Advanced Electric Drive Vehicles – A Comprehensive Education, Training, and Outreach Program

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Project ID # ARRAVT034

Overview

Timeline

- Project start date: 01/21/2010
- Project end date: 01/20/2013
- Percent complete: 60

Barriers

- Curriculum Integration
- Fast Evolving Technology
- Input from Industry

Budget

- Total $6,256,324
  - DOE share: $5,000,000
  - Contractor share: $1,256,324

Partners

- Project lead: Missouri S&T
- University of Central Missouri
- Linn State Technical College
- St. Louis Science Center

Relevance

- **Objectives**
  - Prepare the next generation of engineers and technicians who will be working on electric, hybrid, and plug-in hybrid vehicles
  - Promote public awareness
  - Create new jobs
    - Develop an Advanced Automotive Technology Minor Degree Program for undergraduate engineering students (Missouri S&T)
    - Develop an Automotive Certificate Program for technicians, product support managers, and educators/trainers (U of Central Missouri)
    - Develop an Associate of Applied Science Degree Option in Electric-Drive Vehicles (Linn State)
  - Save existing jobs
    - Develop an Electric Drive Vehicle Technology Graduate Certificate Program for industry engineers (Missouri S&T)

Approach: Missouri S&T (Lead)

- Coordination of educational, outreach, assessment, and dissemination activities
- Course and curriculum development for an Undergraduate Engineering Minor Program
- Course and curriculum development for a Graduate Certificate Program
- Assessment, outreach, and dissemination partner
- Integration of research and education

Approach: University of Central Missouri (sub)

- Course and curriculum development for a Non-Degree Certificate Program
- Course and curriculum development for Safety Awareness Certifications
- Regional course adoption campus
- Assessment, outreach, and dissemination partner

Approach: Linn State Technical College (sub)

- Course and curriculum development for an Associate of Applied Science Degree Option
- Course and curriculum development for a Technical Certificate in Advanced EDV Maintenance
- Regional (statewide) course adoption campus
- Assessment, outreach, and dissemination partner

Approach: St. Louis Science Center (sub)

- Public outreach, out of school time learning
  - The Electric Uphill Derby: An Electric Vehicle Outreach Initiative for Youth Development and Learning During Out of School Time
- Consumer education
  - Unplugged: Electric Vehicles to Drive Our Future: an exhibit and programs to inform and engage the consumer
- Assessment and dissemination partner

Progress: Missouri S&T

Missouri S&T Objectives	Status
Acquisition and Purchase of the Required Laboratory Equipment	Accomplished
Acquisition and Purchase of the Required Software	Accomplished
Curriculum Development	On Target
Outreach	On Target
High School Summer Camp	Accomplished
Evaluation and Revision of the Developed Material	On Target
Assessment	On Target

Progress: Central Missouri

U of Central MO Objective	Status
Course Material Collection	Accomplished
Course Outline and Syllabus Development	Accomplished
Test Equipment Acquisition	Accomplished
Submission of new course and new EV certificate program to UCM curriculum process for approval	Accomplished
Chassis Dynamometer acquisition & installation	Accomplished
PHEV and/or EV vehicle & material procurement	Accomplished
Finalize new course & certificate material for submission to state of MO for approval	Accomplished

Progress: Linn

Linn State Objectives- Phase I	Status
Conduct advisory council meetings	Accomplished
Document curriculum	On Target
Validate Curriculum	On Target
Initial approval of curriculum	Accomplished
Participate in instructor training on EDVs	Accomplished
Conduct the Automotive Summer Institute	Accomplished
Confirm national partnerships with other education institutions	In Progress
Acquire final approval of new courses	On Target
Develop brochures and marketing materials	In Progress

Progress: Science Center

St. Louis Sci. Cent. Objectives- Phase I	Status
Front-end evaluation with museum visitors	Accomplished
Recruit content advisory board	Accomplished
Design and test prototype experience platform elements with public	In Progress
Evaluate, select and procure electric vehicle	Accomplished
Design story boards and outlines and shoot rough cut for Science Minutes	In Progress

Major Accomplishments

Courses Offered in Fall 2011

Course #	Course Title	Hours	Enrollment	Campus
EE 205	Electromechanics	3	28	Missouri S&T
EE 208	Electromechanics Laboratory	1	24	Missouri S&T
EE 305	Electric Drive Systems	3	32	Missouri S&T
EE 409	Advanced Electric-Drive Vehicles	3	27	Missouri S&T
EMGT 311	Human Factors	3	35	Missouri S&T
EMGT 314	Management for Engineers and Scientists	3	21	Missouri S&T
EMGT 386	Safety Engineering Management	3	28	Missouri S&T
SYS ENG 368	System Engineering and Analysis I	3	21	Missouri S&T
ME 221	Applied Thermodynamics	3	48	Missouri S&T
ME 279	Automatic Control of Dynamic Systems	3	57	Missouri S&T
ME 279	Automatic Control of Dynamic Systems	3	54	Missouri S&T
ATM 2130	Automotive Electrical Systems	4	12	Univ Central MO (UMC)
ATM 3120	Steering & Suspension Systems	4	17	Univ Central MO (UMC)
ATM 3124	Automotive Braking Systems	4	15	Univ Central MO (UMC)
ATM 3134	Advanced Powerplant Systems	3	14	Univ Central MO (UMC)
ET 1010	Applied Electricity	4	40	Univ Central MO (UMC)
AMT 138	Automotive Electrical/Electronics II	6	8	Linn State Tech (LSTC)
AMT 207	Heating/Air Conditioning	5	8	Linn State Tech (LSTC)

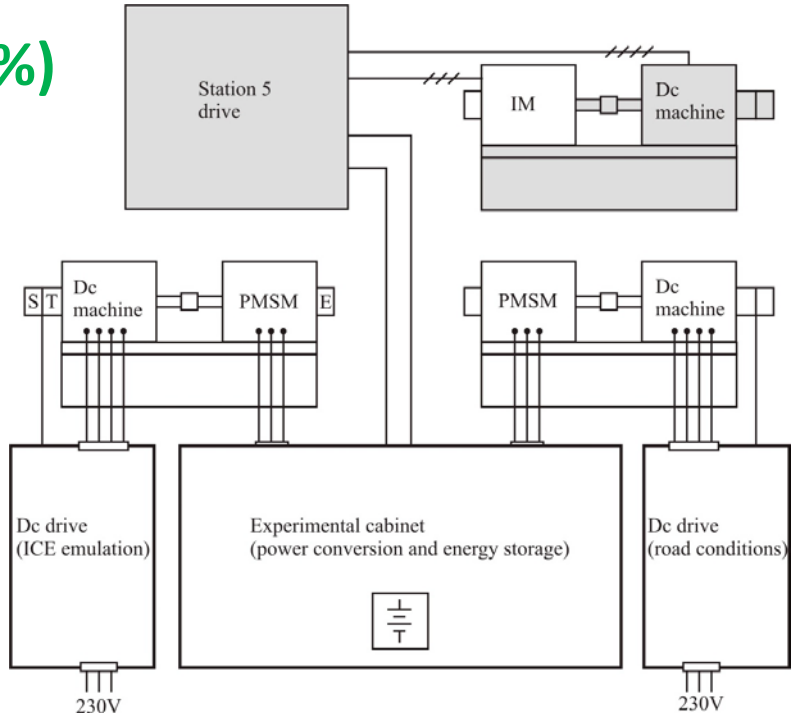
Major Accomplishments

Courses Offered in Spring 2012

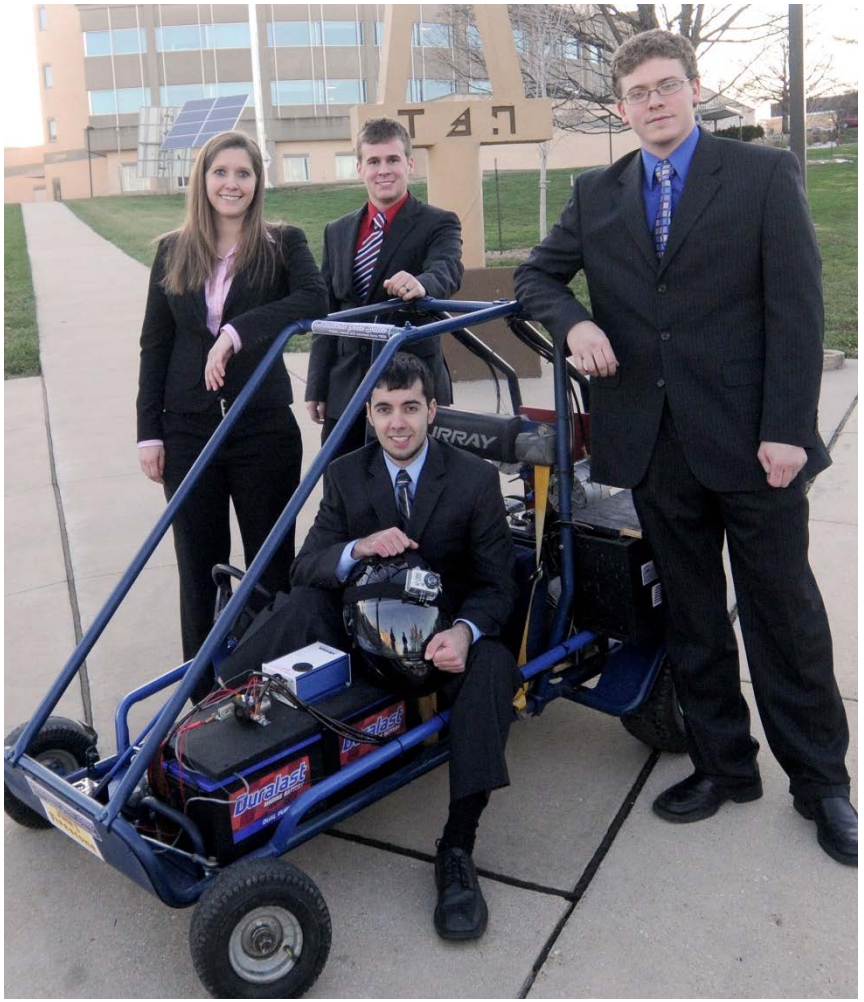
Course #	Course Title	Hours	Enrollment	Campus
EE 205	Electromechanics	3	39	Missouri S&T
EE 208	Electromechanics Laboratory	1	30	Missouri S&T
EE 309	Electric Drive Vehicles	3	22	Missouri S&T
EE 353	Power Electronics	3	38	Missouri S&T
EE 354	Power Electronics Laboratory	2	3	Missouri S&T
EE 402	Advanced Theory Of Electric Machines	3	10	Missouri S&T
EMGT 251	Marketing Management (EV project compon	3	15	Missouri S&T
EMGT 311	Human Factors	3	41	Missouri S&T
EMGT 314	Management for Engineers and Scientists	3	29	Missouri S&T
EMGT 411	Human Systems Integration	3	22	Missouri S&T
ME 221	Applied Thermodynamics	3	47	Missouri S&T
ME 261	Engineering Design	3	218	Missouri S&T
ME 279	Automatic Control of Dynamic Systems	3	37	Missouri S&T
ME 279	Automatic Control of Dynamic Systems	3	48	Missouri S&T
MS&E 348	Energy Materials - combined	3	6	Missouri S&T
MS&E 448	Advanced Energy Materials	3	6	Missouri S&T
SYS ENG 368	System Engineering and Analysis I	3	22	Missouri S&T
SYS ENG 435	Model Based Systems Engineering	3	12	Missouri S&T
ATM 4134	Advanced Vehicle Systems	2	7	Univ Central MO (UMC)
AMT 213	Automotive Electrical/Electronics III	8	27	Linn State Tech (LSTC)
AMT 270	Electric/Hybrid Drive Systems	6	5	Linn State Tech (LSTC)
EPG 130	Generator, Alternator, and Motor Fundamen	2	5	Linn State Tech (LSTC)
AMT 138	Automotive Electrical/Electronics II	6	16	Linn State Tech (LSTC)
AMT 207	Heating/Air Conditioning	5	28	Linn State Tech (LSTC)

Major Accomplishments

- **Development of a 20-hp Series Hybrid Powertrain for Educational Purposes**
  - **Acquisition and Purchase of the Required Laboratory Equipment (100%)**
  - **Hardware installation (100%)**
  - **Software integration (50%)**



Major Accomplishments



Major Accomplishments (SLSC)

- Electric Vehicle Advisory Board
- Design and Test Prototype Experience Platform Elements with the Public
- Content Development
- Evaluate, Select, and Procure Electric Truck
- Unplugged: UpHill Derby Summer Camp
- Traveling Exhibit
- Internet and Social Media

Major Accomplishments (SLSC)

Previous Accomplishments

Courses Offered in Spring 2011

Course #	Course Title	Hours	Instructor	Enrollment
ME 378	Mechatronics	3	Robert Landers	17
EE 301	Electric-Drive Vehicles	3	Mehdi Ferdowsi	30
EE 353	Power Electronics	3	Luke Watson	31
EE 354	Power Electronics Laboratory	2	Reza Ahmadi	5
EE 401	Power Converter Modeling and Control	3	Jonathan Kimball	22
EE 205	Electromechanics	3	Mehdi Ferdowsi	29
EMGT 311	Human Factors	3	Susan Murray	32
EMGT 411	Human Systems Integration	3	Susan Murray	10
EMGT 366	Business Logistics/Supply Chain	3	Long	5

Collaborations/Partnerships

- University of Central Missouri (sub)
- Linn State Technical College (sub)
- St. Louis Science Center (sub)
- Smith Electric Vehicles, outside the VT Program, data analysis
- City of Kansa City, outside the VT Program, demonstration

Future Work

- Continue Curriculum Development Efforts
- Finish Software Integration of the 20-hp Series Hybrid Powertrain
- Continue the Public Outreach Activities
- Continue the Assessment Activities
- Dissemination

Summary

- Most tasks are progressing according to project timeline
- No major challenges as of now
- The new courses are popular among students. Some of our graduates have found jobs in the automotive industry.
- The industry support has been encouraging