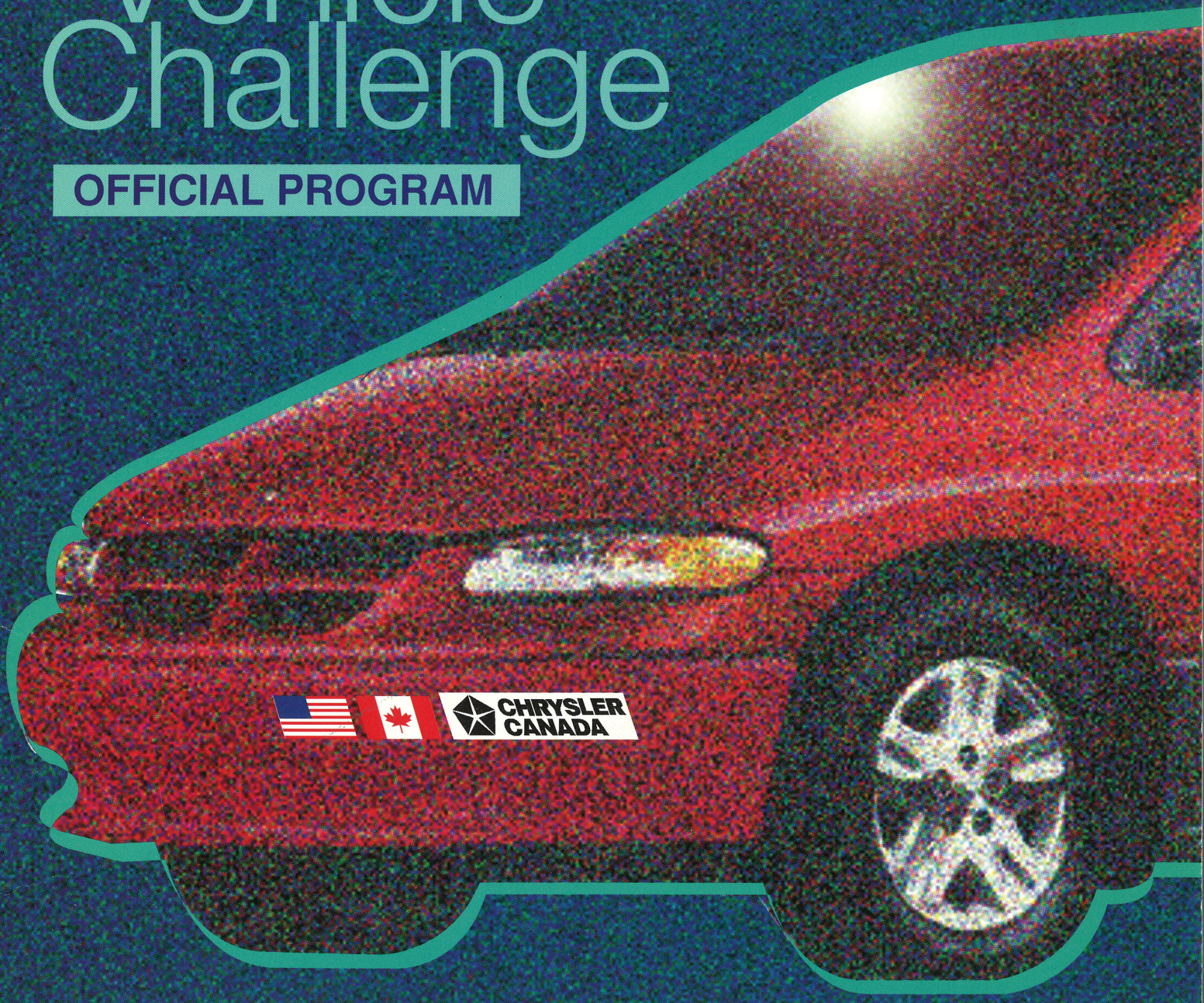
# 1996 PROPANE Vehicle Challenge

## OFFICIAL PROGRAM




May 29 - June 4, 1996

Windsor & Toronto, Ontario, Canada

PROPANE VEHICLE CHALLENGE

Natural Resources Canada | Ressources naturelles Canada

# News Release

## NATURAL RESOURCES CANADA PARTICIPATES IN THE 1996 PROPANE VEHICLE CHALLENGE FOR STUDENTS

OTTAWA—Anne McLellan, Minister of Natural Resources Canada (NRCan), today announced NRCan's participation in the 1996 Propane Vehicle Challenge for students.

"NRCan's involvement in the 1996 Propane Vehicle Challenge reflects the importance this government places on advanced technology that contributes to sustainable development," said Minister McLellan. "Alternative transportation fuels are important in helping Canada meet its international climate change commitments. Furthermore, environmental technology makes good business sense."

This annual North America-wide competition challenges science and engineering students to design environmentally friendly vehicles which run on alternative power sources. This year's Challenge asks students to convert gasoline-fueled vehicles to dedicated propane operation.

The 1996 event, which promises to be one of the most rigorous and rewarding competitions of its kind, will involve more than 100 students from 12 universities across Canada and the United States. The two Canadian universities joining the challenge are the University of Alberta, and the University of Quebec (École de Technologie Supérieure). At least one canadian university team has consistently placed in the top four since 1989.

"In the recent Speech from the Throne, our government made a strong commitment to youth and to providing support for science and technology initiatives. NRCan's participation in the 1996 Propane Vehicle Challenge for students demonstrates this commitment. NRCan is determined to capture the benefits of this S&T partnership to support its sustainable development goals, while at the same time promote a stronger science culture among Canada's youth," said Minister McLellan.

The University of Windsor and Chrysler Canada Limited will be hosting this year's Challenge. It will take place at the University of Windsor/Chrysler Canada Automotive Research and Development Centre in Windsor from May 30 to June 4. Sponsors are NRCan's Canada Centre for Mineral and Energy Technology (CANMET), a research and development arm of the department; the United States Department of Energy; and Chrysler Canada.

The Challenge is an excellent opportunity for some of North America's top science and engineering students to demonstrate progress in the alternative transportation technology. It also raises public awareness of alternative transportation fuels and highlights NRCan's role in the development of alternative energy technology. NRCan will be providing $120,000 towards the total $800,000 cost of the competition.

Funding for this initiative was provided for in the March 1996 federal budget and is therefore built into the existing fiscal framework. This initiative is an example of how this government is prioritizing its spending so that it can better serve Canadians by making efficient us of their tax dollars.

For further information, please contact:

Lisa Hart
Press Secretary
Minister's Office
(613) 996-2007

Bryan Cook
Director General
Energy Technology Branch- CANMET
(613) 996-8109

'96 PROPANE VEHICLE CHALLENGE

# ABOUT THE CHALLENGE

The 1996 Propane Vehicle Challenge is a student engineering competition cosponsored by Natural Resources Canada, U.S. Department of Energy, and Chrysler Canada. It is designed to provide future engineers with unique educational opportunities to design, build, and test real-world propane-fueled vehicles.

Students from a variety of disciplines, including engineering, computer science, business, and communications have the opportunity to work together in vehicle development teams. Beginning with conventional 1996 Chrysler minivan platforms, the teams develop dedicated propane vehicles, while maintaining the performance that consumers expect from gasoline vehicles.

Safety, energy efficiency, and the use of alternative fuels are the cornerstones of the Propane Vehicle Challenge. This competition explores a range of new approaches which will improve the performance of propane vehicles.

The teams will compete in a series of dynamic and static events at the Chrysler Canada and University of Windsor facilities in Windsor. When these are complete, the teams will embark on an over-the-road range event from Windsor to Toronto. While in Toronto, the finalists in the design competition will present their design strategies before an audience at the Windsor Workshop on Alternative Fuels. Conference participants will view the vehicles and cast their vote for the winner of this event. At the conclusion of the competition events, awards will be presented at a ceremony at Nathan Phillips Square in Toronto.

PROPANE VEHICLE CHALLENGE

**Department of Energy**
Washington, DC 20585

May 30, 1996

Welcome Propane Vehicle Challengers!

I am pleased to see that many of same schools which competed in other DOE-sponsored competitions have returned for the 1996 Propane Vehicle Challenge--along with some new teams--to make this year's Challenge especially exciting.

The Propane Vehicle Challenge is a milestone event. It is the first time the Department of Energy (DOE) has ever sponsored a competition in Canada and it is the first competition designed specifically to demonstrate the performance of propane as a transportation fuel. With this competition as a beginning, we hope to learn more about improving engine efficiency so that propane can ultimately produce the range that we get from conventional vehicles. We hope to evaluate new ways of storing propane onboard that are both lightweight and inexpensive. And finally, we would like to continue to evaluate the emissions of competition vehicles to see how (or if) they change over time. Our goal, of course, is to firmly establish propane as a viable alternative to gasoline.

Chrysler Canada has been a superb host and co-sponsor, and we are pleased once again to be working with Natural Resources Canada. This is a partnership which has continued productively for many years.

I wish you all success (and luck, too!) during the week's events and look forward to following your achievements in the future. And, I hope to see each school competing again next year in Texas when we embark on the second year of Propane Vehicle Challenge.

Sincerely,

Thomas J. Gross
Deputy Assistant Secretary
Office of Transportation Technologies
Energy Efficiency and Renewable Energy

Printed with soy ink on recycled paper

'96 PROPANE VEHICLE CHALLENGE

# WHY PROPANE?

Propane is used as a transportation fuel by more than 350,000 vehicles in the United States and more than 170,000 vehicles in Canada. Although it has been used consistently as an agricultural transportation fuel for 60 years, it is only recently that Chrysler Canada and Ford began to produce and market propane vehicles in Canada and/or the U.S.

Propane is a by-product of natural gas processing; it also comes from crude oil refining. Propane has the potential to improve exhaust emissions, has a reasonable range, and has significant potential for infrastructure expansion. There are currently about 10,000 propane vehicle stations in the U.S. and 5,000 in Canada.

Like all alternative fuels, propane needs improvement before it can compete equally with gasoline. Some of the challenges faced by the propane transportation industry include the need for:

- Improved on-board storage that is lightweight, inexpensive and safe;
- improved engine efficiency so that the driving range will extend;
- confirmation of propane as a low emission fuel; and
- verification of emission characteristics over time.

These are some of the technical issues that student teams will be working on in the 1996 Propane Vehicle Challenge.

PROPANE VEHICLE CHALLENGE

CHRYSLER CANADA
Official Sponsor of the Canadian Olympic Team

**TO ALL PROPANE VEHICLE CHALLENGE PARTICIPANTS:**

Welcome to the Automotive Capital of Canada!

The Canadian automobile industry was born right here in Windsor, Ontario more than 90 years ago. The Chrysler Corporation of Canada - - Chrysler Canada today - - was founded in Windsor on June 17, 1925 only eleven days after Walter P. Chrysler founded the Chrysler Corporation across the river in Detroit.

Today, Chrysler is the only manufacturer still building vehicles in Windsor. Our Windsor Assembly Plant is the home of Chrysler's industry-leading minivans. The first Chrysler minivan was built in our Windsor plant in 1983. Since then, more than three million of these industry-leading vehicles have rolled out of the Windsor Assembly Plant destined for Chrysler's North American and oversees export markets.

Chrysler Canada is pleased and extremely proud to be co-hosting the 1996 Propane Vehicle Challenge in the brand-new University of Windsor/Chrysler Canada Automotive Research and Development Centre.

The first jointly operated automotive research facility of its kind in Canada, the University of Windsor/Chrysler Canada Automotive Research and Development Centre will pursue niche research in new automotive product technology. The university/industry link is essential to more effectively direct educational programs towards addressing the needs of the automotive industry for future high-technology job requirements.

We're delighted that the 1996 Propane Vehicle Challenge is the premiere public event at this unique automotive engineering facility. The Propane Vehicle Challenge is a genuinely exciting hands-on educational project which will be of substantial benefit to all of the participating students, and Chrysler, in advancing practical alternate fuel vehicle technology research.

Sincere best wishes for an enjoyable, and productive, vehicle design challenge.

G. Yves Landry
President and Chief Executive Officer

Chrysler Canada
At Point of Mailing

PROPANE VEHICLE CHALLENGE

# KEY SPONSORS

## Natural Resources Canada

Natural Resources Canada, through its research and technology development arm, CANMET (Canada Centre for Mineral and Energy Technology), is a proud sponsor of the 1996 Propane Vehicle Challenge. By combining the next generation of technical innovators with some of North America's emerging alternative transportation technologies, the Propane Challenge is helping to ensure a sustainable, environmentally responsible transportation future.

## U.S. Department of Energy

DOE has been sponsoring student vehicle competitions since 1989. Over 13,000 students have received hands-on engineering experience in competitions which demonstrate the performance of all types of advanced vehicle technologies. Many of these students move on to take jobs in the automobile industry, bringing with them an understanding of and enthusiasm for these technologies that has not existed in the past.

## CHRYSLER CANADA

Chrysler Canada has been a strong proponent of alternative fuels for several years. It has introduced several compressed natural gas (CNG) platforms, including full-size vans and wagons, minivans, and a full-size pickup truck. It has also manufactured an M-85 Intrepid Flex-Fuel Vehicle and plans to introduce a full-size propane van and wagon.

# 1996 Propane Vehicle C

## Wednesday, May 29 - Thursday, May 30

- Student teams will arrive on Wednesday and Thursday at the Chrysler facilities in Windsor. Vehicle registration and pit assignments will take place during both these days.
- On Thursday at 8:30a, **Safety and Technical Inspections** will begin at Chrysler Canada's R&D Centre and continue throughout the day. Vehicles will be checked for overall safety and to ensure compliance with Challenge rules.
- All participants must attend the safety meeting at 6:30p. Safety procedures, last minute changes, questions regarding the competition, and other important information will be discussed.
- SKIT NIGHT! Join us for food and fun as each team offers to amuse and entertain us following the safety meeting.

## Friday, May 31

- Last chance to pass the safety and technical inspection!
- Chrysler plant tours begin at 1:30p for those interested.
- **Driveability Testing** begins at 8:00a. A judge will drive each competition vehicle and compare its driveability with a comparable gasoline vehicle.
- At 8:00a vehicles will begin **Cold Start Testing**. At 8:30a vehicles will begin **Hot Start Testing** using the same procedure.
- All vehicles drive to Chrysler's Highland Park, MI facility for emissions and fuel economy testing at 6:00p.

## Saturday, June 1

- Vehicles undergo dynamometer testing to measure the total amount of pollutants produced during operation and the fuel economy. Vehicles will be run on a full FTP cycle to determine **Emissions** and **Fuel Economy** measurements, and a Highway Fuel Economy Dynamometer Schedule (HFEDS) for fuel economy. Exhaust gases will be sampled before and after the catalyst in order to measure catalytic converter efficiency.

While emissions/fuel economy testing is underway in Highland Park, **Oral Presentations** will take place at the University of Windsor. Two members from each team will make a 15-minute presentation to a panel of judges and answer questions for an additional 5 minutes. They will describe their approach to the conversion, fuel economy, emission control, cold and hot start, driveability, and performance enhancement strategies. The presentation will be judged on content, format, and delivery. These sessions are open only to members of the presenting team. The top two presentation teams will have the opportunity to deliver their presentations again in Toronto before a new panel of judges at the Windsor Workshop on Alternative Fuels on June 4.

### EVENT SCORING

| Event | Points | Bonus Points |
|---|---|---|
| **Emissions** | 200 | 50 |
| **Design** | | |
| Written design report | 75 | N/A |
| Vehicle design inspection | 75 | N/A |
| Oral design presentation | 25 | N/A |
| **Fuel Economy** | | |
| Range Event | 100 | N/A |
| EPA combined (55% City/45% Hway) | 100 | N/A |
| **Performance** | | |
| Cold-start | 25 | N/A |
| Hot-start | 25 | N/A |
| Acceleration | 75 | N/A |
| Driveability | 75 | N/A |
| Solo | 75 | N/A |
| Range | 150 | 2 points/16 X-km |
| **Total Points** | 1,000 | |

# Challenge Competition Schedule

## Sunday, June 2

- From 9:00a to noon, vehicles will be displayed at the University of Windsor for judges for the **Design Inspection Event**. Teams will select up to three members to be present during the inspection to answer questions from the judges. No other team members may participate in the design judging event.
- **Acceleration Event** begins at 1:30. Vehicles will be timed over a 1/8-mile straight-line course from a standing start. During acceleration, the noise of the vehicle will be measured. Vehicles exceeding 80dBA will be penalized.
- **Solo Event** begins at 3:30. Vehicles will be tested in a series of acceleration, braking, slalom, and obstacle-avoidance situations. The objective of the event is to finish with the minimum amount of time. Each team will be allowed two runs by each of two drivers; the fastest of the four runs will be used for the team's time.

## Monday, June 3

- Vehicles depart Windsor for Toronto to determine maximum **Range** and **On-road Fuel Economy.** Two team members, plus a judge will be in each minivan. The judge will record the final position of the minivan in case the vehicle runs out of fuel before the final destination. This final position will be used to calculate the final range of the vehicle and the total points for the event. The fuel consumed during the event will also be calculated.

## Tuesday, June 4

- Final **Oral Presentation** and **Design Review** judging occurs for top two teams at the Windsor Workshop on Alternative Fuels from 8:00 to noon.
- Presentation of awards at Nathan Phillips Square at noon.
- Luncheon at Toronto Colony Hotel at 12:45.


Range: On-road fuel economy event as vehicles travel from Windsor to Toronto.

MEET THE TEAMS

# GMI Engineering & Management Institute

**Vehicle Name/Number:** 11

**Team Leader:** Simon Kwan and Eric Anderson

**Faculty Advisor:** Dr. Pinhas Barak, Dr. B. Chehroudi, Prof. Ubong

**Team Members:** Renee Hughes, Todd Tischler, Asaf Salama, Jeanine Asch, Karl Zeising, Angela Klein, Lorena Dan, Kevin Varnes, Jamieson Provan, Mike Perkins, Marc Baker, Ryan Brown, John Celmins, Seokhyun Eun, Bryan Cill, Nick Harasymiw, Tim Kish, Mike Miller, Thanh Nguyen, Brent Parde, Marc Scodellar, Slaven Slijivar, Jason Trotter, Kevin Varnes, Frank LoScrudata, Shawn Dill, Brandon Taylor, Brian Dunbar.

**Vehicle Strategy:** The GMI team will use a combination of modified pistons, intake manifold, and specialized fuel injectors. We will raise the compression ratio to about 12.2: 1, and have designed our own fuel tank.

# The University of Texas at Austin

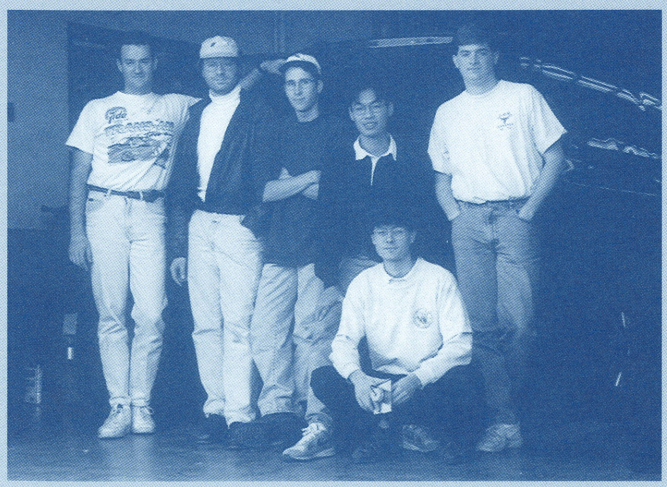
**Vehicle Name/Number:** 3

**Team Leader:** Mark Walls

**Faculty Advisors:** Dr. Ron Matthews
Dr. Matt Hall

**Team Members:** Rudy Stanglmaier, Michael Muhlert, Steve Johnson, Dimitrios Dardalis, Juang Mok, Martin Lin.

**Vehicle Strategy:** Sequential liquid-phase injection of propane.



# Western Washington University

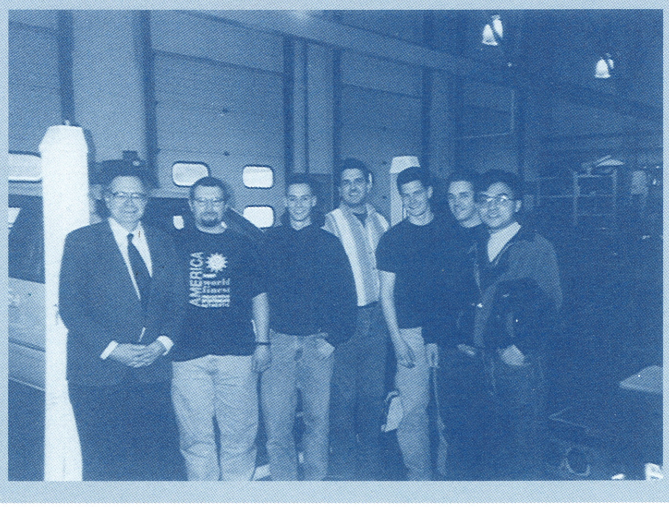
**Vehicle Name/Number:** Viking 27 / 1

**Team Leader:** Chris Gallager

**Faculty Advisor:** Dr. Michael Seal

**Team Members:** Eric Rosen, Yan Guo, Leo Schimdt, David Kaplan, Michael Gatza, Matt Botting, Sean O.

**Vehicle Strategy:** Our primary goal is to achieve high fuel efficiency while maintaining the emission benefits of propane. Using a standard conversion approach to propane, we will use a 21 gallon tank mounted under the tailgate and an additional tank, approx. 10 gal., mounted before the rear axle. Additional equipment will include the necessary requirements for propane fuel.



MEET THE TEAMS

# The University of Texas at El Paso (UTEP)

**Vehicle Name/Number:** 2

**Team Leader:** Simon Vega
James Schalla

**Faculty Advisor:** Dr. Ryan Wicker

**Team Members:** Luis Andrade, Lane Fisher, Dave Holloway, Ruben Muro, Scott Olsen, James Schalla, Paul Valdespino.

**Vehicle Strategy:** UTEP will use either gaseous injection or carburetion. It will be combined with a modified intake, compression ratio, and cooling system to provide a vehicle with ultra-low emissions and high fuel economy.

**IN MEMORY OF SIMON VEGA**

**Argonne National Laboratory's Center for Transportation Research will present an award at the 1996 Propane Vehicle Challenge to honor the memory of Simon Vega. Simon Vega, a key member of the University of Texas at El Paso's Propane Vehicle team and Hybrid Electric Vehicle team, died suddenly in an accident on March 15. We have decided to establish the Simon Vega Spirit of Competition Award to be given annually to the collegiate team building an alternative-fueled vehicle that best embodies the positive attitude, abundant energy, and hard work towards goal achievement the Simon stood for.**

# University of Oklahoma

**Vehicle Name/Number:** Turbo Schooner / 4

**Team Captain:** Shane Goodwin
**Co-Captain:** Faruk Muratovik

**Faculty Advisor:** Dr. William Sutton

**Team Members:** Kurt Backlund, Stan Wheeler, David Lynch, Brad Dingus, Danny McCullough, Ed Lickteig.

**Vehicle Strategy:** To increase the performance of the engine running on propane and to reduce natural exhaust emissions. Performance will be enhanced by increasing the compression ratio of the engine by adding a turbocharger. Emissions will be controlled through precise control of airfuel ratio and the use of catalysts specifically designed for propane.

# Cedarville College

**Vehicle Name/Number:** 6

**Team Leader:** Scott Hoadley

**Faculty Advisor:** Chuck Allport

**Team Members:** Eric Anglund, Alyssa Arndt, Daniel Cochrane, Jeffrey Connors, David Edwards, Jeremy Farlow, Stephen Goodenough, Nathan Hart, Daniel Hicks, Jeffrey House, Scott Husband, Tobey Jacobson, Adam Krampe, Greg Larson, Andrew Lawrence, Shawn Lundvall, Cynthia McFadden, John Moodie, Christopher Nolt, Luke Postema, Paul Puryear, Jeffrey Saunders, Daniel Skurdal, Jedediah Smith, Natalie Vandemark, Jonathan Wu, Heather Bosley, Julie Brower, Rhonda Carnahan, Jodie Delich, Angela Pappas, Samantha Sternad, Tricia Walker, Phil Wittmer.

**Vehicle Strategy:** We have taken a parallel path—a conservative approach compatible with the time available this year and some more progressive actions to integrate later. The current configuration is based on gaseous injection, basic engine mods and commercial tanks. The parallel activities are pointed to liquid injection and more custom components.

MEET THE TEAMS

# Villanova University

**Vehicle Name/Number:** 7

**Team Leader:** Christopher M. Reynolds

**Faculty Advisors:** Professor William C. Koffke, P.E.
Dr. John N. Majerus

**Team Members:** Carol A. Mathews, Michael H. Petticord, Christopher M. Reynolds, Robert J. Wimmer, Jr.,

**Vehicle Strategy:** To develop a cost-effective, after-market propane conversion system that utilizes liquid fuel injection and can be accomplished with minimal engine modifications.

# Texas A&M University

**Vehicle Name/Number:** 12

**Team Leader:** Chris Vasiliotis

**Faculty Advisor:** Dr. Make McDermott

**Team Members:** Chris Vasiliotis, Jeff Rashall, David Melcher, Michael Billetdeaux, Jonathan Bloomer, Edward Ferguson, Matthew Fontenot, Jason Hoyle, Lee Huddleston, Glenn Isbell, Donald Jay, Junius Jones, Elizabeth Kuttesch, William Peebles, Andrew Rabroker, Michael Sestak, Justin Smith, Jeffrey Thiele, Khoa Vu, Bill Bevers, Jeremiah Brown, Jeremy Eubanks, Jon Fleitman, Oskar Kudla, Matt Morrison, Cynthia Halim, Srini Srivatsa.

**Vehicle Strategy:** Texas A&M University has chosen to pursue sequential gaseous injection for their entry into the 1996 Propane Vehicle Challenge. With tight fuel delivery scheme and good emissions control, along with multiple engine modifications specific to Liquified Petroleum Gas, Texas A&M University will deliver a very competitive entry.

# The University of Alberta

**Vehicle Name/Number:** Apollo / 8

**Team Leader:** Neal Booth

**Faculty Advisor:** Dr. J. D. Dale

**Team Members:** Kelly Schoof, Melanie Salomons, Andrew Searle, Kelly Roberge, Warren Morrical, Wade Keller, Glenn Brown, Chris Eklund, Mark Pardell, Kent Klepachek, Marisa Tosi, Matt Beaubien, Jason Kinch, Todd Ratke, Isaak Berg, Andrew Love.

**Vehicle Strategy:** To build a practical propane-powered vehicle using off-the-shelf parts and technology. The engine remains almost stock, with a slightly raised compression ratio. The fuel system consists of a feedback controlled vapour system, with a 65 L (52 L usable volume) tank.

MEET THE TEAMS

# Ecole de technologie supérieure

**Vehicle Name/Number:** DARWIN / 5

**Team Leader:** Stephane Fortin

**Faculty Advisor:** Dr. Ahn Dung Ngo

**Team Members:** Stephane Fortin, Patrice Seers, Sebastien Turcotte, Jean-Pierre Tessier, Alain Cotz, Francois Tellier, Pierre Caissey, Jean-Francois Des-champs, Jean-Sebastien Rivest, Julie Bertrand, Thierry Nadeau, Radosav Krstic, Francois Sasseville, Jean Trottier.

**Vehicle Strategy:** ETS will demonstrate a new type of propane reservoir, and a new generation of catalyst will be installed. The compression ratio will be upgraded to 12:1.

# Texas Tech University

**Vehicle Name/Number:** 10

**Team Leaders:** Joe Vara (ME) and Richard Howlett (EE)

**Faculty Advisors:** Mr. Jesse Jones, Dr. Timothy Maxwell, Dr. Michael Parten and Dr. Darrell Vines.

**Team Members:** Joe Vara, Richard Howlett, Clint Isennock, Donald Nuckels, Shannon Ogerly, Spencer Wheat, Todd Hong, Scott Everett, Bobby Little, Philip Simon, Chad Tibor, Yuan Zhu.

**Vehicle Strategy:** The team is building their own fuel controller for gaseous injection. Several other minor adjustments will be made to optimize the engine for fuel economy and emissions.

# Illinois Insitute of Technology

**Vehicle Name/Number:** Lean Green Machine / 9

**Team Leader:** John M. Carr

**Faculty Advisor:** Dr. Francisco "Paco" Ruiz

**Team Members:** Pal Selley, Brian Snyder, Dominador Ruiz, Jr., Carlos Zeleya, Priyanker Balekai, Anthony Baran.

**Vehicle Strategy:** Gaseous propane will be injected using CNG injectors that are mechanically compatible with the manifold on the vehicle. The pressure of the propane will be adjusted depending on the temperature of the propane so the delivery rate will be constant.

# MEET THE TEAMS

## University of Windsor

HOST TEAM

**Vehicle Name/Number:** Pro-beaver / 99

**Team Leader:** Robert Wester and Joe Chiasson

**Faculty Advisor:** Dr. Gary W. Rankin

**Team Members:** Arthur Arps, Doug Bain, Jason J. Bastien, Joel Brush, Dominic Caranci, Kum-Wah Chan, Joseph Chiasson, Frank Ciuca, Paul Crutchley, John Feloniuk, Sandeep Ghai, James Harkus, Jennifer Hebert, Chris Hoffman, Jon-David Kehoe, Pak Kai Lam, Wai-Tak Leung, Kung Lim, Lisa Lortie, Marco Nardone, Eric Sanderson, Richard Schroeder, Chad Smith, Slavko Stojanovic, Chang Taing, Peter Tenzer, Ken Trudelle, George Vudrag, Robert Wester, Tutush Woldemariam.

**Vehicle Strategy:** Gaseous carburetion, gaseous injection and liquid injection techniques were considered by separate design teams. Gaseous injection was chosen as the technique to implement. Fuel heaters are being considered for use during cold operating conditions.

---

Although University of Windsor will participate in the Challenge events, it will not compete for awards.

# ADDITIONAL SPONSORS

NPGA
National PROPANE GAS Association

CONOCO
CLEAN AIR MOTOR FUEL

PHILLIPS 66 ULTRACLEAN

SUNOCO


SEJ
SLEEGERS ENGINEERING INC.

HOSTED BY:

CHRYSLER CANADA & THE UNIVERSITY OF WINDSOR

# '96 PROPANE VEHICLE CHALLENGE

May 29 - June 4; Windsor & Toronto, Ontario, Canada

Cedarville College
Texas A&M University
Texas Tech University
The University of Alberta
École de technologie supérieure
Illinois Institute of Technology
The University of Texas at Austin
The University of Texas at El Paso
University of Oklahoma
Villanova University
Western Washington University
GMI Engineering & Management Institute

---

Natural Resources Canada

U.S. Department of Energy

Argonne National Laboratory • University of Chicago

CHRYSLER CANADA