotion Plug-in Conversion Modules from A123Systems Inc. to operate as plug-in hybrid electric vehicles. RRC evaluated performance of the 10-vehicle demonstration fleet over a three-year period, with special attention to cold-weather operations.

### Reduced-Emission Diesel-Engine Integration

RRC staff and students designed and built a prototype of Motor Coach Industries' 2010 J4500 and 2007 D4500 buses to allow them to accommodate the latest U.S. EPA standards for new reduced-emission engines. RRC worked as part of the project team to design and integrate airflow, water and electrical components to enable the prototypes to meet the new standards.

### Hydrogen-Fuel-Cell-Powered Transit Bus Demonstration

In 2006, RRC operated the bus and hydrogen refueling station as part of the demonstration and testing of the 40-foot, zero-pollution emitting New Flyer Industries vehicle that was outfitted with three HyPM 65 fuel-cell power modules and ultra-capacitors (to recapture energy from the bus's brakes).

### Hybrid Hydrogen Internal Combustion Transit Bus Demonstration

This project was an "in-fare" service demonstration of a hybrid hydrogen bus in cold-weather conditions. RRC staff generated the hydrogen fuel, operated the refueling station, maintained and serviced the bus, and provided troubleshooting expertise.

For more information, please contact:

Ray Hoemsen, P.Eng.  
Director, Applied Research &  
Commercialization Red River College  
[rhoemsen@rrc.ca](mailto:rhoemsen@rrc.ca)

