



# Contact Information

PENNSTATE



Pennsylvania Transportation Institute

## Mission Statement

The Pennsylvania Transportation Institute Hybrid and Hydrogen Vehicle Research Laboratory will contribute to the advancement of hybrid and hydrogen vehicle technology to promote the emerging hydrogen economy by providing vehicle modeling and testing capability to vehicle researchers, hydrogen researchers, industry and government.

### Hybrid & Hydrogen Vehicle Research Laboratory

[WWW.VSS.PSU.EDU/HHVRL](http://WWW.VSS.PSU.EDU/HHVRL)

Joel R. Anstrom, Director  
201 Transportation Research Building  
University Park, PA 16802  
phone 814.863.8904  
[jra2@psu.edu](mailto:jra2@psu.edu)

### Industrial Research Office

gateway to innovation

[WWW.IRO.PSU.EDU](http://WWW.IRO.PSU.EDU)

The Industrial Research Office assists companies in identifying and accessing Penn State faculty expertise and research centers, and works to foster University-industry research partnerships. Personal attention is given to company representatives to assess their technical needs and facilitate linkages to appropriate Penn State resources.

Tanna M. Pugh, Director  
119 Technology Center  
University Park, PA 16802  
phone 814.865.9519  
[tannapugh@psu.edu](mailto:tannapugh@psu.edu)



# Hybrid & Hydrogen

## Vehicle Research Laboratory



This publication is available in alternative media on request. Penn State is committed to affirmative action, equal opportunity, and the diversity of its workforce. U.Ed. RES 07-10.

## HYBRID & HYDROGEN VEHICLE RESEARCH LABORATORY (HHVRL)

The Hybrid & Hydrogen Vehicle Research Lab (HHVRL) is part of the Vehicle Systems and Safety Program under the Pennsylvania Transportation Institute (PTI) at The Pennsylvania State University. We facilitate industrial research and development of hybrid and hydrogen vehicle products and build relationships between industry and our engineering students. The HHVRL is seeking regional and international partners for future research, development, and education activities in the field of energy-efficient vehicle technologies.

## CURRENT FACILITIES

### *Hybrid Electric Vehicle Laboratory*

The HEV laboratory is equipped with lifts and machining equipment to perform fabrication and alterations of advanced vehicle platforms. PTI research programs and student teams such as Challenge X use this facility to develop advanced vehicles.

### *Hydrogen Fueling Station*

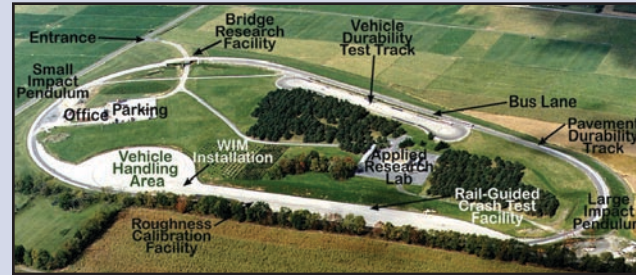
Developed by Air Products and Chemicals, Inc. with funding from US DOE, the commercial hydrogen fueling station was installed at Penn State University Park in Fall 2004. This station will be used to fuel in-service hydrogen vehicles during a demonstration period and serve as a refueling station for fuel cell buses under test at the PTI Bus Research and Testing Center.



The commercial hydrogen fueling station next to Beaver Stadium.

### *One-mile Test Track*

The PTI maintains a one-mile test track used by the Bus Research and Test Center and other research programs to perform fuel economy, vehicle handling tests, life testing, and crash testing.



### *Heavy Vehicle Laboratory*

Funded by the FTA, the heavy vehicle laboratory located at the Bus Research and Testing Center is used for bus maintenance, emissions testing, and research. This new facility houses a Schenck Pegasus 72" roll dynamometer, an AV-900 power processing machine, and maintenance lifts. This equipment can support research and testing of hybrid electric and fuel cell trucks and buses.

## RECENT PROJECTS

The *Long-term Hydrogen Vehicle Demonstration* is a project to demonstrate the long-term operational performance of the hydrogen fueling station. A fleet of vehicles has been converted to run on hydrogen with sufficient demand to heavily load the hydrogen station.

The *DOT Battery/Ultra-capacitor System for Transit Buses* project investigated the benefits of combining ultra-capacitors with batteries in energy storage systems.

*Integrated Vehicle Stability System Modeling of Hybrid Vehicles* demonstrated the feasibility of integrating ABS, TCS, and Active Yaw Control into hybrid vehicle platforms and extended a vehicle dynamics model to include HEV drive systems.

PTI has demonstrated distributed power generation technology integrated into fuel cell and hybrid vehicles.

## NEW RESEARCH INITIATIVES

The HHVRL is developing Hardware in the Loop (HIL) testing capability linking real time vehicle models with physical components between Penn State and industry laboratories. HIL is intended to speed the development of components and control strategies for advanced vehicles and their sub-systems. Our emphasis is HIL testing of energy storage components for hybrid electric and fuel cell vehicles. HIL takes advantage of our existing modeling and testing capabilities for light to heavy vehicles including small and heavy chassis dynamometers and power processing machines. HIL testing of advanced vehicle systems at the HHVRL offers vehicle developers a less expensive and faster path than full prototype testing.

## EDUCATION PROGRAMS

The HHVRL is integrated with the US DOE-sponsored Graduate Automotive Technology Education Program at Penn State. The Penn State GATE faculty offer graduate engineering curriculum covering theory of energy storage systems for advanced vehicles: batteries, capacitors, and flywheels along with elements of advanced combustion, power electronics, and control theory. By sponsoring GATE research projects and student internships, vehicle developers can network with top engineering graduate students in the field of advanced vehicles.

### *HHVRL Integration of Advanced Vehicle Research and Education at Penn State*

1. Promote advanced automotive research projects with industry related to hybrid electric, hydrogen fuel cell vehicle, and alternative energy products.
2. Foster industrial-government-academic partnerships for demonstrations of new energy efficient transportation technologies and alternative energy use in advanced automotive and power systems.
3. Create skilled engineers through undergraduate and graduate engineering programs, research projects, and industry internships to promote retention within Pennsylvania companies.
4. Expand the dissemination of technology, knowledge and IP through outreach, workshops and publications.