PURDUE ENGINEERING

PURDUE UNIVERSITY

PURDUE UNIVERSITY COLLEGE OF TECHNOLOGY

Breakfast Slide Show

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

Electric cars are nothing new
This electric car was made in Detroit in1914

US Vehicle roadmap

Typical Fleet Vehicles

2009 2010 2011 2012

Sport/Luxury

Tesla Roadster

Porsche 918 PHEV

Tesla Model S

Audi A1 PHEV

Cadillac XTS PHEV

Fisker Karma

Volvo V70 PHEV

Compact

Mini EV

Zenn EV

Wheego

Smart EV

Think City

Mitsubishi i-MiEV

Toyota Prius PHEV

Honda insight PHEV

Sedan/SUV

GM Volt

Nissan Leaf

Toyota Rav4 EV

Coda EV

BYD e6 EV

Ford Focus EV

Light Trucks

Smith Electric Edison

Navistar eStar

Ford Transit Connect

Mercedes Vito E-cell

Renault Kangoo

Bright Auto Idea

BEV PHEV

GE

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

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.

Funded by US Dept of Energy at $6.2M

Purdue Electric Vehicle

- **Electric Vehicle Initiative - Consortium of Indiana technical universities/colleges**
  (Indiana Advanced Electric Vehicle Training & Education Consortium I-AEVtec)

PURDUE UNIVERSITY · IUPUI · IVY TECH COMMUNITY COLLEGE · INDIANA UNIVERSITY NORTHWEST · PURDUE UNIVERSITY CALUMET

Workforce Development

- **Work With Industry to Develop Degree/Certificate Programs in Technology & Engineering**
  (Design, Manufacture, Maintenance, Emergency Response - electric vehicles and Smart Grid (BS/MS)

Education

- **Produce Web Courses on Batteries, Fuel Cells, Electric Motors/Controls, Hybrid Engines, Smart Grid Technology & Promote Consumer Acceptance**
- **Establish the SmartEnergyHub - EV, PHEV, FCV and SMART GRID Technologies**
- **Develop Educational Modules for Secondary Schools**

Economic Development

- **Develop Active Industry & Government Partnerships (electric vehicles/Smart Grid)**
- **Manage Power Peaks/Spikes & Work on Innovative Methods to Keep Price of Electric Power Attractive to Industry**
- **Develop an Electric Vehicle Grand Prix go- kart race to inspire students to commit to a career in electric vehicle technology**

Electro-Mechanical Systems

- *Stations for 4 teams*
- *Full electrical diagnostics*
- *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."

Course Rigor

- Power calculations included:
  - Drag coefficients
  - Vehicle weight
  - Rolling resistance
  - Incline or decline grades
  - Desired acceleration and vehicle top speed
- Electronics and battery systems developed to meet power needs

$$P_{total} = (1 / h_{total})\, P_{aero} + P_{roll} + P_{grade} + P_{acceleration} \quad (1)$$

$$P_{aero} = \tfrac{1}{2}\, C_d\, \rho_{air} A_{frontal} (V+V_w)^2 V \quad (2)$$

$$P_{roll} = C_{roll}\, m_{vehicle}\, g\, V + C_{1roll}\, m_{vehicle}\, g V^3 \quad (3)$$

$$P_{grade} = m_{vehicle}\, g\, V \sin\theta \quad (4)$$

$$P_{acceleration} = C_{inertia}\, a_{required}\, m_{vehicle}\, V \quad (5)$$

where;

P_{total} = total required power (W)

P_{aero} = power required to overcome aerodynamic loss (W)

P_{roll} = power required to overcor

P_{grade} = power required to climb a

$P_{acceleration}$ = power required to achieve

$A_{frontal}$ = frontal area (m^2)

a = vehicle acceleration (m/s^2

C_d = Coefficient of drag

C_{roll} = Coefficient of rolling resis

$C_{inertia}$ = Coefficient of inertia (acc

parts of the vehicle su

flywheel, shafts,

C_{1roll} = another coefficient of roll

squared vehicle

quantity.

g = gravitatio

m = vehicle m

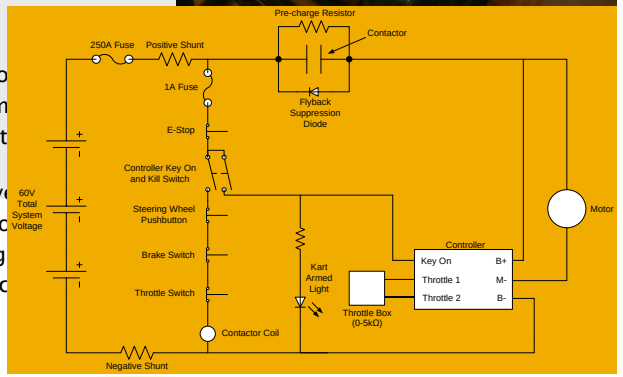
ρ_{air} = air densit

V = Vehicle v

V_w = Wind velc

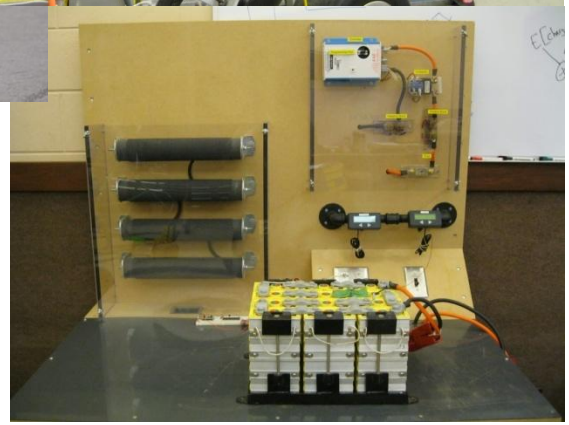
θ = incline (g

h_{total} = total effic



EV Technology Laboratory

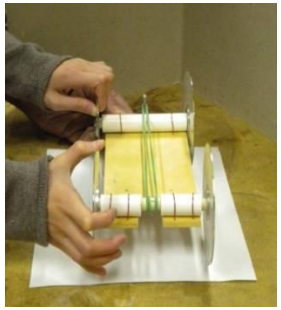
- Laboratory tests and designs were proven in the real world
  - Validation of Calculations
  - Competition
  - Teamwork
- EV Race Tested:
  - Endurance
  - Innovation
  - Design
  - Optimization
  - Outreach
- Students balance performance and energy efficiency in context
- Future Small Vehicle Dynamometer

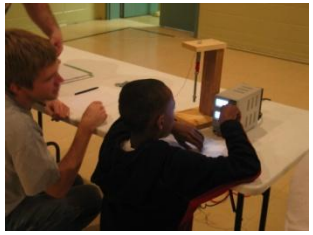


EV Dyno Laboratory

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





Bauer

Bauer Community Family Resource Center
Goal: Introduce and Foster STEM
Hands-on Learning Based Activities
Weekly Program (12-15) + Purdue Faculty and Students

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

Educational Event
- Strategy & Skill Based
- Fastest time
- Energy efficiency
- Technical design
- Community outreach

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

- Corporate sponsorships
- Substantial scholarships
- Associated K-12 event
- Technology Celebration Week

Inaugural 2010 *Purdue evGrandPrix!*

17 Teams/Karts = 100+100 Students
80 laps = 40 + 40
2000 Fans
70+ TV Stations/400+ Media Sites

The Inaugural Purdue evGrandPrix

Indianapolis Motor Speedway

- **Inaugural Purdue Collegiate evGrandprix**
  - Part of Emerging Technology/Alternative Energy Weekend
  - 40+ Teams
  - International Event (Cal Poly Tech to UK)
  - Grand Prix Track Layout - 100 Laps

Purdue's International evGrandPrix

www.evgrandprix.org

evGRANDPRIX

recharge innovation.

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

evGRANDPRIX
recharge innovation.

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