Indiana Advanced Electric Vehicle Training and Education Consortium (I-AEVtec)

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Purdue University
May 13, 2012

Project ID:
ARRAAVT032

Overview

TimeLine

Project Start Date 12/15/2009

Project End date

12/15/2012

Percent Complete – 75%

Project Funding

Budget

DOE Share – $6,147,000

Cost Share – $1,848,084

Spent 12/31/2011

DOE Share – $3,792,473

Cost Share - $626,601

Barriers

1. Developing a sufficient quantity of trained engineers and technicians for the future electric vehicle industry
2. Delivery of information to a wide student, educator and community audience
3. Engage Industry
4. Having a sufficient pipeline of students interested in this technology

Partners

- Purdue University
- Ivy Tech
- IUPUI
- Norte Dame
- Purdue Calumet
- North Carolina Central University

Relevance

Overall Objective

Develop programs to educate and train the workforce needed to design, manufacture and maintain the electric vehicle industry in the 21st century.

Objectives:

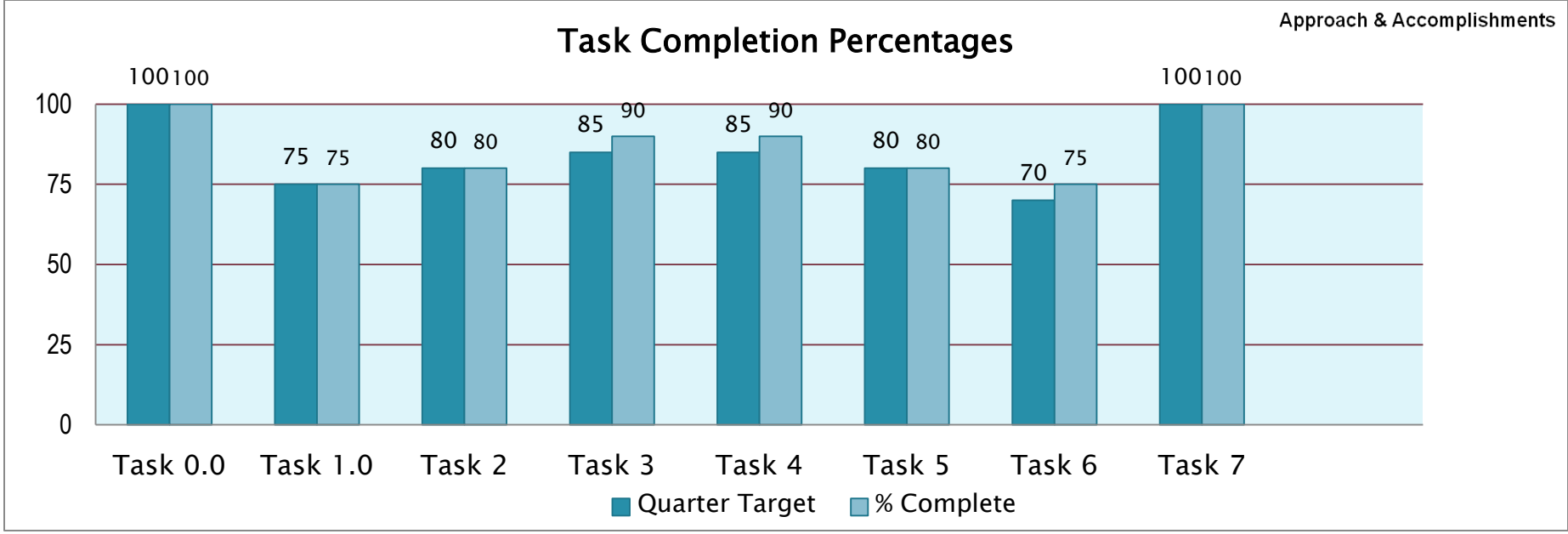
1. Development of degree/certificate programs in electric vehicle technology at the I-AEVtec partner institutions
2. Produce a series of web-enabled courses that address batteries, fuel cells, electric motors and controls, hybrid engines, grid technology and consumer issues concerning this technology.
3. Deliver these programs to students in Indiana and the Midwest.
4. Establish the ElectricVehicle-Hub - as the website for EV, PHEV and FCV technology, including educational material, simulations, video demonstrations and information for the general public.
5. Develop an active partnership with industry and government stakeholders in advanced electric vehicles in order to ensure that the educational products meet the demands of employers.
6. Develop a series of educational modules for secondary schools that satisfy Indiana's curricula requirements so that they can be used in the classroom.
7. Begin development of an Electric Grand Prix go-kart race to excite the imagination of young people to commit to a career in electric vehicle technology

Developing the needed workforce (Barrier 1)

Communication of educational and consumer information (Barrier 2)

Engage Industry (Barrier 3)

Developing pipeline of future students (Barrier 4)



Task 0.0 Project Management **–** Develop project plan

Task 1.0 Development of degree/certificate programs in electric vehicle technology at the I-AEVtec partner institutions

Task 2.0: Produce a series of web-enabled courses that address batteries, fuel cells, electric motors and controls, hybrid engines, grid technology and consumer issues concerning this technology

Task 3.0 Deliver these programs to students in Indiana and the Midwest

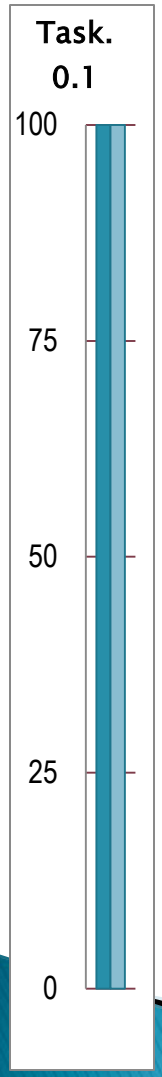
Task 4.0: Establish the ElectricVehicle-Hub - as the website for EV, PHEV and FCV technology, including educational material, simulations, video demonstrations and information for the general public

Task 5.0 Develop an active partnership with industry and government stakeholders in advanced electric vehicles in order to ensure that the educational products meet the demands of employers.

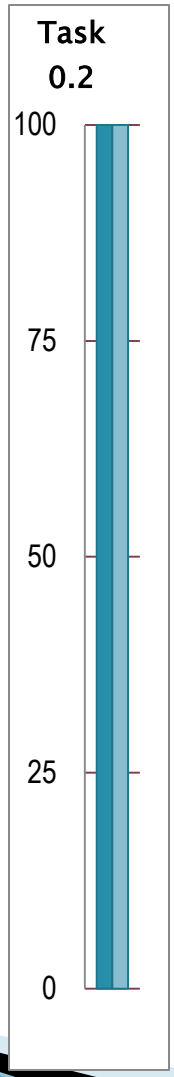
Task 6.0 Develop a series of educational modules for secondary schools that satisfy Indiana's curricula requirements so that they can be used in the classroom.

Task 7.0: Begin development of an Electric Grand Prix go-kart race to excite the imagination of young people to commit to a career in electric vehicle technology.

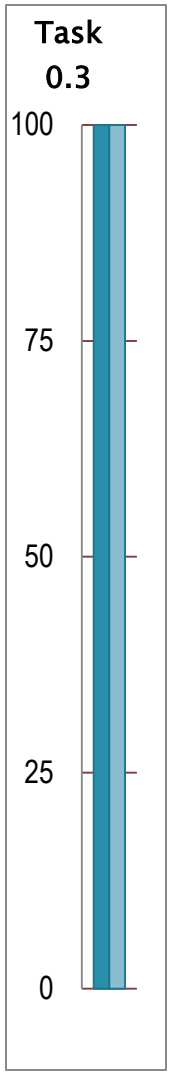
Task 0.0: Grant Project Management



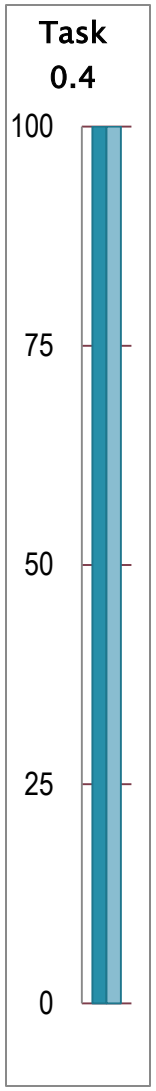
Subtask 0.1: Establish Executive Board and Public/Private Advisory Board



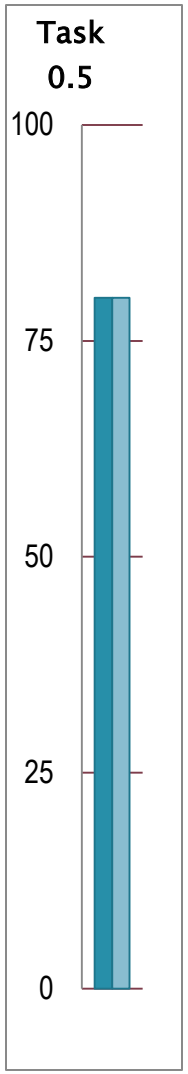
Subtask 0.2: Establish Project Management Team



Subtask 0.3: Develop detailed roadmap for I-AEVtec project with time sequence of which courses will be developed/offered in Year 1 and those courses that will be developed/offered in Year 2



Subtask 0.4: Develop communication plan for I-AEVtec team with meeting schedule.

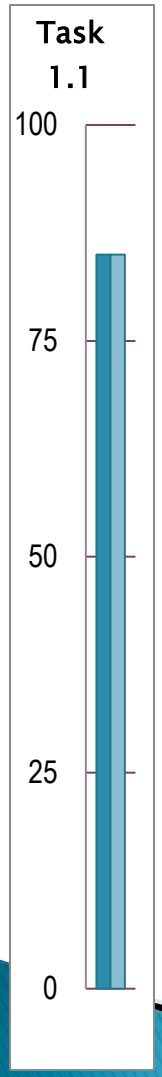


Subtask 0.5: Determine need for inter-institutional agreements and begin execution of paperwork

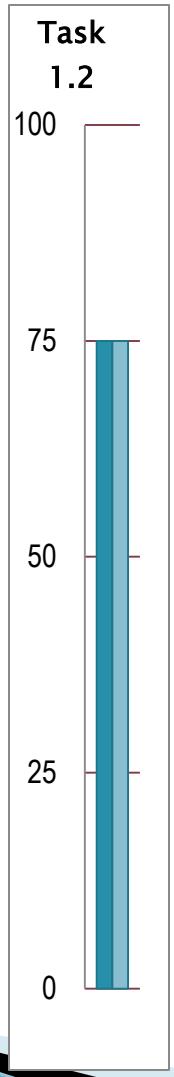
Task 1.0 - Degree/Certificate programs in electric vehicle technology at the I-AEVtec partner institutions

- Purdue
  - Engineering – Certificate as part of BS or MS
  - Technology – Certificate as part of BS or MS
- Notre Dame
  - Engineering – Certificate as part of BS or MS
- IUPUI
  - Engineering – Certificate as part of BS or MS
- Ivy Tech
  - Associate Degree in electric vehicle technology
  - First Responder certificate
- Purdue – Calumet
  - Modules for undergrad p-chemistry lecture/lab
- Indiana Univ. – Northwest
  - Modules for undergrad p-chemistry lecture/lab
- North Carolina Central University
  - Modules for undergrad p-chemistry lecture/lab

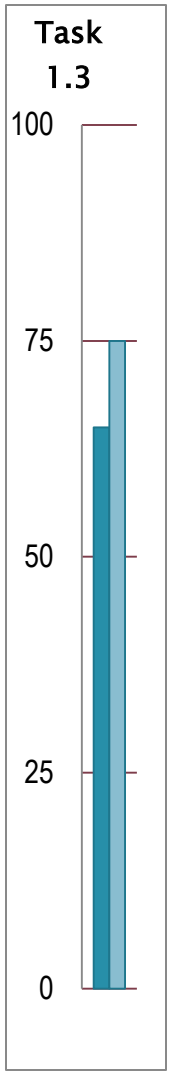
Task 1.0: Develop Certificate and Degree Programs in EV, PHEV and FCV.



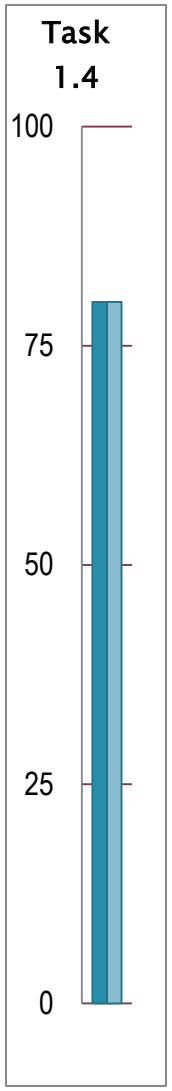
Subtask 1.1:Develop Degree/Certificate Program: Each institution will prepare a detailed plan of their degree/certificate program in advanced electric vehicle technology.



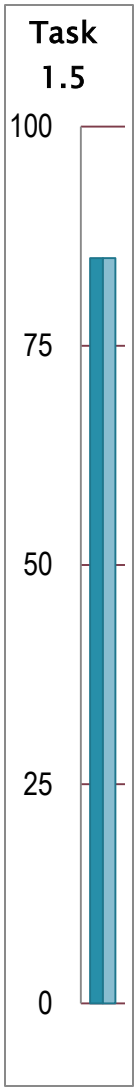
Subtask 1.2: Integration of Individual Institution Degree/Certificate Program Plans: Present integrated plan to Public/Private Advisory Board to ensure plan meets needs of industry and government.



Subtask 1.3 Complete Approval Process for Degree/Certificate Program: Each institution shall satisfy the existing institutional policies.



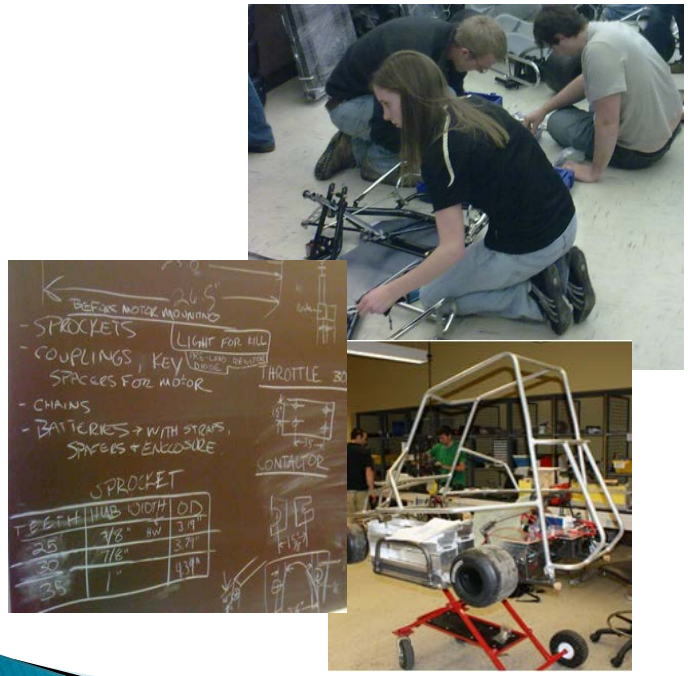
Subtask 1.4: State Certified Electric Transportation System for First Responders: Complying with Indiana Fire Training System, develop requirements for this system.



Subtask 1.5: Inclusion of Materials on EV, PHEV, and FCV: Determine requirements for the inclusion into secondary school curricula.

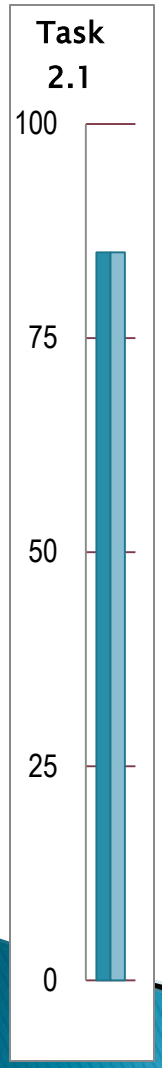
Task 2.0 Education Programs

- The faculty from these institutions, with consultation with industrial partners, will design degree and certificate programs in EV, PHEV and FCV technology which build upon their existing educational programs and areas of expertise.

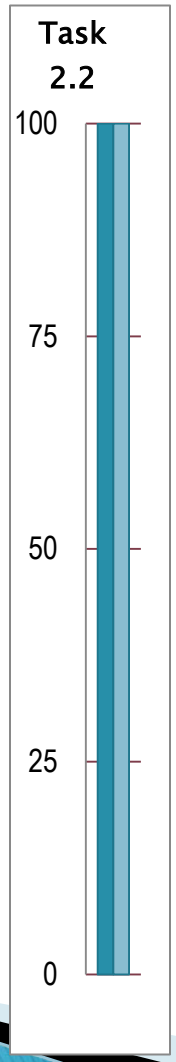


Academic Unit	Level	Title	Area of Study
Purdue	400	Automotive Prime Movers	Hybrid Vehicle
	300 - 400	Reenergizing Society through the Use of Battery Technology	General Student Introduction
	500	Electrochemical Engineering	Batteries
	597	Design and Simulations of Rechargeable Batteries	Batteries
	500	Design and Analysis of Hybrid Electric Vehicle Drive train	Drive train
	400 / 500	Introduction to Energy Storage Systems	Batteries
	500	Electric Vehicle Systems, Design and Fabrication	EVGrand Prix - Kart Build
	321	Electromechanical Motion Devices	Electric Motors
	500	Electric and Hybrid Vehicle Systems	EV and PHEV introduction
	300 +	Introduction to Electric Vehicle Technology	Technology - Introduction
	500	Electric Vehicle System Controls	
	100	Motorsports safety course	Technology - Introduction
	300	EVGP Sustainability	Technology - Introduction
	300	EPICS - EVEI - 1 - Infrastructure	Event
	300	EPICS - EVEI - 2 - Out reach	Event
	300	EPICS - EVEI - 3 - Education	Event
	300	Event Teams	Event
	500	Battery Lab	Batteries
	500	Vehicle Lab	Hybrid Vehicle
IUPUI	500	Automotive Control	Engines
	400	Electronic fundamentals of hybrid and electric vehicles	HEV/Elect.
	500	Modeling, analysis, and control of electric and hybrid vehicles	HEV
	500	Special Topics in Energy Systems (Power System Grid Control and Market Administration)	Grid/Elect.
	500	Power train Integration	Veh./HEV
	500	Renewable Energy and Fuel Cells	Fuel Cells & Battery
	300	Electric Power Networks and Interfaces	Grid/Elect.
	400	Hybrid and Electric Transportation	Battery & HEV
	300	Energy Storage Devices and Systems	Batteries
	500	Intro to Renewable Energy	Fuel Cells & Battery
Notre Dame	400	Electrochemical Energy Conversion and Storage	Batteries
	400	Electric and Hybrid Vehicles course	Hybrid Vehicle
IVY Tech	200	Auto #1	Hybrid Vehicle
	200	Auto #2	Hybrid Vehicle

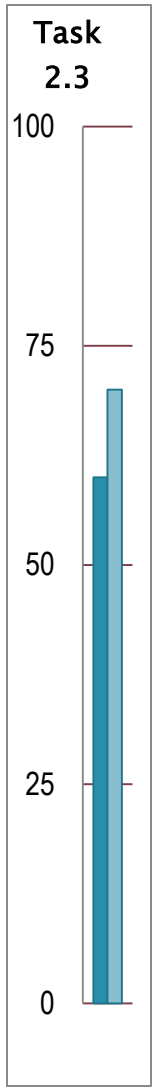
Task 2.0: Produce a series of web-enabled courses that address batteries, fuel cells, electric motors and controls, hybrid engines, grid technology and consumer issues concerning this technology



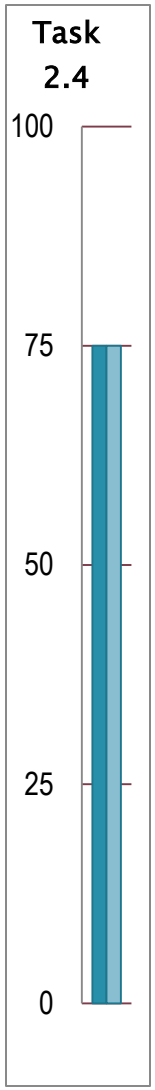
Subtask 2.1: Development of New Courses I: Based upon the developed project roadmap, begin development of new courses that will be offered inYear1



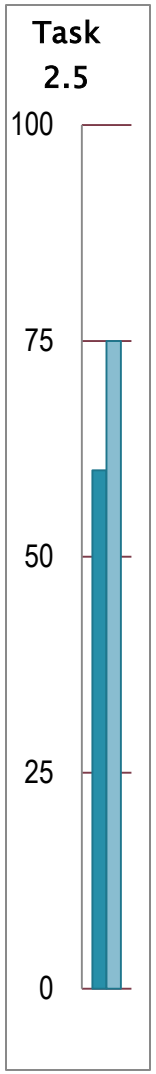
Subtask 2.2:Course Materials Templates: Develop template(s) for course materials to be uploaded on the EV Hub.



Subtask 2.3: Development of Simulation Models: Identify two topics where computer simulation would be valuable and begin development of these simulation modules that will be hosted on the EV Hub.



Subtask 2.4:Web-Enabling Existing Courses I: Based upon the developed project roadmap, begin web-enabling the existing courses.

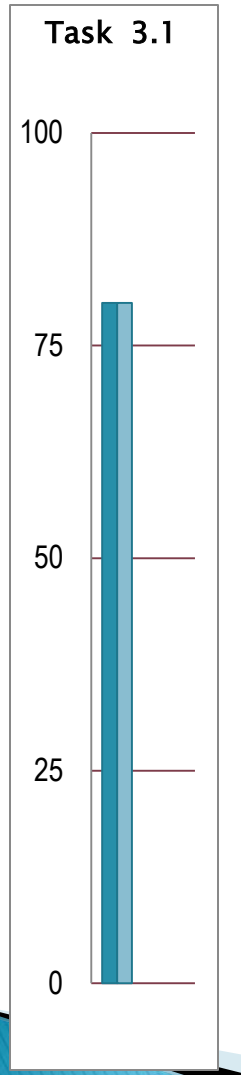


Subtask 2.5:Laboratory Development: Design the teaching laboratories, including modifications to existing laboratories. Purchase and install equipment for these laboratories.

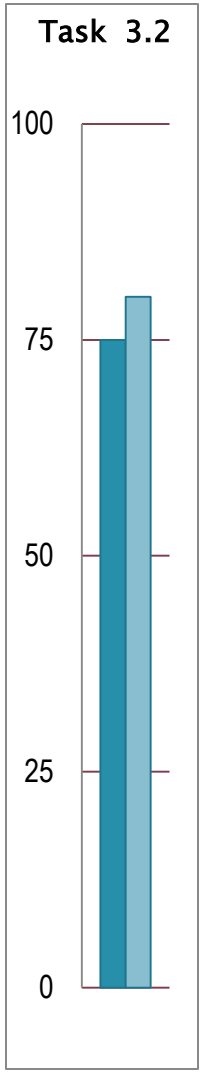
Task 3.0 Status of I-AEVtec Partnership

- Purdue 2011
  - 5 courses with approx. 225 students
  - 13 course sequence designed & courses are being developed
  - Established sub-contracts with partner institutions
- Ivy Tech
  - Offering 5 courses with approx. 60 students
  - Establishing new Associate Program in EV Technology
  - Working on Design of Lab
  - Offered first – First Responder program
- Notre Dame
  - 4 Courses with approx. 49 students
- IUPUI
  - 4 Courses with approx. 69 students
- Purdue – Calumet
  - Developing simulation for course work
  - 7 Courses with approx. 80 students
- Indiana Univ. – Northwest⟶ North Carolina Central University
  - Developing simulation for course work
  - 2 Courses with approx. 70 students

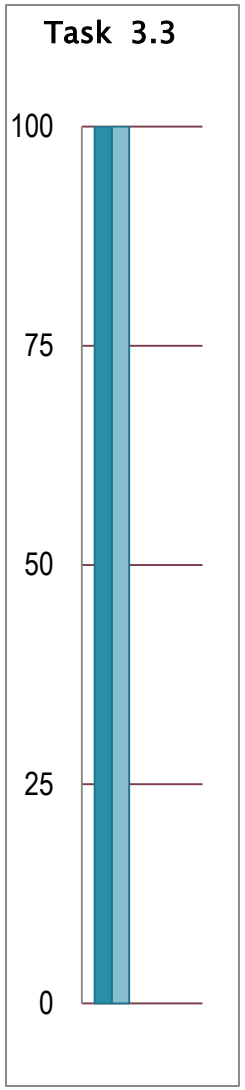
Task 3.0: Deliver Degree and Certificate Programs to Traditional and Non-Traditional Students.



Subtask 3.1: Development of Recruiting Materials: Prepare recruiting materials to attract students to new degree/certificate programs.

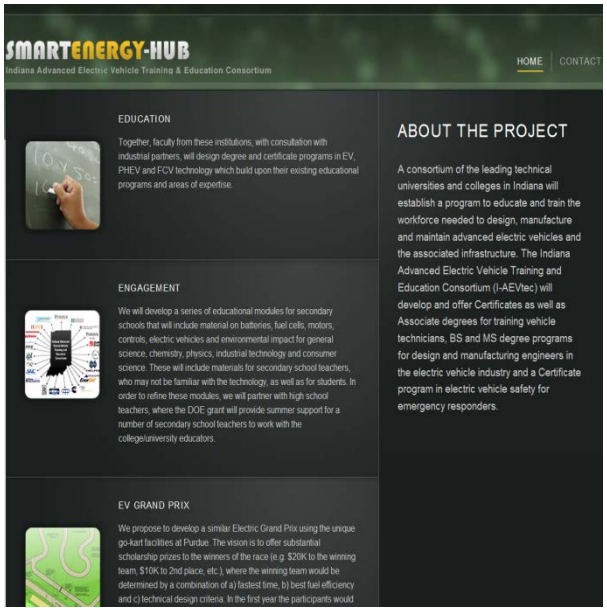


Subtask Recruitment: Offer degree and/or certificate programs at partner institutions



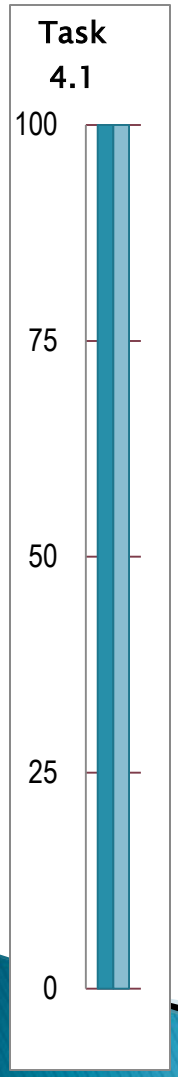
Subtask Course Development and Provision: Develop and offer First Responder Train-the-Trainer course.

Task 4.0 Electric Vehicle Hub
SmartEnergyHub.org

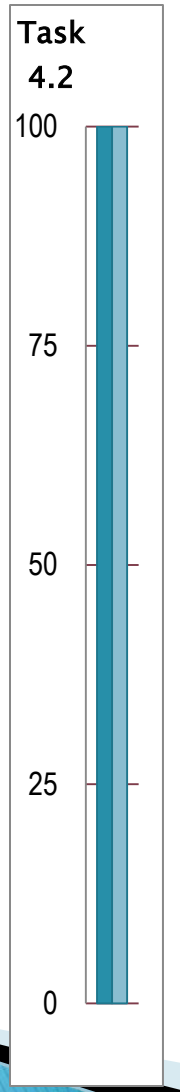


- Delivery of I-AEVtec educational material
  coursework – lecture notes, syllabus, homework, exams streaming videos of experiments demonstrations lectures computer simulations
- Information for general public
- Teacher Section with lesson plans and activities
- Secure website for research discussions, wikis and blogs
- On going discussion with Grant Partner regarding join Hub use as a the delivery system

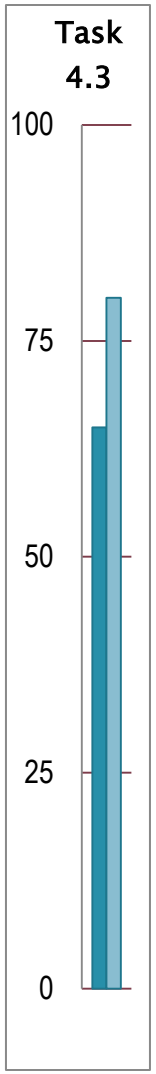
Task 4.0: : Establish the Electric Vehicle Hub (EV Hub).



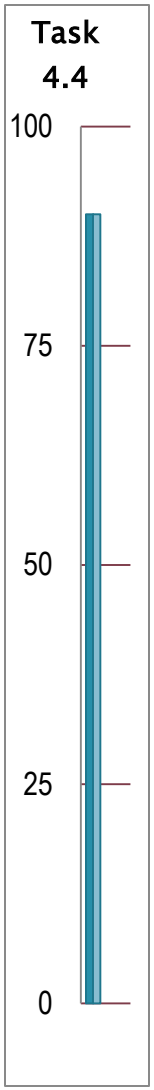
Subtasks 4.1 EV Hub Infrastructure: Establish infrastructure with technology services at Purdue. .



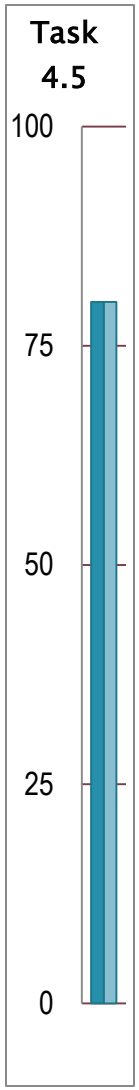
Subtasks 4.2 EV Hub Design: Develop structure and format of EV Hub.



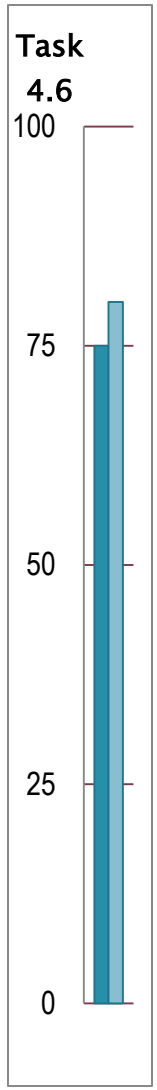
Subtask 4.3: EV Hub Course Development: Populate initial course material on EV Hub.



Subtask 4.4: EV Hub Consumer Outreach: Develop structure of consumer outreach part of EV Hub.



Subtask 4.5: Increase public awareness of the availability of EV Hub as the source for information concerning EVs, PHEVs and FCVs.



Subtask EV Hub Long-Term Plan: Develop a long-term plan for operation/maintenance of EV Hub.

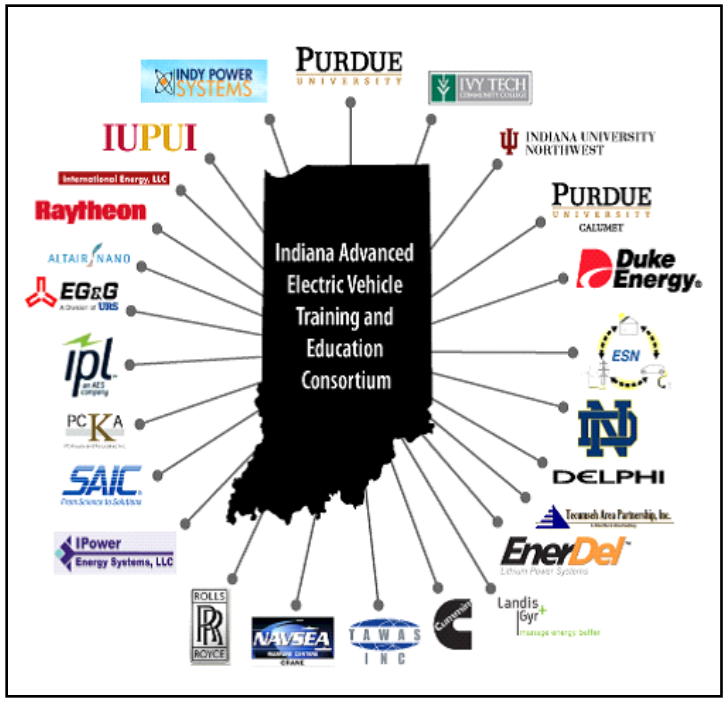
5.0 Industry Partnerships

- First Advisor Board meeting with good representation from the varieties industrial sectors.
  Topics included:
  - Workforce development
  - Summer interns
  - research focus

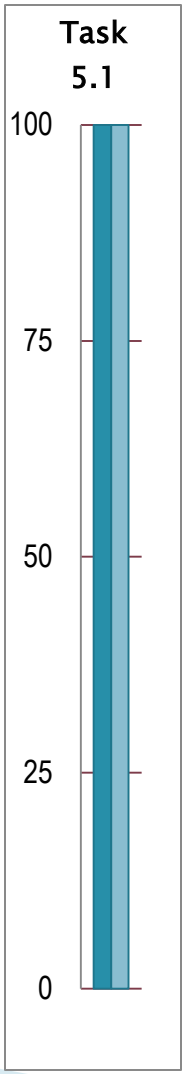
- Larger deployment opportunities in support of specific workforce needs

  Off site course to Delphi
  HEV 101 – over 100 participates to-date
  Course currently being made into a web-based delivery format
  Additional employees are scheduled at attend
  Other companies are seeking access

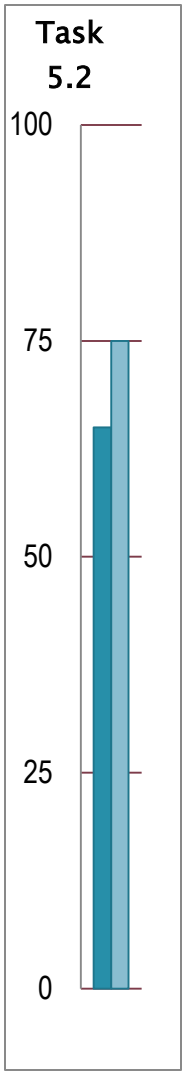
  Faculty on site at Crane Naval Surface Warfare Center in 2011
  Developed MS program in Energy Storage Systems for Crane that is currently being offered by Purdue



Task5.0: Partnership with Regional EV, PHEV and FCV Industries and Governmental Agencies.



Subtask 5.1 Establish relationship and yearly meetings with industry/government



Subtask 5.2 :Develop a feedback mechanism to determine effectiveness of our graduates

6.0 K-12 Engagement

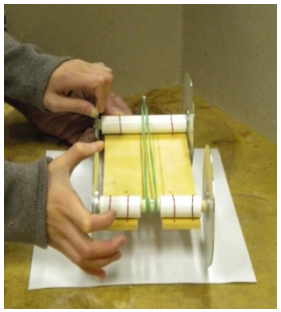
•Develop educational modules for secondary schools that illustrate electric vehicle technology, that meet Indiana's curricula requirements that can be used in the classroom.

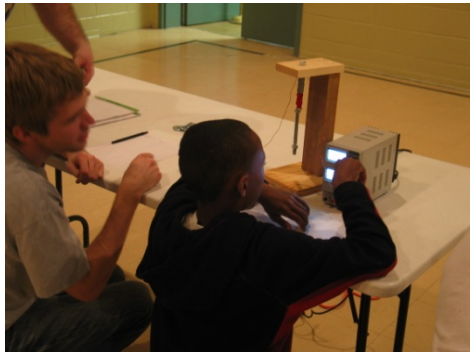
•Modules on batteries, fuel cells, motors, controls, electric vehicles and environmental impact for general science, chemistry, physics, industrial technology and consumer science.

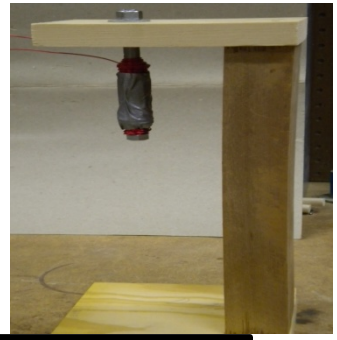
•These will include materials for secondary school teachers, who may not be familiar with the technology, as well as for students.

•Partner with high school teachers -summer support for secondary school teachers to work at Purdue.

•Purdue University Spring Fest engages with more than 25,000 students, families and local media







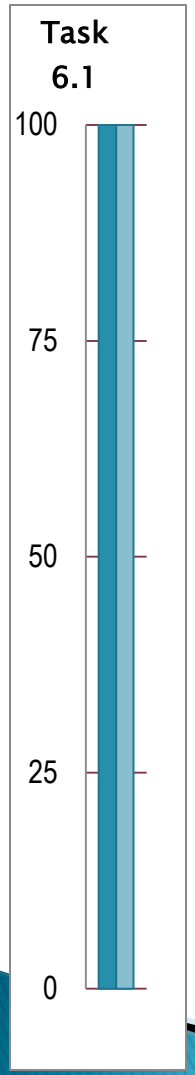
Partnership with 4H: 12 module electric vehicle program
150,000 3rd through 12th grade students in Indiana
6 million 3rd-12th grade in the US

Purdue Spring Fest / Indiana State Fair

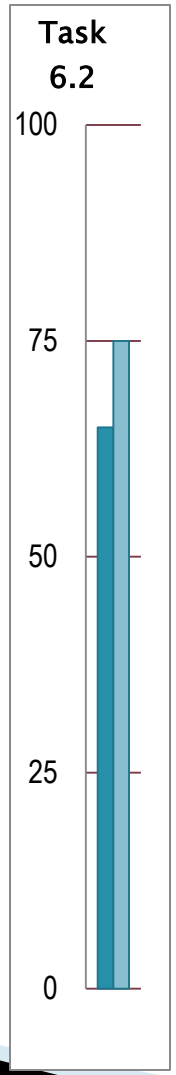
Great day for college students, industry, parents & kids

- **Purdue Spring Fest 2010 – 30,000 attendees**
- **Purdue Spring Fest 2011 – 35,000 attendees**
- **Indiana State Fair 2011 - 200,000 attendees**

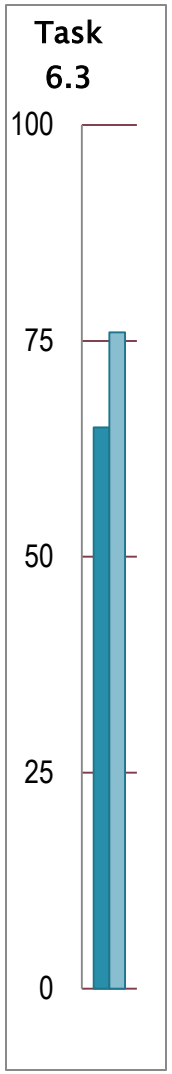
Task 6.0: Secondary School Program in EVs, PHEVs and FCVs and Consumer Outreach.



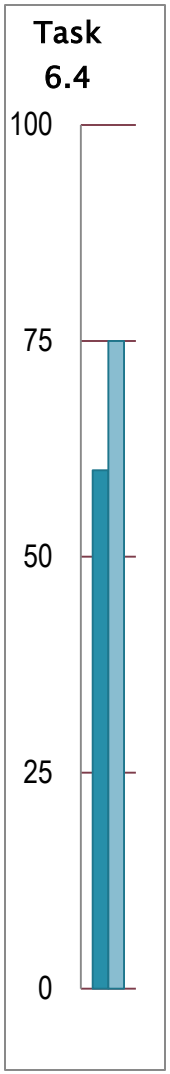
Subtask 6.1: Teacher Recruitment: Recruit secondary school teachers to develop modules for use in science, industrial arts, consumer/family science, etc. courses.



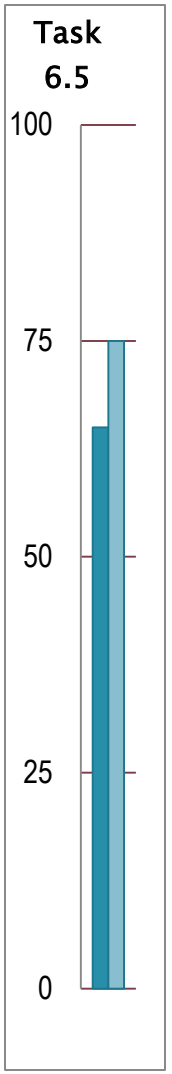
Subtask 6.2: Establish Course Requirements: Develop the requirement for educational modules in various aspects of vehicle electrification for inclusion in current secondary school curricula.



Subtask 6.3: Educational Module Development: Develop initial secondary school educational modules to meet state education standards.

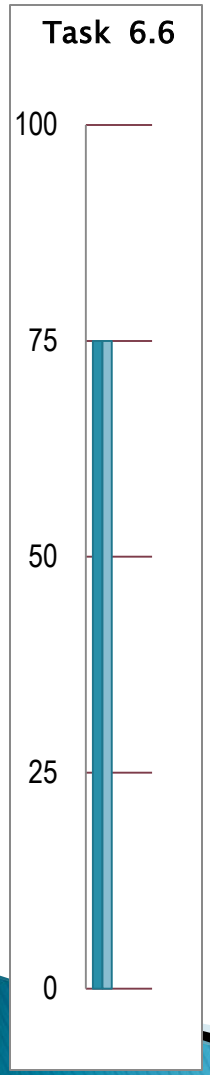


Subtask 6.4: Module Evaluation: Test these initial modules in selected schools via the teachers that helped create them.

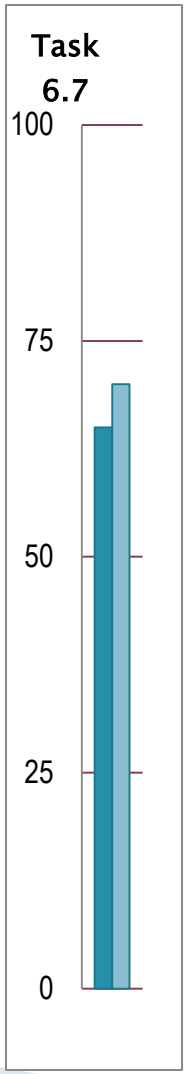


Subtask 6.5: Module Integration: Refine and web-enable on EV Hub the initial modules.

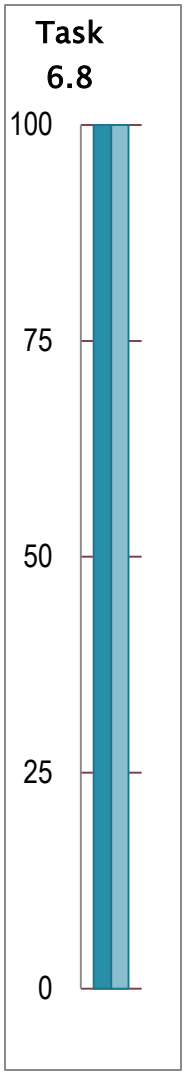
Task 6.0 Cont: Develop Certificate and Degree Programs in EV, PHEV and FCV.



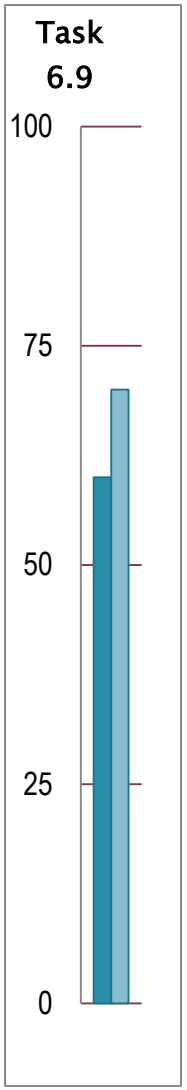
Subtask 6.6: Second Set Module Delivery and Assessment: Develop, deliver, assess and web-enable second set of secondary school educational modules.



Subtask 6.7: Third Set Module Delivery and Assessment: Develop, deliver, assess and web-enable third set of secondary school educational modules



Subtask 6.8: EV Hub Web Application: Initial design of consumer focused web-application for the EV Hub

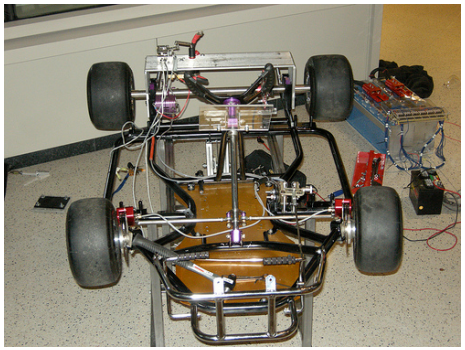


Subtask 6.9: Evaluation of EV Hub Web Application: Implement and refine the design of Task 6.8 and test with a group of consumers.

evGRANDPRIX
recharge innovation.

a competition to design, build, and race the fastest and most energy-efficient battery electric powered go kart.

Unique go-kart track at Purdue
Event scoring
- **fastest time**
- **energy efficiency**
- **technical design**
- **community outreach**



evGRANDPRIX
recharge innovation.

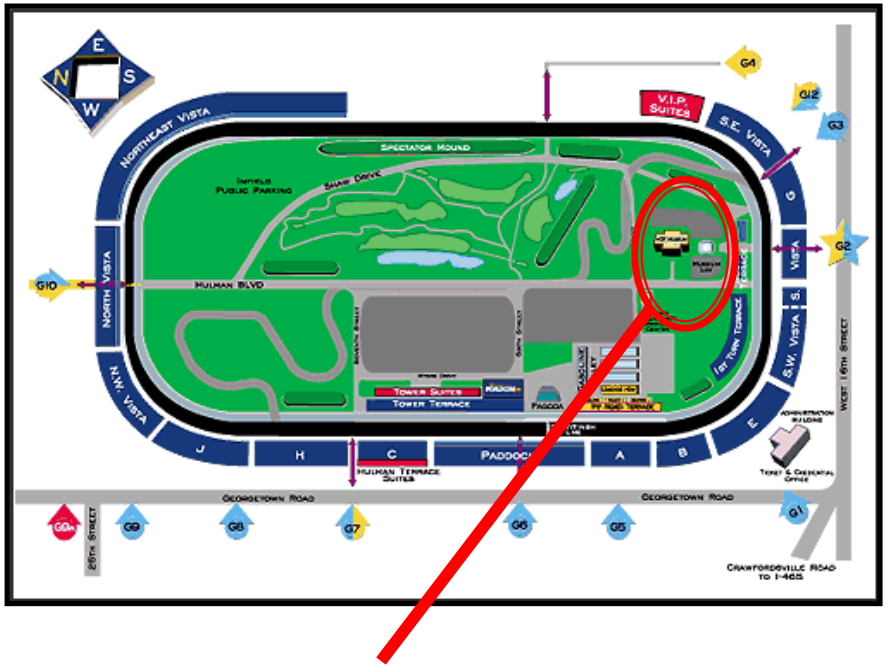
a competition to design, build, and race the fastest and most energy-efficient battery electric powered go kart.

- EvGrandPrix 2010
- 80 laps (approx. l hours)
- 17 Teams – 100 students with common focus
- Additional 150 students and staff in support roles

- Purdue's EvGrandPrix 2011 April 30, 2011
- 25 Teams
- 100 laps

Purdue's EvGrandPrix 2012
April 28, 2012

Purdue's International EvGrand Prix



- International EvGrandPrix 2011
- 100 laps (approx. I hours)
- 30 Teams – 160 students with common focus
- Additional 200 students and staff in support roles

International EvGrand Prix 2012
May 12, 2012
100 laps
Estimated 40 Teams

Indianapolis Motor Speedway Opening Day
Estimated Attendance - 125,000

Task 7.0: Electric Grand Prix.

Subtask 7.1: Initial Development: Evaluate existing electric go-kart technology and determine suitability.

Subtask 7.2: Financial Development: Develop financial model for race and Scholarships.

Subtask 7.3: Race Development: Develop an initial scoring system for go-kart balancing the race with engineering design.

Subtask 7.4 Fund Raising Plan: Develop plan for raising resources from individuals, companies and foundations.

Summary

- A total of 30 courses in various aspects of electric vehicle and associated technologies have been designed and have/are being delivered
- HEV 101 has been developed and delivered to Indian industry
- An industry advisory board has been established to ensure that educational programs meet industrial needs
- Various certificate and degree programs at the Associate and BS level are in the process of being established
- Outreach programs on electric vehicle technology
  - hands-on science/engineering projects with 4H (6.5 million K-12 students)
  - Spring Fest at Purdue – 20,000 attendance
  - Over 45 difference events
- evGrand Prix go-kart race
  - April 19, 2010 at Purdue Grand Prix Track – 2,000 in attendance
  - April 21, 2011 at Purdue Grand Prix Track
  - May 7, 2011 – Inaugural Collegiate Grand Prix race at Indianapolis Motor Speedway with college teams from across the nation and from Europe

Program is on schedule with respect to all DOE project goals and milestones