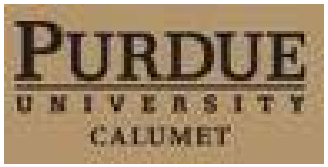
Indiana Advanced Electric Vehicle Training and Education Consortium (I-AEVtec)

Project ID: ARRAVT032



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

US Dept of Energy - $6.2M plus $ 1.9M Cost Share

Partnership: Purdue (Engineering and Technology)
Ivy Tech IUPUI Purdue-Calumet
Notre Dame IU - Northwest

A consortium of the leading technical universities and colleges in Indiana will establish a program to educate and train the workforce needed to design, manufacture and maintain advanced electric vehicles and the associated infrastructure. The Indiana Advanced Electric Vehicle Training and Education Consortium (I-AEVtec) will develop and offer Certificates as well as Associate degrees for training vehicle technicians, BS and MS degree programs for design and manufacturing engineers in the electric vehicle industry and a Certificate program in electric vehicle safety for emergency responders.

Major Project Activities

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

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

Current Status of I-AEVtec Partnership

- Purdue
  - Spring semester – 4 courses with approx. 60 students
  - 13 course sequence designed & courses are being developed
  - Designing Battery and EV Labs
  - Established sub-contracts with partner institutions
- Ivy Tech
  - Sub-contract in place
  - Teaching 2 courses with approx. 30 students
  - Working on establishing new Associate Program in EV Technology
- Notre Dame
  - Sub-contract in place
  - Course planned for Fall '10 semester
- IUPUI
  - Sub-contract nearly in place
- Purdue – Calumet
  - Sub-contract in place
- Indiana Univ. – Northwest
  - Sub-contract in place

I-AEVtec Course Development

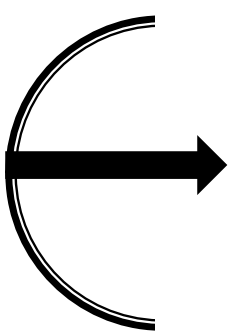
Web-enabled courses in batteries, fuel cells, electric motors, hybrid engines, grid technology and consumer issues

Gas/Oil/Coal

Solar

Wind

Bio Energy



SmartGrid

EV/PHEV

Power Electronics

Electrochemical

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.

Yearly Enrollment in I-AEVtec (est.)

	Degree or Certificate	Individual Classes
Purdue/Eng. - BS	100	1000
Purdue/Technol.– BS	40	400
Purdue - MS	30	100
Ivy Tech	40	60
IUPUI	90	300
Notre Dame	8	25
Purdue - Calumet	NA	15
IU-Northwest	NA	15

Table 1. Summary of new courses ■, existing courses to be web-enabled□, and supporting courses □

Institution	Number	Name	Level	Area
Purdue-West Lafayette	ECET 385	Introduction to Automotive Electronics	2	Electronics
	ECET 499	Power Electronics in Energy Systems	2	Electronics
	MET 426	Internal Combustion Engines	2	Engine
	ECET 231	Electrical Power and Controls	2	Electronics
	ECET 372	Process Controls	2	Electronics
	ECET 257	Consumer Power Electronics	2	Electronics
	MSx	Battery Science and Technology	2,3	Battery
	MSE/CHE-xxx	Introduction to Batteries	1,2	Battery
	MSE/CHE-xxx	Battery Fabrication and Testing Laboratory	2,3	Battery
	ME440	Internal Combustion Engines	2	Engines
	ME 255	Vehicle Design and Fabrication	2	Vehicle
	ME 482	Control System Analysis and Design	2	Electronics
	ME 504	Automotive Control	2,3	Electronics
	ME 540	Internal Combustion Engines	2,3	Engines
	ME/MET/ECE	Electric Vehicle Lab	2,3	EV/HEV
	ECE 321	Electromechanical Motion Devices	2	Electronics
	ECE 323	Electronic Motion Devices and Systems Lab	2	Electronics
	ECE 423	Electromechanical Motion Control	2	Electronics
	ECE-425	Electric Machines	2	Electronics
	ECE-432	Elements of Power System Engineering	2	Grid
	ECE-433	Power Electronics	2	Grid/ Electronics
	ECE-434L	Power Electronics Laboratory	2	Grid/ Electronics
	ECE-532	Computational Methods for Power System Anal.	3	Grid
	CFS – xxx	Consumer Acceptance of Electric Vehicles	2	Consumer
Ivy Tech-Lafayette	AUTC 103	Principles of Alternative/Renewable Energy	1	Battery/Elect./FuelCell
	AUTC 107	Engine Principles and Vehicle Service	1	Engines
	AUTC 109	Engine Performance I	1	Electronics
	AUTC 111	Alternative Fuels Installation & Application	1	Battery/ Vehicle
	AUTC 113	Electrical and Electronics I	1	Vehicle/Electronics
	AUTC 123	Electrical and Electronics II	1	Electronics
	AUTC 127	Engine Repair	1	Engines
	AUTC	Hybrid Systems	1	Vehicle
	AUTC 2xx	Battery maintenance and installation	1	Battery
	AUTC 243	Advanced Electronics	1	Electronics
	AUTC 249	Advanced Vehicle Technologies	1	Vehicle
	AUTC 1xx	Intro to Batteries, Standards & Applications	1	Battery
IUPUI	ME 597	Principles of Turbomachinery	2,3	Engines
	ME 504	Automotive Control	3	Engines
	ECE 321	Electromechanical Devices and Systems	2	Electronics
	ECE 427	Power Electronics	2,3	Electronics
	ECE 432	Intro to Power Systems	2,3	Electronics
	ECE 495	Electronic Fund. of Hybrid and Electric Vehicles	2,3	HEV/Elect.
	ECE 495	Modeling, Analysis, and Control of HEVs	2,3	HEV
	ECE 595	Electric Network and Smart Grids	2,3	Grid/Electronics
	ECE 595	Energy Systems	2,3	Grid/Electronics
	ECE 576	Electric Power Systems	2,3	Electronics
	ME 500	Powertrain Integration	2,3	Vehicle/HEV
	MET 542	Intro to Renewable Energy	2,3	Fuel Cells
	ME 597	Renewable Energy and Fuel Cells	2,3	Fuel Cells & Battery
	ENE 3XX	Electric Power Networks and Interfaces	2	Grid/Electronics
	ENE 4XX	Hybrid and Electric Transportation	2	Battery/HEV
	ENE 3YY	Energy Storage Devices and Systems	2	Battery
	ENE 4YY	Fuel Cell and Battery Engineering	2,3	Battery/Fuel Cell
	ECE ZZZ	Industrial Energy Systems Design	2	Grid
Notre Dame	CBE40911	Fuel Cells Science and Technology	2,3	Fuel Cell
	CBExxxx	Introduction to Fuel Cells	1,2	Fuel Cell
	CBExxxx	Fuel Cell Laboratory	2,3	Fuel Cell
Calumet/ IU-NW		Battery & Fuel Cell Modules for Phys. Chemistry	1,2	Battery & Fuel Cells

Electric Vehicle Hub

Establish an informational outlet – the Electric Vehicle Hub – as the website for EV, PHEV, and FCV technology, including educational material, simulations, video demonstrations and information for the general public

Core technology: HUBzero™

- Unique science gateway technology developed at Purdue
- NSF sponsorship ($13.5M over 7+ years)
- NanoHub- the international web portal for nanotechnology
  - 90,000 users/visitors per year

SmartEnergyHub.org

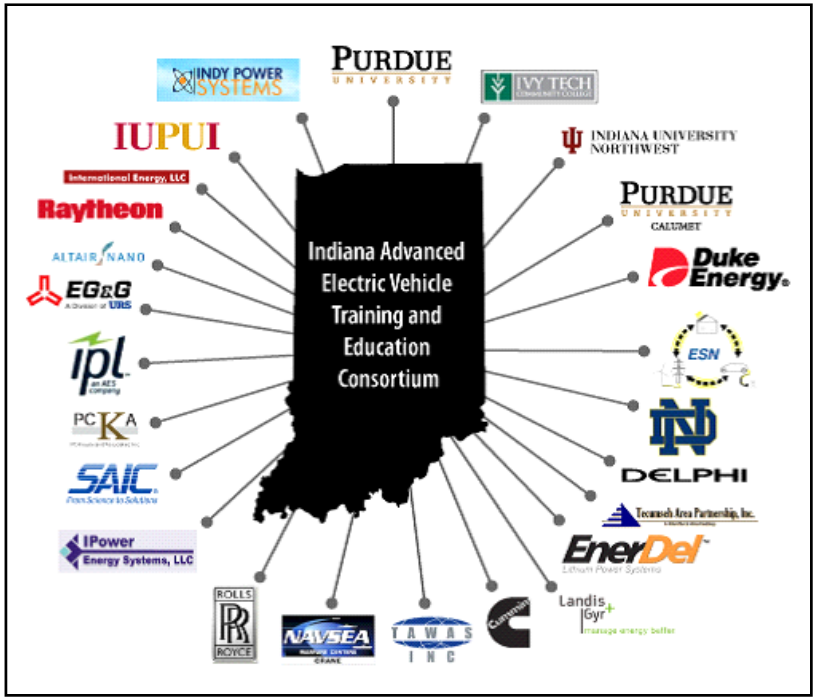
- ElectricVehicle-Hub; Battery-Hub; SmartGrid-Hub; Windmill-Hub
- Delivery of I-AEVtec educational material
  - coursework – lecture notes, syllabus, homework, exams
  - streaming videos of experiments
  - demonstrations
  - lecturescomputer simulations
- Information for general public
- Secure website for research discussions, wikis and blogs
- Advanced searching capabilities
  - example: search for “fuel cells” - find scholarly articles + education materials + consumer information + relevant simulations + discussion sites

Industry Partnerships

- Develop an active partnership with industry and government in advanced electric vehicles to ensure that the educational products meet the needs and demands of employers

- These activities include workforce development, summer interns, research focus and assist with the economic engine for the state of Indiana and surrounding states.

- Larger deployment opportunities in support of specific workforce needs
  - MS program with Delphi
  - MS program with Crane
  - (several certificates that can be assembled into a MS degree)



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

Emerging 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

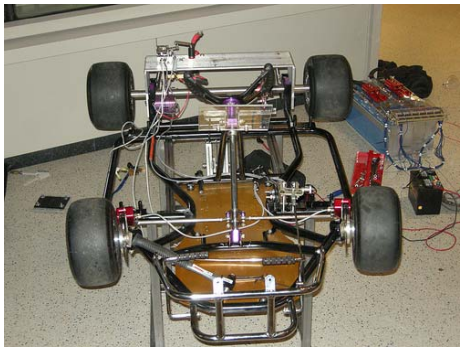
Spring Fest 2010

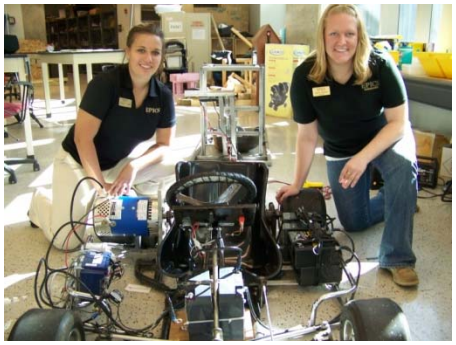
Great day for college students, industry, parents & kids

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**
- **Timeline**
  - **Year 1 I-AEVtec partners + other Indiana colleges**
  - **Year 2 Regional universities and colleges**
  - **Year 3 National event**
- **Vision**
  - **Corporate sponsorships**
  - **Offer substantial scholarships**
  - **Associated K-12 event**
  - **Technology Celebration Week**





Inaugural evGrandPrix

		Attendance
1st Annual Race	April 18, 2010	2,000

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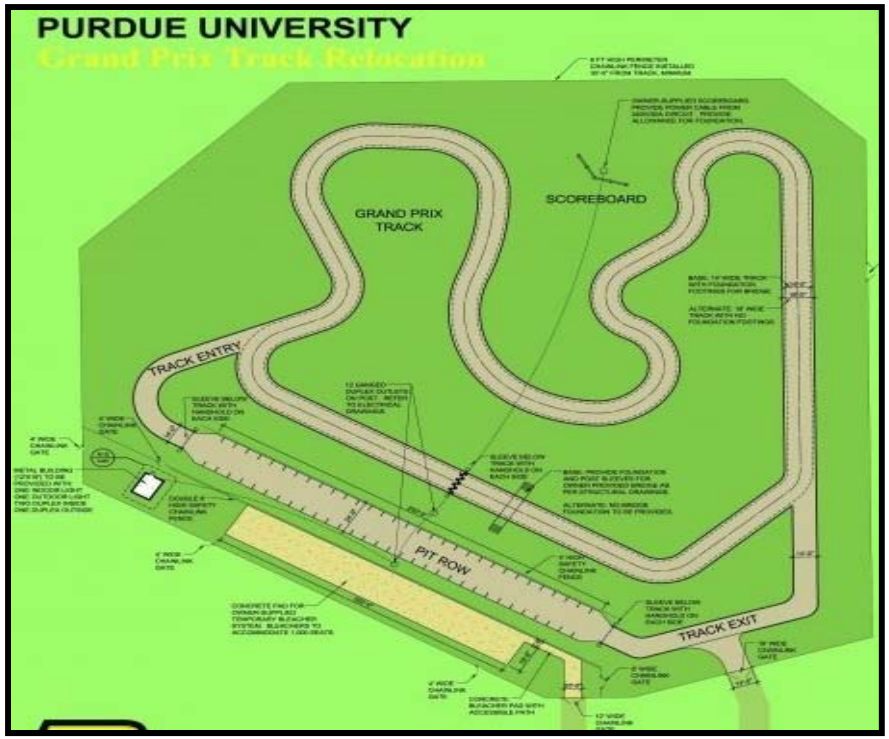

- 100 laps (approx.l 2 hours)
- 15 Teams – 90 students with common focus
- Addition 100 students and staff in support roles

Vision

Year 1 – Indiana
Year 2 – Regional
Year 3 – National

Courses in Spring 2010 semester

College of Engineering

EPICS 1 (15 Students) Design, plan and implement the core infrastructure for the EVGrand Prix event

EPICS 2 (11 Students) Design, plan and implement the outreach component for the EVGrand Prix

College of Technology

Electric Vehicle Systems (24 Students) Basic instruction on electromechanical systems and then building 4 karts to be used in the evGrand Prix – scalable to other institutions

evGRANDPRIX recharge innovation.

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

CNIT 581 – Electro-mechanical Systems (goKart build class)

go-kart Laboratory

- *Stations for 4 teams*
- *Full electrical diagonistics*
- *4 go-kart components*
- *Future – small dynamometer*

Recent email from a current Purdue student

"Also, you might be intrigued to know that I just received a job offer at Tesla Motors out in Los Angeles working on chassis design and power train of their upcoming Model-S EV. During my interviews I had a lot to say about the things we have been learning in this class and they were pretty impressed with what we are doing."

evGRANDPRIX
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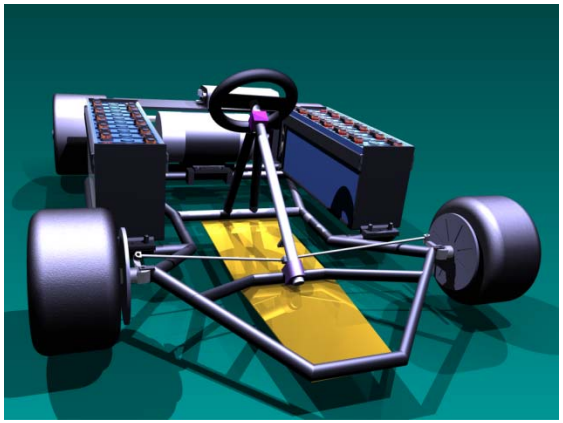
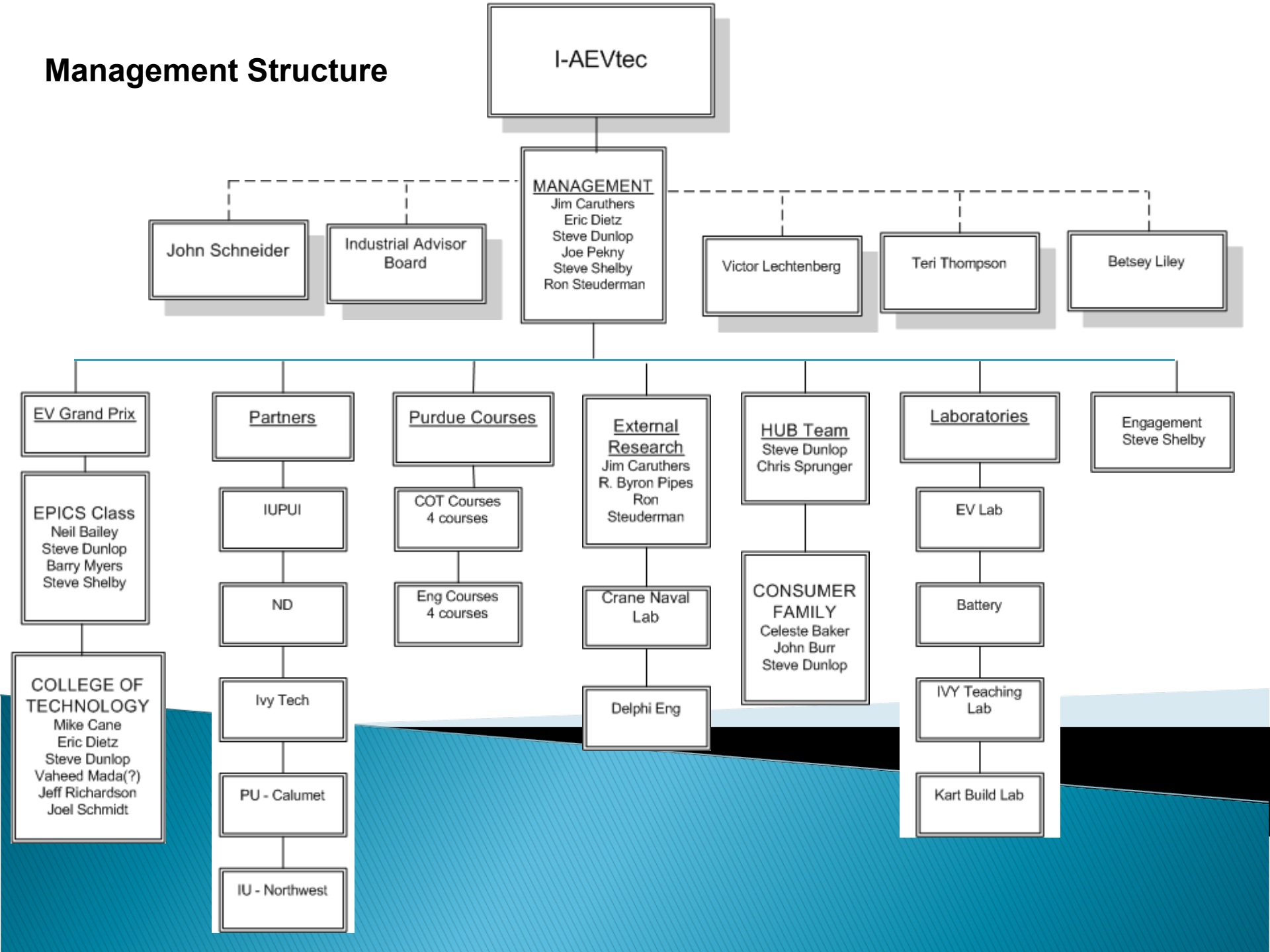
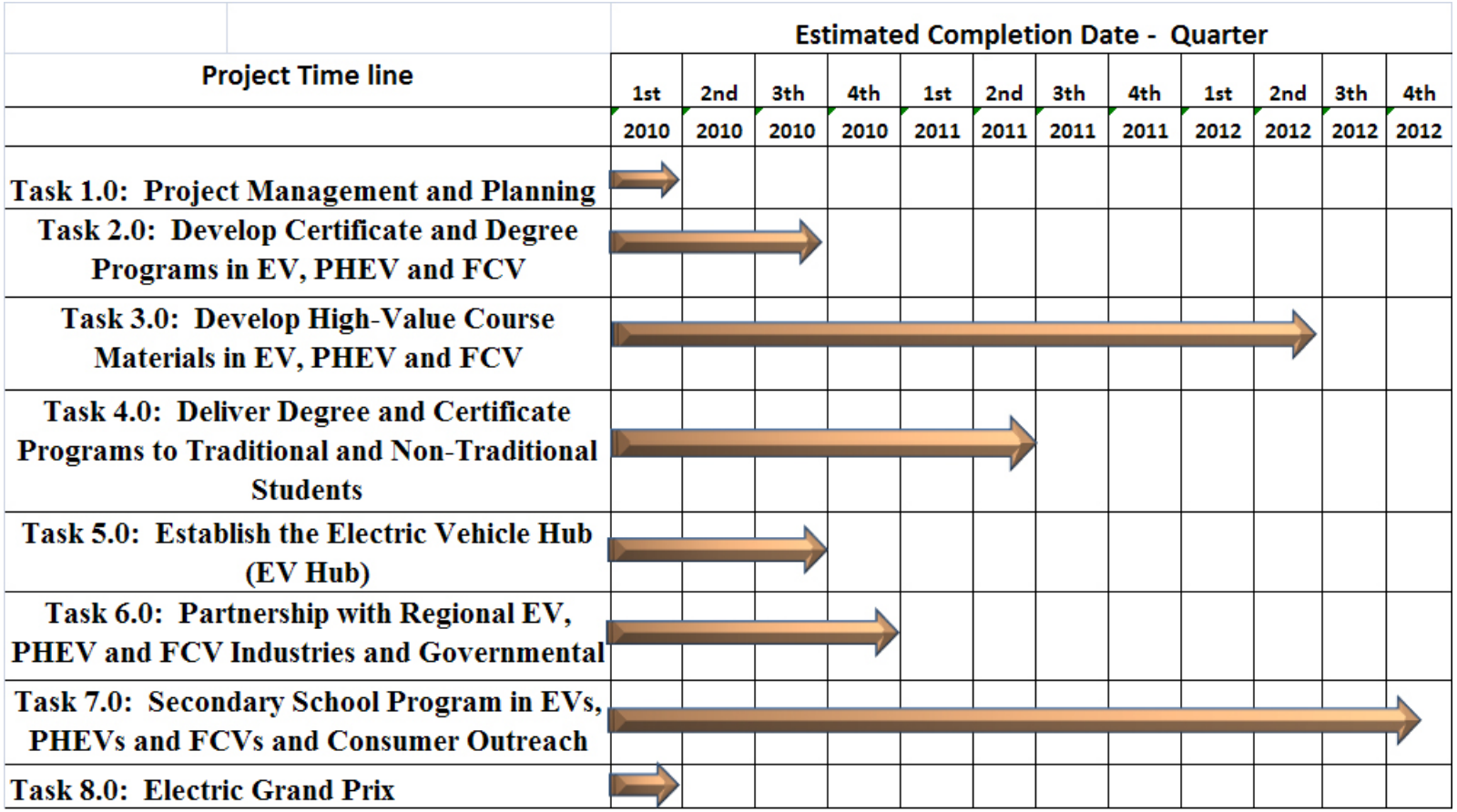


Management Structure



Project Timeline



Limited View (full Gantt chart is 5 pages)

Summary

- Education and Training Program that involves the major technical universities in Indiana
- Good initial progress in establishing program
- Excellent response from
  - Students
  - Industry partners
- Community outreach
  - Specially designed coursework programs
  - ElectricVehicleHub
  - evGrandPrix

Thank you. Questions ??