Overview

Timeline
• Starting Date: October 01, 2005
• Completion Date: May 31, 2012
• Percent Complete 97%

Budget
Govt. Share: $581,468.00
Cost Share : $154,644.00
Total : $736,112.00

Barriers
• Building a coherent Automotive Program across the Engineering College and ITS
• Laboratory Space

Partners
• Green Transportation Lab (MAE)
• STEP’s Program ITS
• Hydrogen Production and Utilization Laboratory (MAE)
Outline – UC Davis GATE Center

• Brief History
• Main Goal & Objectives
• Focus research areas
• Classes
• Outreach and Publications
• Application Process
• Graduate Research Projects
• Summary
The Merging of the GATE Centers at UC Davis

GATE Fuel Cell Center of Excellence 1999-2004

GATE Hybrid Electric Vehicle Center of Excellence 1999-2004

Fuel Cell, Hydrogen, & Hybrid Vehicle (FCH2V) Center of Excellence

2005-2011
FCH²V Goals & Objectives

Goals:
- Train future engineers to ensure the United States remains competitive
- Conduct research in the area of advanced automotive technology

Objectives:
- Support research of FCH²V technology (graduate fellowships, selected with a competitive proposal process)
- Support dissemination of FCH²V research results & knowledge (publications, outreach and workshops)
- Support curriculum development around FCH²V technology (expand and enrich course offerings)
- Support industrial/government collaboration of FCH²V technology (workshops, graduation placement, internships)
Cross Training for Transportation Leaders

Collaboration of Departments: ITS and College of Engineering

- Emissions Control
- Aerodynamics
- Transmissions
- Internal Combustion
- Advanced power cycles
- Batteries and Capacitors
- Energy and Transportation Policy
- Hydrogen Production
- Energy Efficiency
- Life-Cycle Analysis
- Instrumentation
- Fuel Cell Chemistry
- Hybridization

Collaboration of Departments: ITS and College of Engineering
FCH²V Center Research Areas

• Fuel Cell and Hybrid Component Level Research
  ▪ Energy storage (batteries, ultracapacitors)
  ▪ Continuously variable transmissions (CVT)
  ▪ Emissions reduction with hybrid and hydrogen enabled technologies
  ▪ Electronic Control systems

• Vehicle and Energy Systems Research
  ▪ Vehicle systems modeling
  ▪ Fuel cell auxiliary power units
  ▪ System Integration
  ▪ DOE Challenge X competition (Trinity)

• Fuel Pathway Analysis (STEPS Program)
  ▪ Infrastructure economics
  ▪ Environmental analysis
Leverages Existing Programs & Partners

H2 Production & Utilization Laboratory
http://mae.ucdavis.edu/hypaul/index.htm

H2 Pathways and STEPS Programs
http://steps.its.ucdavis.edu/

UC Davis Challenge X Team
http://www.team-fate.net/

FC Auxiliary Power for Trucks
Research and Training Facilities

- Hybrid Vehicle Power Systems Lab (ITS-Davis)
- Hybrid Vehicle Design, Assembly and Test Labs (MAE)
- Hydrogen Production and Utilization Lab (MAE)
- On-campus Hydrogen Refueling Station (ITS-Davis)
FCH²V Center Curriculum

- Advanced Energy Systems (Course and Lab)
- Vehicle Systems Lab
- Hydrogen Pathways – Technology, Pathways, Economics and Policy
- Fuel Cell Systems (Course and Lab)
- FCH²V Center Electives, 40 classes available:
  - Mechanical and Aeronautical Engineering (MAE)
  - Chemical Eng. and Materials Science
  - Biological Systems Engineering
  - Electrical Engineering
  - Transportation Technology and Policy (ITS-Davis graduate group)
Outreach and Publications

Comprehensive website for outreach purposes and as a research collaboration tool

http://gate.its.ucdavis.edu
Fellowship Application Process

1. An updated CV
2. Current academic transcript
3. Complete twelve month research plan
4. Letter of sponsorship from a participating professor
Research Plan Components

1. Research plan description
2. Expected contributions
3. Research Methodology
4. Literature review
5. Timeline and Deliverables
6. Interim publications
7. Interaction with other researchers
8. Personal Education Plan (as it relates to the research)
9. List of advisors and role each one will play in your research, including outside (non-academic) contacts
GATE Graduate Fellowships

Competitive Award 2010 - 2011

- Scott Varnhagen - The Wankel Engine as a Range Extender for Electric Vehicles: an Experimental and Simulation Study
- Zach McCaffrey - Converting Biomass to Fuel Cell Grade Hydrogen via Gasification
- Adam Same - In-situ Neutron Radiography as a Method of Analysis of Lithium Ion Batteries for Electric Vehicles

Also partially supported in 2011

- Nadia Richards - Hydrogen Production through Stratified Reformation: Simulation and Experimental Analysis
- Shahla Mammadova - Enhanced heat transfer for EGR systems via flow impingement and deflection structures

Competitive Award 2009 – 2010

- Alexander Allan - Characterizing the environmental, economic and energy demand impacts attributable to interactions between electric-drive vehicles and the California electricity grid
- William Marin – The Effect of Hydrogen on the Diesel cycle
- David Kashevaroff - An Investigation of Hybrid Mode Reformation for Fuel Cell Applications
GATE Graduate Fellowships

**Competitive Award 2008 - 2009**

- Doug Saucedo - Improving Fuel Economy for Hybrid Electric Vehicles using Electric Turbo-Compounded Internal Combustion Engines through Control System Modeling
- Jason Greenwood – Utilization of Hydrogen Enrichment to Enhance Combustion and Reduce Emissions of Mixed Alcohols in Ultra-Lean Conditions
- David Kashevaroff - The Potential of Using Autothermal Reformation With Copper-based Catalysts in Vehicle Applications

**Competitive Award 2007 - 2008**

- Andrew Shabashevich – Analysis of Waste Heat Recovery from Light-Duty Hybrid Electric Vehicles
- David Vernon – Thermal integration and system design for utilizing waste heat and exhaust gases
- Eddie Jordan - Hydrogen enriched ethanol combustion in IC engines
- Wayne Leighty - Structural Econometric Modeling of the Investment Timing Game in Alaska Oil and Gas Exploration and Development
GATE Graduate Fellowships

Competitive Award 2005 - 2006

• David Vernon - Hydrogen Enrichment Via Chemical Recuperation to Increase Efficiency and Reduce Emissions in Engines.


• Matt Caldwell – Hydrogen Production from Unpurified bio-derived alcohol mixtures: fundamental investigation of ATR and economic and infrastructure pathway analysis

Competitive Award 2006 - 2007

• Eddie Jordan - Hydrogen enriched ethanol combustion in IC engines
  ▪ Nils Johnson - Potential for coal-derived hydrogen with CCS
  ▪ David Vernon – Thermal integration and system design for utilizing waste heat and exhaust gases
  ▪ Jonathan Woolley - Characterizing the hydrogen conversion trends associated with auto thermal reformation of octane ethanol mixtures.
## UC Davis GATE Students

<table>
<thead>
<tr>
<th>GATE Center (Year)</th>
<th>M.S. Candidates</th>
<th>Ph.D. Candidates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2010</td>
<td>33</td>
<td>19</td>
</tr>
<tr>
<td>2011 (expected)</td>
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<td>2</td>
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### Organizations that hired graduates:

Summary / Key Lessons

• GATE program has expanded and strengthened the automotive technology research and education programs at UC Davis

• Leveraging with other programs allows for increased resources for research and strong interaction with other researchers

• Competitive process for student research awards works well

• GATE builds human infrastructure
FCH²V GATE Center - Building human infrastructure