

## **Purolator's "Greening The Fleet" Initiative – On The Road And Reducing Greenhouse Gas Emissions**

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### **ABSTRACT**

Greenhouse gas (GHG) emissions from developed countries decreased by 5.9%, from 1990 to 2003. However, Canada was noted by the United Nations as having the largest increase (57.5%). Considering the fossil fuels used in transportation represents 26% of GHG emissions in Canada more leadership in implementing Green technologies and solutions is needed. Three years into its "Greening the Fleet" initiative Purolator Courier is aggressively and proactively providing that leadership to the transportation industry.

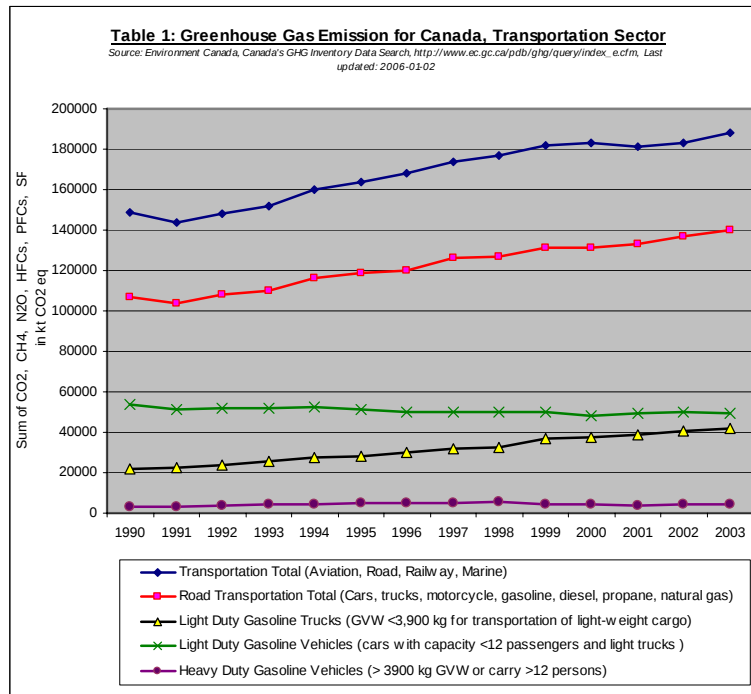
In 2005, ten hybrid electric vehicles (HEVs) and one hydrogen fuel cell hybrid electric vehicle (FCHEV) were deployed into Purolator's courier fleet reducing fuel consumption, GHG and smog causing emissions by 40%. Twelve months of testing have proven from an environmental, technical and economic perspective, that hybrid electric vehicles are feasible in the commercial fleet environment. After having driven over 70,000 kilometres, Purolator continues to believe in its Green technologies. And its commitment is demonstrated by the fact it has ordered another 115 hybrid electric vehicles to be delivered in 2006 and 2007.

Purolator will realize significant operational efficiencies, support Canada's commitment to the Kyoto protocol, reduce smog causing emissions in major urban centres and help incubate sustainable hybrid electric and fuel cell industries in Canada by continuing this initiative.

### **The Issue: Greenhouse Gases - Truck Energy and Emissions**

As part of its commitment to the Kyoto protocol Canada agreed to reduce its greenhouse gas emissions to 6% below 1990 levels by the 2008 – 2012 period, which means that emissions will have to be 20-25% below their projected level.<sup>i</sup> Recent studies have shown that greenhouse gas (GHG) emissions from developed countries decreased by 5.9%, from 1990 to 2003. However, Canada has been noted by the United Nations Climate Change Secretariat as having the largest increase (57.5%) of any developed country.<sup>ii</sup>

In 2002, the Environmental Affairs Branch of Industry Canada reported that *“Transportation currently generates more GHG emissions than any other sector. The use of fossil fuels in transportation represents 26 percent of GHG emissions in Canada, particularly carbon dioxide (CO<sub>2</sub>) and nitrous oxide (N<sub>2</sub>O).”*<sup>iii</sup> Transportation emissions have continued to grow and within the transportation sector truck energy use has been a leading contributor. During the period from 1990 to 2003 GHG emissions from Light Duty Gasoline Trucks (GVW <3,900 kg for transportation of light-weight cargo) have increased by 93%. As a comparison, emissions from Light Duty Gasoline Vehicles (cars with capacity <12 passengers and light trucks ) decreased by 8% over the same period. (See Table 1)



Up until 2000, trucks were not subject to the same fuel efficiency or government emissions standards. At the same time, medium and heavy trucks usage experienced strong growth. Any effective strategy for reducing GHG emissions in Canada must include a short and long-term strategy to reduce emissions from these vehicles. Considering the fossil fuels used in transportation represents 26% of GHG emissions in Canada more leadership in implementing improved technologies and other solutions is also necessary. Specifically, Canada needs to deploy more “Green” technologies such as hybrid electric and fuel cell vehicles.

## **The Opportunity**

Purolator's Greening the Fleet initiative not only encourages but challenges other fleet operators and their employees to contribute to a "greener", more sustainable Canada. From the project's inception, one of the main goals has been to apply principles of sustainable development and to use the company's own fleet of curbside delivery vans to prove the commercial viability, environmental and societal benefits of the HEVs and FCHEVs for the transportation sector. This project has a wide range of potential applications within the transportation sector, as similarly-sized duty trucks are used by the courier, mail delivery, food and beverage industry, service contract industry and service trucks used by Canada's largest municipalities. As Purolator has one of the largest commercial fleets in the country, it has the power to make a significant difference to our environment, public health and the future of the "green" vehicle market.

The company's initial findings indicate that it is possible to significantly cut fuel consumption and reduce GHGs and other emissions in a cost-effective way. Purolator's Greening the Fleet initiative has validated results contained in a 2001 report "Greening the Canadian Courier Fleet: Strategies for Improved Fuel Efficiency" which was submitted to Greenpeace and Sierra Legal Defence Fund. The findings of this Torrie Smith Associates (2001) report support Purolator's vision that reducing fuel consumption in courier vehicles by 50% is within the reach of available and cost effective technologies. The report further supported Purolator's belief that how quickly the target can be achieved depends on the level of leadership and initiative taken by the industry. The Torrie Smith Associates report concluded:

*"Technologically demonstrated and cost effective improvements in the fuel efficiency of the pickup-and-delivery vans used by courier companies and other urban delivery services are available now (2001) but need to be deployed at a much greater rate if the greenhouse gas and air pollution from these vehicles is to be brought down to safe levels."*<sup>iv</sup>

Purolator believes that a stepped, integrated approach is key to the successful implementation of green technology. Such an approach has allowed Purolator to analyze and improve the various components of the entire system (i.e., diesel engine, battery, electric drive, power storage, diesel generator, fuel cell module, hydrogen storage and delivery systems, etc.). By analyzing all system components at each step along the way, the company has been able to realize significant efficiencies, and emission reductions, in the implementation of green technologies.

#### **Purolator's "Greening the Fleet" Initiative – Three Years After**

Three years into its "Greening the Fleet" initiative Purolator Courier is aggressively and proactively providing leadership to the transportation sector. The vision for the Greening the Fleet initiative is to replace its national fleet of 3,000 urban delivery vehicles with two types of environmentally superior vehicles: HEVs and hydrogen FCHEVs.

The curbside delivery van is at the core of Purolator's operation. The company has an extensive delivery network that delivers more packages to more destination points in Canada than any other courier. Handling more than 6.1 million pieces each week, Purolator's network consists of 143 operation facilities across Canada including three main hub facilities, 14 regional depot/hubs and 12 foot-courier locations, 170 shipping centres, over 500 authorized shipping agents, more than 480 drop boxes and customer contact centres (in Moncton and Montreal).

To move the volumes that Purolator does, more than a million pieces each day, an extensive infrastructure of materials processing facilities, transportation vehicles and personnel are required. Purolator boasts the largest ground fleet of any Canadian courier. It has more than 3,100 courier vans, 358 medium trucks, 800 highway trailers, and 340 tractors. It also has the largest dedicated air express fleet in Canada with over 25 dedicated chartered aircraft and 686

aircraft support equipment moving more than 400,000 pounds of air freight each night.

Purolator's vision is ambitious in scope, requiring the development and deployment of new technologies with a number of partners in order to realize a fleet of vehicles that will significantly reduce energy consumption, air and noise pollution. While embarking on a journey of technical innovation, Purolator's goal is to marry environmental benefits with a sound economic model that will lay the foundation for revolutionary developments in the light and medium truck industry of Canada.

#### Hybrid Electric Vehicle

The first phase of Purolator's Greening the Fleet initiative was 'on-the-road' in October 2002, when Azure Dynamics delivered to Purolator a trial hybrid diesel-electric vehicle. This vehicle was used for parcel delivery in Vancouver and then in Alberta to test its cold weather suitability. Based on the success of the initial tests Purolator signed a deal with Azure to introduce second-generation HEVs into its fleet. In 2005, ten hybrid electric were deployed into Purolator's courier fleet. All HEVs were introduced into the city of Toronto where air pollution is of particular concern. The goals were a 50% reduction in GHGs currently emitted by conventional courier vehicles and to significantly reduce other pollutants such as smog causing emissions.

In 2005, the 10 HEVs deployed had over 1,175 operating days and drove 70,850 kilometers (as of Jan. 31, 2006). **Fuel consumption and GHG emissions from the HEVs were 40% lower (on average) compared to Purolator's current curbside gasoline powered vehicle. This equates to consuming 10,628 fewer liters of fuel, preventing the emission of 25,081 kilograms of CO<sub>2</sub>, 2 kilograms CH<sub>4</sub> and 11 kilograms N<sub>2</sub>O.** In summary, Phase 1 has proven a success as it substantially reduced GHG and smog-causing emissions, fuel consumption and operating costs.

### Hydrogen Fuel Cell Hybrid Electric Vehicle

In 2005, Purolator road tested its first prototype of a zero-emissions hydrogen FCHEV on a parcel delivery route in Toronto. Purolator's FCHEV is the first courier delivery vehicle of its kind in Canada and was developed by Purolator and its partners Hydrogenics Corporation, Natural Resources Canada and Industry Canada. This vehicle was refueled with hydrogen produced and stored using Purolator's on-site electrolyzer fuelling station.

The FCHEV system consists of a fuel cell power module and high capacity battery storage system optimized to deliver and manage the vehicle propulsion system. As this project is based on the HEV platform, it involved replacing the diesel genset with the fuel cell – which works in combination with high capacity batteries to provide all of the vehicle's power requirements. The integration of a fuel cell to replace the diesel genset is the second technological step essential in the validation of the FCHEV platform. This step is providing a 'leading edge' snapshot for Purolator in its quest to "green" its curbside fleet. It is providing a direct comparison of the economics of hydrogen fuel, FCHEV overall performance versus the diesel/battery HEV.

This program is also demonstrating on-site refueling of hydrogen and its role in the future hydrogen infrastructure as it pertains to fleet operations. Purolator believes that combining the FCHEV with on-site hydrogen production, storage and refueling in a commercial fleet setting, is a "global first". For this project, Hydrogenics' used its fuel cell Proton Exchange Membrane (PEM) expertise to develop a PEM electrolyzer platform that produces hydrogen via water electrolysis. In this platform conventional city water is conditioned and used as the fuel to produce hydrogen.

This electrolysis process requires grid connection and approximately 150 kilowatts of electricity to produce 70 kilograms of hydrogen per day. The remaining by-product, oxygen, is vented into the atmosphere. The hydrogen is then compressed into on-site steel hydrogen cylinders and stored at 6000 psi in cylinders that are

attached to a hydrogen refueling station. This station delivers hydrogen at 5000 psi as the fuel for the FCHEV.

The current refueller has enough capacity to satisfy the requirements of 5 to 6 FCHEV curbside vans. Purolator's hydrogen refueler (electrolyzer) was assembled in the summer of 2005. Based on the Federal Government's desire to create a network of hydrogen refueling stations, Purolator is at the fore-front in terms of being able to demonstrate the feasibility for companies with fleets.

In terms of progress to date, the FCHEV was fully operational the summer of 2005, and operated on urban courier routes in the city of Toronto. The FCHEV eliminated 100% of GHGs and smog-causing emissions currently emitted from conventional gasoline/diesel delivery vehicles. And, Purolator is now in the process of establishing funding for another five FCHEVs.

Purolator believes a whole new sector providing low and zero emission delivery vehicles is being set in motion. In September 2005 Purolator placed an order for another 115 HEVs to be delivered in 2006 and 2007. This will bring the total number of HEVs in the fleet to 134. The initiative could lead the way for an extraordinary effect on the air quality of Canada's largest cities. If commercial HEVs were on urban roads rather than current standard gasoline and diesel vehicles, significant reductions in greenhouse gas and smog-causing emissions would occur which would have a substantial positive impact on the health of Canadian citizens.

#### **Commercialization of Technology Within Purolator's Operations & In Partnership**

In order to create the vehicles envisioned by the Greening the Fleet initiative, Purolator pulled together a consortium of cutting-edge technology companies and government funding agencies. Purolator pursued and formed partnerships with Hydrogenics Corporation of Mississauga, Azure Dynamics of Vancouver, Unicell Ltd. and

Natural Resources Canada (the Canadian Transportation and Fuel Cells Alliance Program) and Industry Canada (Technology Partnerships Canada's h2 Early Adopters Program).

Azure Dynamics Corporation develops and produces electric and hybrid-electric commercial and military vehicles. It has delivered more than 4,000 vehicles to its customers, including the Purolator prototype HEV and the second-generation curbside van.

The development of a zero-emission FCHEV delivery van by Purolator and its consortium partners involves the integration of hydrogen-compatible technologies, combining current state-of-the-art fuel-cell technology, batteries and ultra-capacitors. The technology supplier, lead proponent and program manager for the fuel-cell project is Hydrogenics. This corporation is a global leader in the development of fuel cell technologies.

Consortium member Unicell Limited is involved in designing and producing specialized truck bodies for the FCHEV that include lightweight materials, wheel-hub motors and a lower vehicle floor. These features will help to improve the overall design of the FCHEV by enhancing the vehicle's aerodynamics, energy efficiency and ergonomics. Unicell is the largest Canadian-owned truck body manufacturer. It has designed five completely new truck bodies, which are industry leading, premium products, sold throughout North America.

Another important member of the consortium is the Government of Canada. Purolator's initiative has received funding and support from two federal programs, NRCan being the primary funding partner. The Canadian Transportation Fuel Cell Alliance program was created to demonstrate and evaluate different fuelling options for fuel cell vehicles. The program is also analyzing the ways the fuel may be delivered to vehicles, establish safety standards for fuelling stations, and develop training and certification programs for the people who install and maintain those stations. Technology Partnerships Canada's h2 Early Adopters Program was designed to demonstrate new

hydrogen technology concepts. Industry Canada anticipates that h2EA program will lead efforts to demonstrate new concepts, such as “hydrogen highways” and “hydrogen villages.”

### **Technology Application To Reduce Environmental Impacts**

Purolator’s Greening the Fleet initiative not only encourages but challenges other fleet operators and their employees to contribute to a “greener”, more sustainable Canada. From the project’s inception, one of the main goals has been to apply principles of sustainable development and to use the company’s own fleet of curbside delivery vans to prove the commercial viability, environmental and societal benefits of the HEVs and FCHEVs for the transportation sector. This project has a wide range of potential applications within the transportation sector, as similarly-sized duty trucks are used by the courier, mail delivery, food and beverage industry, service contract industry and service trucks used by Canada’s largest cities.

As Purolator has one of the largest commercial fleets in the country, it has the power to make a significant difference to our environment and public health. Once Purolator has converted a total of 134 conventional delivery vehicles to HEVs in the next two years it is estimated that GHG emissions will be reduced by over 1,400 tonnes annually. Other air contaminants such as smog-causing emissions will also be reduced, which supports efforts to improve urban air quality and reduce the impact on the health of Canadians. And, once 134 courier vehicles are converted to HEVs resource consumption (fuel usage) will be reduced by over 500,000 litres annually.

Purolator’s strong visionary role in championing low-emission HEVs and zero-emission FCHEVs illustrates their commitment to reducing emissions of GHGs. It also demonstrates commitment to advancing Canada’s support for the Kyoto protocol and promotion of the HEV industry, the fuel-cell industry and the hydrogen economy. Purolator wants to lead by example and inspire others in the transportation industry to strive toward putting greener technologies on Canada’s streets.

## **Conclusion**

The company's initial findings indicate that it is possible to significantly cut fuel consumption and reduce GHGs and other emissions in a cost-effective way. Purolator has validated the results contained in the 2001 report "Greening the Canadian Courier Fleet: Strategies for Improved Fuel Efficiency" submitted to Greenpeace and Sierra Legal Defence Fund. In 2005, the 10 HEVs operated more than 1,175 days and drove 70,850 kilometers. Fuel consumption and GHG emissions from the HEVs were 40% lower (on average) compared to Purolator's current curbside gasoline powered vehicle. This equates to consuming 10,628 fewer liters of fuel, preventing the emission of 25,081 kilograms of CO<sub>2</sub>, 2 kilograms CH<sub>4</sub> and 11 kilograms N<sub>2</sub>O.

Regardless of whether Canada continues to commit to the Kyoto protocol this initiative remains highly relevant to the priorities of reducing resource consumption, in particular fossil fuels, the emission of GHGs and smog-causing emissions. This project is breaking new ground for HEVs, fuel-cell science and battery technology. It has combined technologies in a new way to meet the needs of the fleet.

By seeking to create a viable low-emission fleet, where there are none, creative thinking and innovation must be applied at every stage, whether that's developing trucks, infrastructure, or standards for handling hydrogen fuel. One of the hurdles to commercialization of some "green" technologies used in this initiative was the lack of hydrogen supply infrastructure. Purolator adapted to solve the problem working with Hydrogenics to develop an on-site hydrogen production unit. Success here will demonstrate the viability of hydrogen as a safe, economic and non-polluting fuel in a commercial fleet environment.

Furthermore, from this initiative Purolator is helping to establish codes and standards for the operation and maintenance of HEV and FCHEVs and the production, storage and safe handling of the

hydrogen. These codes and standards can serve as a template for other transportation industries as they begin to adopt fuel-cell technologies and embrace the hydrogen economy. They will also assist with adapting and applying these and other technologies to meet changing applications and needs.

The successful use of these innovative technologies support the principles of sustainable development for Canada and provide a sound and viable roadmap for honouring Canada's commitment under the Kyoto Accord. It will help spawn a new hybrid light-truck industry for Canada, creating jobs that will attract and retain skilled workers in this sector. It also helps position Canada as a leader in technologies that can help meeting changing environmental priorities and applications world-wide.

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<sup>i</sup> The State of Energy Efficiency in Canada in 1999 - Annual Report of the Office of Energy Efficiency, Natural Resources Canada.

<sup>ii</sup> *Key GHG data - Greenhouse Gas Emissions Data for 1990 – 2003* submitted to the United Nations Framework Convention on Climate Change (2005) United Nations Climate Change Secretariat, Bonn

<sup>iii</sup> Environmental Affairs Branch Industry Canada (2002), *The Kyoto Protocol and Industry Growth Opportunities: Input to the AMG Working Group*,  
[http://www.nccp.ca/NCCP/national\\_stakeholders/pdf/competitiveness\\_bkg\\_studies/FINAL\\_growth\\_industries.pdf](http://www.nccp.ca/NCCP/national_stakeholders/pdf/competitiveness_bkg_studies/FINAL_growth_industries.pdf)

<sup>iv</sup> *Greening the Canadian Courier Fleet – Strategies for Improved Fuel Efficiency* Final Report Submitted to Greenpeace and Sierra Legal Defence Fund by Torrie Smith Associates Inc., 2001