

ELECTRIC VEHICLE SERVICE PERSONNEL TRAINING PROGRAM

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Principal Investigator
City College of San Francisco (CCSF)**

May 16, 2012

Overview

Timeline

- **Start: December 22, 2009**
- **End: December 21, 2012**
- **Percent complete: > 65%**

Budget

- **Total project funding**
 - **DOE share: \$500,001**
 - **Contractor share: \$133,640**
- **CY09 Expend: \$ 0**
- **CY 10 Expend: \$128,418**
- **CY 11 Expend: \$147,410**
- **CY 12 Expend: ~\$ 44,000 (to date)**

Barriers

- **The investment required to train technicians to repair/maintain technologies is a MARKET BARRIER**
- **(Consumers) tend to be reluctant to purchase vehicles with new technologies that could be difficult to maintain (3.5.2.7)**
- **Early users need to have technical expertise and assistance (readily available (3.5.2.8)**

Partners

- **Project lead**
 - **City College of San Francisco**
- **Interactions/ collaborations**
 - **Chabot College**
 - **Pat's Garage**
 - **Perfect Sky**
 - **San Francisco Municipal Shops**
 - **Other colleges as study progresses**

Objectives and Relevance (1)

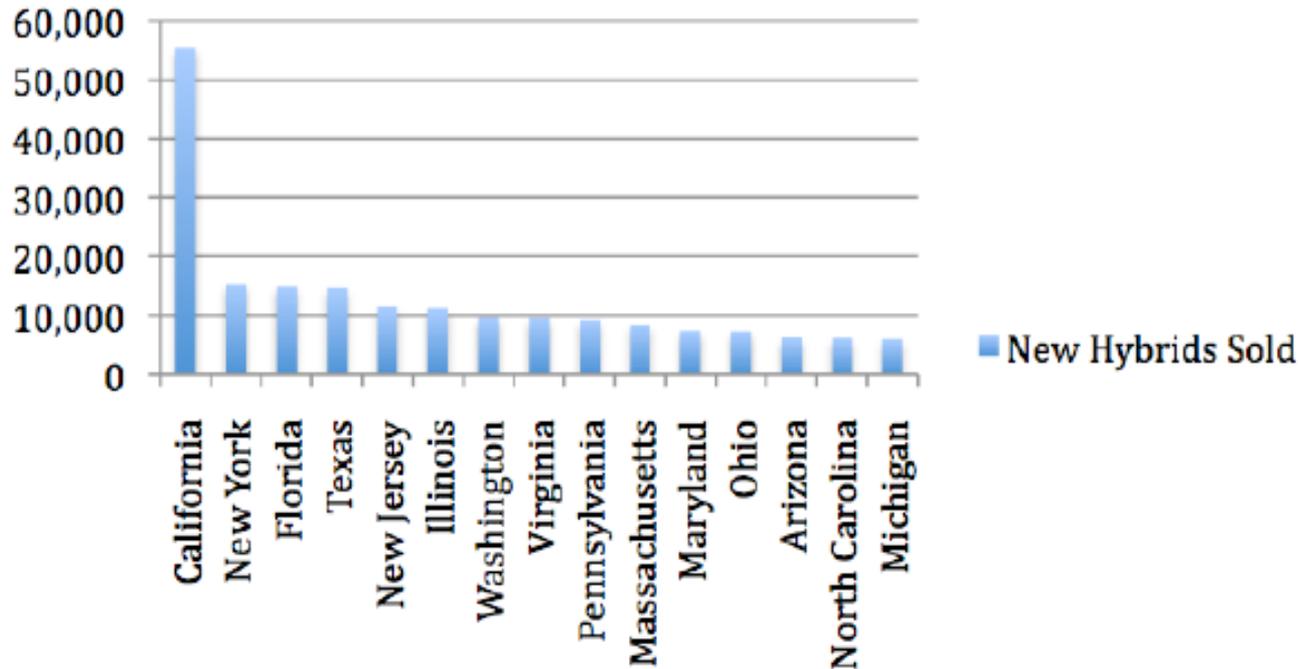
- ▶ **Provide expertise and assistance to consumers and fleet users of hybrids, PHEVs, EVs and FCVs through a trained maintenance workforce**
- ▶ **Educate the new generation of auto technicians to become familiar with electric drive vehicles**
- ▶ **This expertise**
 - **simplifies maintenance accessibility**
 - **lowers cost of maintenance**
 - **assures vehicles operate with optimal environmental performance**
 - **provides beneficial workforce impacts**

Objectives and Relevance (2)

- ▶ **Develop Hybrid, PHEV, EV and FCV curriculum and identify training aids for college technician programs, independent technicians, and municipal fleet operators in Northern California.**
- ▶ **Disseminate curriculum locally to identify problems and test portability.**
- ▶ **Disseminate to sample of colleges and employers in Southern California and neighboring states to identify training support and infrastructure needs**
- ▶ **Adapt curriculum for high school/ vocational schools as feasible.**

Why California? We Buy Hybrids.

Figure 2: New Hybrid Sales by State, 2009



HybridCars.com, "December 2009 Dashboard: Year-End Tally," in partnership with R.L. Polk & Co., January 20, 2010; www.hybridcars.com/hybrid-sales-dashboard/december-2009-dashboard.html.

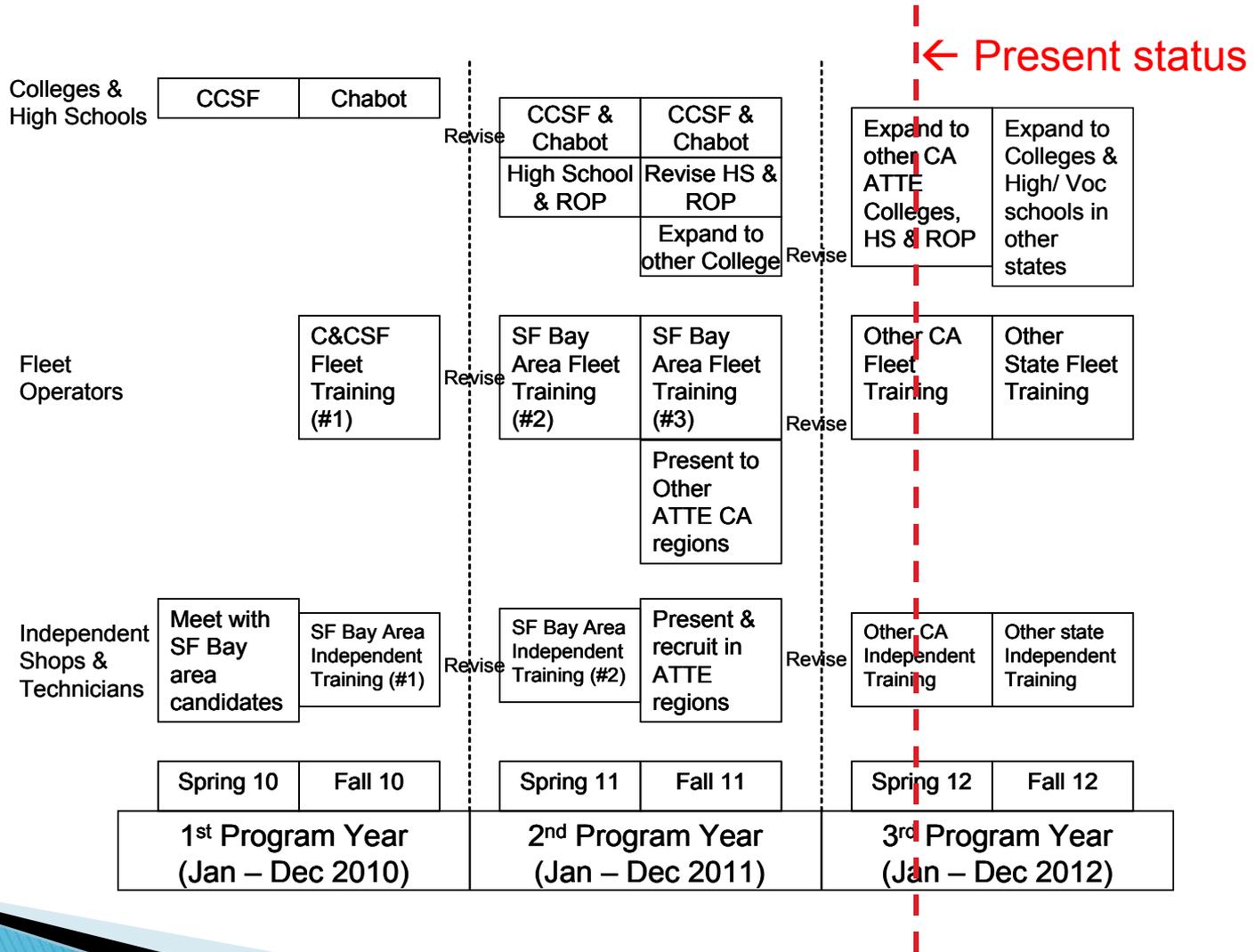
Milestones

Month/Year ending	Milestone
December 2010	<ul style="list-style-type: none">- goal of providing 2 college classes with evolving curriculum at host colleges CCSF and Chabot- 1 fleet operator training program- 1 training for independent technicians
December 2011	<ul style="list-style-type: none">- Expand college training to 3rd SF Bay Area college- Expand training to 2 High Schools and ROPs- Provide 2nd and 3rd Bay Area fleet trainings- Provided 2nd Bay Area independent technician training
December 2012	<ul style="list-style-type: none">- Expand training to 4th California college, one college in a neighboring state and high schools / ROPs- Expand fleet training to 4th California fleet and one in neighboring state- Expand independent technician training to 3rd California location and to one in neighboring state.

Approach/ Strategy (1)

- ▶ **The San Francisco Bay area has the third largest fleet of hybrids among US urban regions. It also one of the 3 areas with greatest hybrid densities (hybrids per 100,000 population).**
- ▶ **Support and consumer problems are arising here early. We have several service centers that specialize in Hybrid maintenance.**
- ▶ **Our approach is to develop a series of related training courses, and then improve course content, equipment requirements and instructor skills. Our three target audiences include:**
 - **Students**
 - **Fleet maintenance personnel**
 - **Independent technicians**
- ▶ **Identify problems with introducing and expanding this type of training by expanding the program geographically**
- ▶ **Our goal is to expand support for these vehicles thereby lowering the cost of ownership, improving aftermarket support and ensuring vehicles operate in the manner they are designed.**

Approach/ Strategy (2)



Collaboration

City & County of San Francisco Maintenance Shops

- Municipal Fleet support with over 400 Hybrids and EVs to maintain.
- Many now out of warranty.



- Supporting CA Community Colleges
- NATEF Certified auto technician programs to host expansions.

Perfect~Sky

- Hybrid Maintenance Training experts
- College and Industry Experience



- Hymotion conversion center
- Extensive PHEV experience

Technical Accomplishments & Progress (1)

- ▶ **First Hybrid Maintenance and Repair course piloted at CCSF during 09-10 academic year.**
 - **Damaged Prius obtained by donation from insurance company**
 - **Saturday class, 30 students, including many industry attendees**
 - **Auto electrical course pre-requisite**
- ▶ **Since expanded to Chabot, COM, and LBCC. Commitments to also support programs at Cypress , SRJC and MHCC (Oregon).**
- ▶ **One fleet program has been provided; three others recruited for summer and fall 2012.**
- ▶ **Three independent technician programs have been provided; two others recruited for summer and fall 2012.**

Technical Accomplishments & Progress (2)

- ▶ **5 starred college locations have provided training**
- ▶ **3 dotted locations are scheduled for training**
- ▶ **Mt. Hood CC in Portland, OR scheduled for training (not shown)**



Technical Accomplishments & Progress

(3)

About the Course

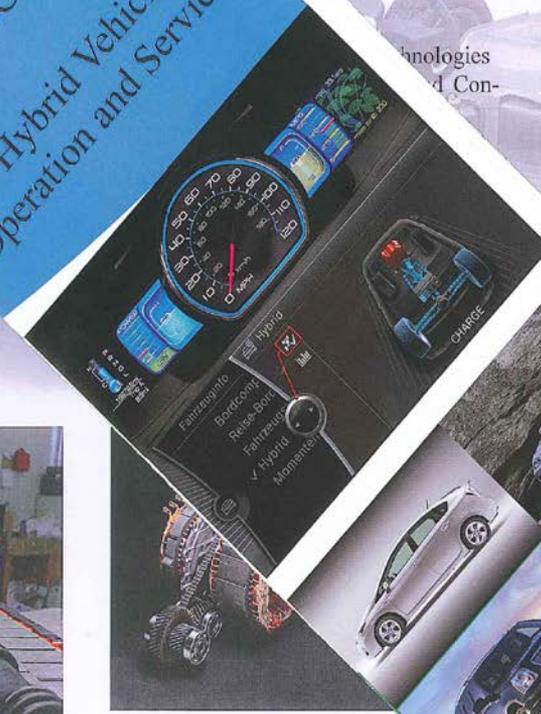
The Hybrid Vehicle Operation and Servicing course provides students with fundamental skills and knowledge to perform service and repair on today's hybrid vehicles. This course will provide students with the knowledge, skills, and abilities to successfully enter the automotive industry. Classroom instruction includes theory and practical application of more than half of the course in the laboratory.



Course Content

Alternative Fuels and the Environment
 Hybrid Vehicles
 Safety Procedures
 Diagnostic Technologies
 and Con-

ATEC9901
Hybrid Vehicle
Operation and Servicing



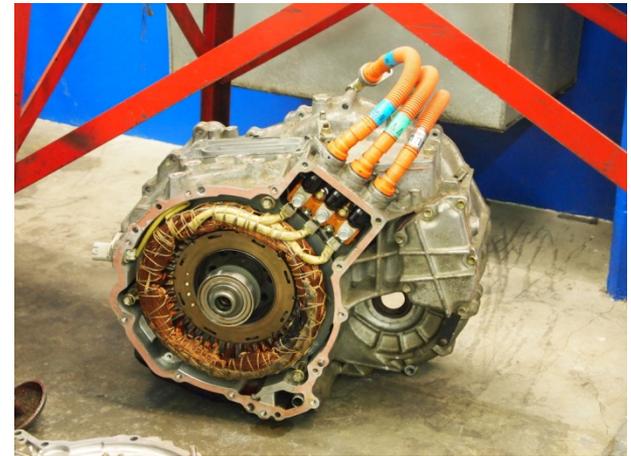
Student Outcomes

- contrast how a hybrid vehicle operates when compared to conventional vehicles;
- identify and relate system integration of hybrid vehicle components and systems;
- demonstrate proper safety procedures when working on and around hybrid vehicles;
- identify, discuss, and measure how hybrid high voltage systems operate; compare and contrast AC and DC electrical systems;
- explain in detail how hybrid electric systems operate, including electric motors, generators and controls;
- analyze how regenerative braking works;
- explain how hybrid transmission systems operate; describe the operation of the cooling and air conditioning systems;
- perform normal, and special maintenance; use scan tool data, related stored diagnostic trouble codes for hybrid vehicle systems;
- and use service information to perform step-by-step diagnosis.

Technical Accomplishments & Progress (4A)



**Hybrid Class and Components:
City College of San Francisco**



Technical Accomplishments & Progress (4B)



Weekend Workshop: Rio Hondo CC

Technical Accomplishments & Progress (5): Relative to Milestones

Month/Year ending	Milestone
December 2010	<ul style="list-style-type: none"> - goal of providing 2 college classes with evolving curriculum at host colleges CCSF and Chabot → 4 provided - 1 fleet operator training program → 1 provided - 1 training for independent technicians → 3 provided
December 2011	<ul style="list-style-type: none"> - Expand college training to 3rd SF Bay Area college → 3rd provided - Expanded training to 2 High Schools and ROPs → 3 provided - Provide 2nd and 3rd Bay Area fleet trainings → 0 provided - Provided 2nd Bay Area independent technician training → no change, 3 provided in 2010
December 2012	<ul style="list-style-type: none"> - Expanding training to 4th California college, one college in a neighboring state and high schools / ROPs → between 4 & 8 CC courses scheduled, one college in OR scheduled, at least one high school scheduled - Expand fleet training to 4th California fleet and one in neighboring state → 2nd, 3rd and 4th are in negotiation in CA; one in OR - Expand independent technician training to 3rd California location and to one in neighboring state → 4th in negotiation; one in OR provided during 2011 (ahead of schedule)

Progress and What We're Learned (1)

- ▶ **Equipment– the first barrier**
 - colleges rarely have funds to obtain a hybrid vehicle; donations are essential (vehicles and parts)
 - a single vehicle is not adequate to keep a class of 20 – 25 students fully engaged
 - need diagnostic software (eg, TechStream ®)
- ▶ **Training Aids**
 - shop vehicles have problems keeping batteries charged
 - considered, but haven't tried other EVs (bikes and scooters)
- ▶ **Faculty Skills**
 - need to support faculty training
 - Outside speakers / experts help immensely
- ▶ **Secondary Schools (High Schools and ROPs)**
 - time constrained
 - a new course doesn't fit their schedules
 - periodic classes to supplement existing instruction preferred

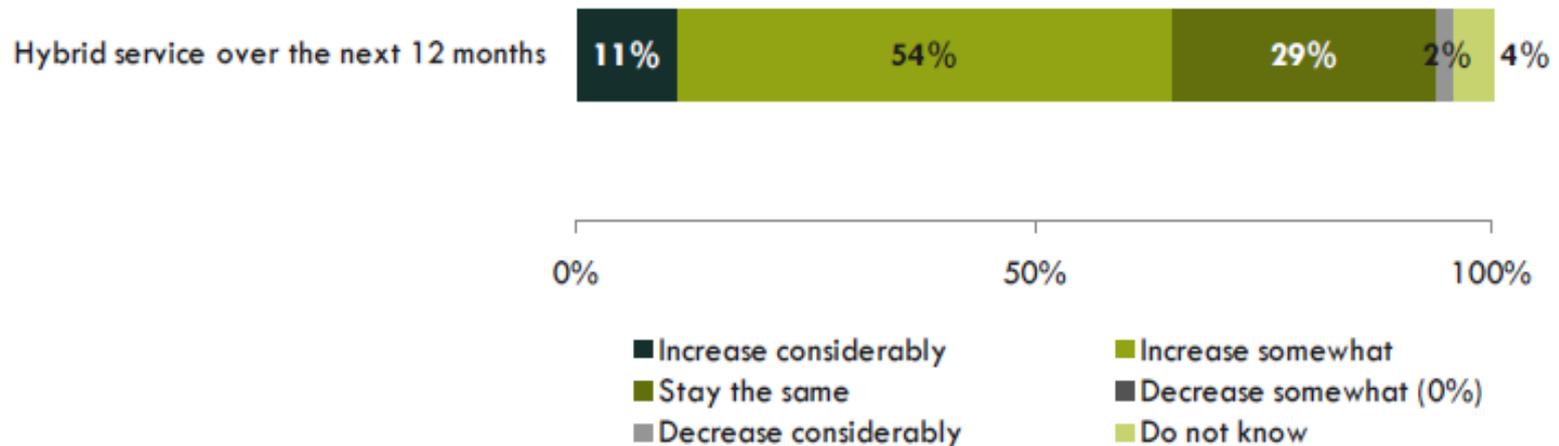
Progress and What We're Learned (2)

- ▶ **Technician Training needs to be adaptable**
 - evenings (max of two per week) or Weekends (but not too many in a row)
 - needs to provide maximum hands-on experience
 - needs to focus on “need to know” information only
- ▶ **Missing...**
 - A good computer-based training aid

Progress and What We're Learned (3)

- ▶ From a 3-county survey of auto maintenance repair facilities in the East Bay to assess job prospects and skill requirements:
 - Growing demand for hybrid-skilled technicians
 - Safety is the starting point, followed by how systems operate
 - Individual community college courses are desired more than a full certificate program

Figure 5: Employer Projections for Servicing Hybrid Cars (Next 12 Months)



Hybrid Vehicles: Maintenance and Repair Occupations, August 2010,

John Carrese, Director, San Francisco Bay Area Center of Excellence, CCSF

funded by Los Medanos and Contra Costa Community Colleges

http://www.coecc.net/Environmental_Scans/hybrid_bay_scan_10.pdf

Proposed Future Work

▶ For the remainder of 2012

- update curriculum as new vehicle data becomes available
- implement training programs at remaining partner colleges
- utilize remaining budget to expand to as many colleges as feasible (requests to partner exceed budget).
- continue to explore a formula that will meet the needs and availability of municipal and commercial fleet operators
- develop technician programs with local partners (shops, colleges and/or service centers)

Lesson Learned / Future Work Needed (Beyond Current Effort)

- ▶ **A computer-based platform with both diagnostic software and vehicle emulation is needed**
 - One vehicle per 20- 30 student class does not permit students sufficient hands-on time to adequately learn TechStream ® (diagnostic) software
 - A computer-based learning platform (emulating both vehicle and diagnostic software) would improve student learning outcome and support remote learning opportunities
 - Based on discussions, this is a common problem nationwide

Summary

- ▶ **The San Francisco Bay Area is one of the leading markets for hybrid and electric vehicles in the United States. Consumer problems need to be addressed here early to assure favorable transition to these new technologies.**
- ▶ **Beyond the factory-trained OEM service network, skills are lacking as regard hybrid and EV servicing. Yet older models are out-of-warranty and are moving out of dealer service networks.**
- ▶ **Hybrid and EV Maintenance and Repair courses are strongly desired by technicians, shop owners and colleges around the state.**
- ▶ **This project is developing and disseminating skills to students and incumbent technicians. We are achieving our milestones on schedule.**
- ▶ **We have identified a major training gap that needs to be overcome for Hybrid and Electric vehicle training to become highly effective.**