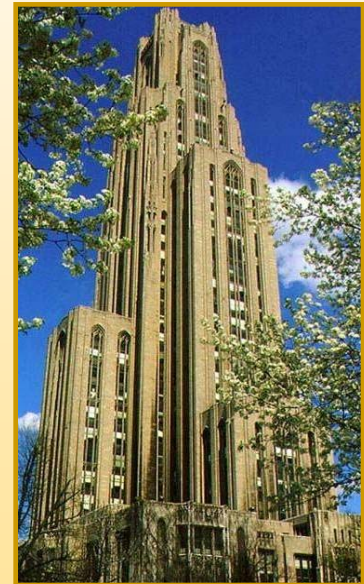




DOE-152: Workforce Training for the Electric Power Sector – The Keystone Smart Grid Fellows Program

**2012 Electric Power Industry Conference
University of Pittsburgh
November 13, 2012 – Pittsburgh, PA**

**Dr. Gregory Reed, Matthew Korytowski,
Rusty Scioscia, Emmanuel Taylor,
Ansel Barchowsky**



**Electric Power & Energy Research for Grid Infrastructure
University of Pittsburgh, Swanson School of Engineering
Pittsburgh, Pennsylvania; USA**

- **DOE-152 Overview**
- **Educational Initiatives**
 - **Newly Developed Undergraduate and Graduate Courses**
 - **Eaton-sponsored Power Systems Lab**
 - **National Academies of Science and Engineering, Energy Ambassador Program**
- **Middle School Curriculum Development**
 - **Introduction to Energy and Electricity**
 - **Pilot Course Planned with Aquinas Academy, Gibsonia PA**
- **Additional Discussion**



DOE-152 Overview



□ Goal of the Grant Program

- “Train the trainers” of tomorrow who will educate the workforce charged with building the Smart Grid

□ Objectives of the Project

- Identify and recruit Fellowship candidates from the targeted pool of community college professors, K-12 science and math teachers, recent B.S. graduates seeking careers in electric power.
- Provide financial support for two cohorts of students in University of Pittsburgh’s Power and Energy Initiatives.

Defining Smart Grid

“The implementation of various enabling power system automation, communication, protection, and control technologies that allow real-time interoperability between end-users and energy producers, in order to enhance efficiency in utilization decision-making based on energy resource availability and economics.”

- Dr. Gregory Reed

Engineering Society of Western Pennsylvania,
Pittsburgh Engineer Magazine, April 2010

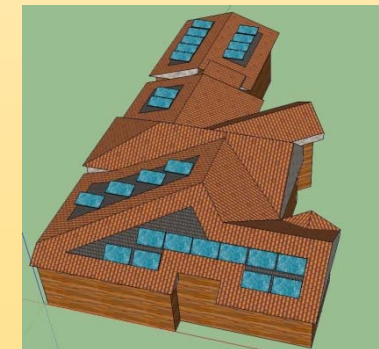
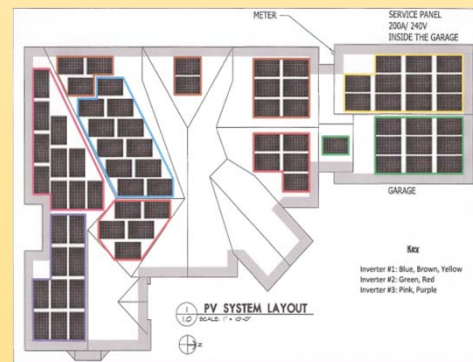
Educational Initiatives



- ❑ Coursework- Newly Developed Courses since 2009
 - Undergraduate:
 - ECE 1770 – Power Distribution Systems Engineering
 - Graduate: ECE 2795 – Special Topics in Power
 - Renewable and Alternative Energy Systems
 - Advanced Power Electronic Technologies: FACTS & HVDC
 - Smart Grid Technologies and Applications
- ❑ Tutoring/Mentoring
 - Power engineering fundamentals for undergraduate student researchers
 - ECE 1769 – Power Systems Analysis I
- ❑ National Academies of Science and Engineering
 - Energy Ambassadors Program

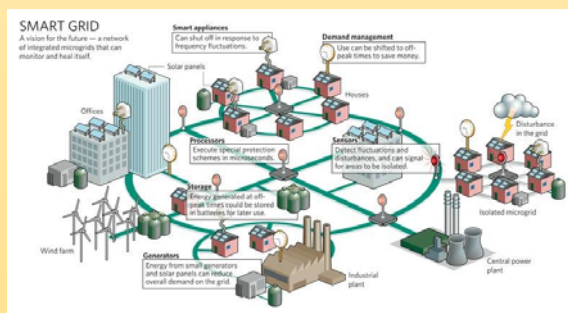
- ECE 1770: Power Distribution Systems Engineering and Smart Grids
 - Course Overview
 - Provide an introduction to the practical aspects of power distribution systems and emerging smart grid technologies, including applications and design.
 - Course Topics
 - Distribution system components
 - Industrial and utility distribution system characteristics
 - Voltage regulation
 - Computer modeling and analysis via PSCAD
 - Impact of alternate energy / distributed generation
 - Smart grids technologies

- Power Distribution Systems Engineering and Smart Grids
 - Course Project
 - Each semester a team based project is assigned.
 - Example projects include residential solar design
 - Project teams submitted designs for identical houses in varying geographical locations
 - Overall Design Objective:
 - Design a PV array to maximize system output ignoring costs and roof structure limitations.
 - Compliance with National Electric Code specifying power and ground cables and conduits
 - Operation within all equipment specifications especially inverters
 - Incorporation of local solar irradiance data and correction factors for temperature and tilt angle



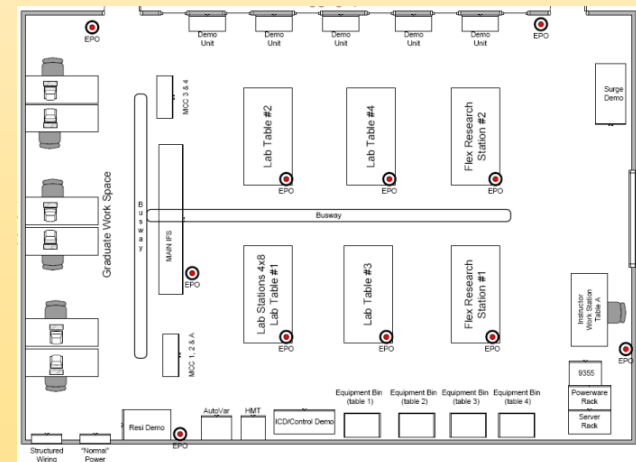
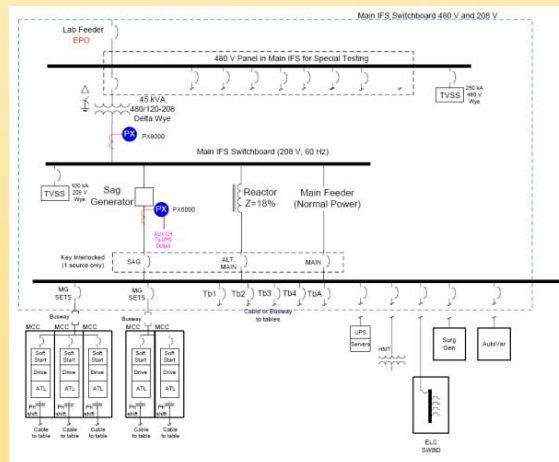
□ ECE-2795: Smart Grid Technologies and Applications

- Course topics and description:
 - Emerging technologies dedicated to reliably, efficiently and safely managing electric power across utility, commercial, industrial, and residential networks.
 - Application of smart grid technologies from power generation through power consumption including grid automation, smart meters, demand response, communication and control, monitoring and diagnostics, relaying, electric vehicle integration, grid connectivity, renewable energy, cyber security, microgrids, and business processes and markets.



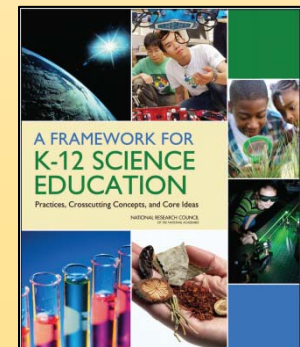
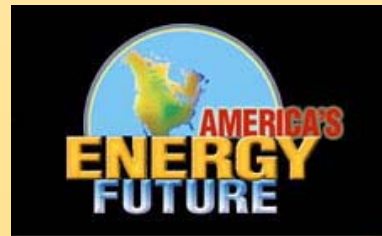
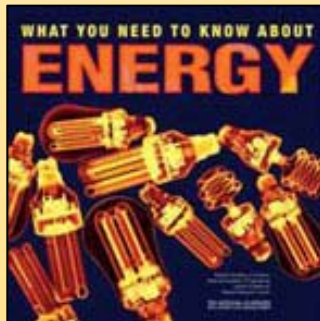
□ Eaton-sponsored Power Systems Lab

- Completion planned for March, 2013
- Eaton is providing equipment-in-kind for a new state-of-the-art power system laboratory planned for construction in Benedum Hall, as part of the Swanson School's transformation plan currently underway
- The lab will provide research facilities for faculty and graduate studies, as well as capabilities for hands-on learning associated with new course developments at the undergraduate and graduate level in power engineering



□ National Academies of Sciences & Engineering

- Energy Ambassadors Program
- Program Objectives:
 - To provide innovative outreach and education on science and engineering for community and opinion leaders, students and educators, and other target groups, in order to:
 - To build on the respect people hold for scientists and engineers and to address the need for a greater popular understanding of scientific issues, with energy as the initial focal topic
 - Pilot program for eventual national development - Pittsburgh region selected for its national position as an energy sector capitol and industry/academic leaders in energy



Middle School Curriculum Development Pilot Program with Aquinas Academy



Curriculum Development

- ❑ Introduction to Energy and Electricity
 - ❑ Pilot program with Aquinas Academy – Gibsonia PA
 - ❑ Planned for Spring 2013 term

- ❑ Key Topics (Lessons/Lectures)

1. Energy Overview
2. Energy Resources & Development
3. Energy Diversification and Utilization
4. Electricity Concepts
5. Energy & Electricity Delivery
6. Electricity Generation
7. Electric Power Systems & Smart Grids
 - 7b. Tour of Eaton and Pitt Labs
8. Economic, Societal, and Global Aspects



1. Energy Overview

- Energy definition
- How we use energy
- How much energy do we use
- Grand Challenges
- History
- Electricity & Transportation



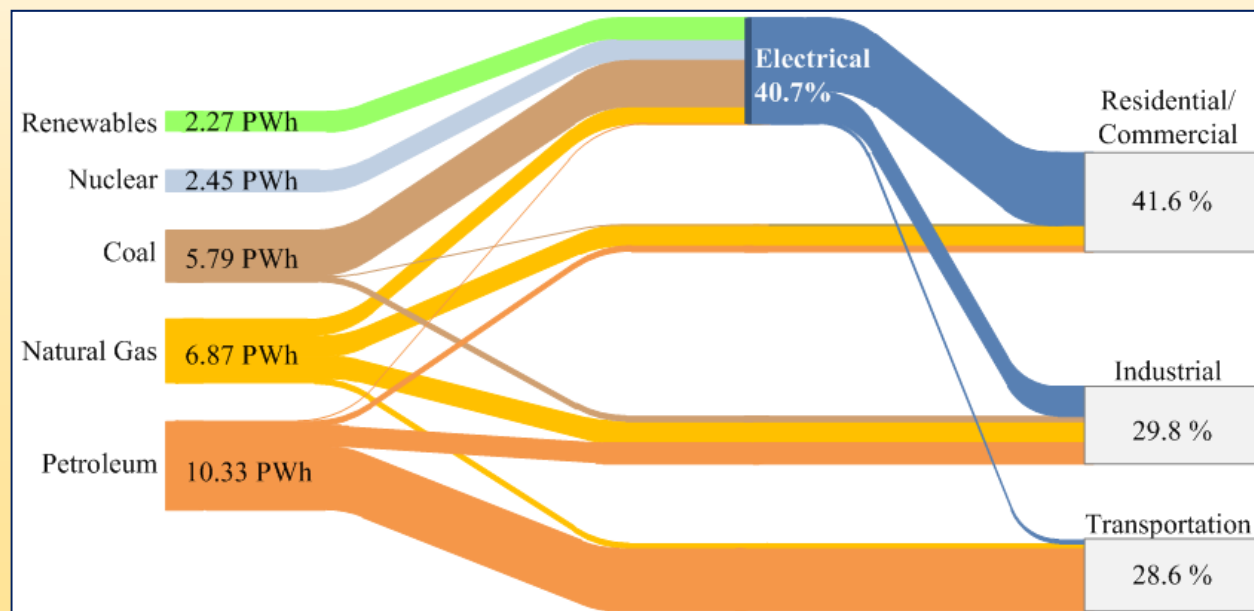
2. Energy Resources and Development

- Fossil Fuels (Coal, gas, oil)
- Nuclear
- Renewables (Wind, solar, geothermal, biofuels)
- What are all of these resources?
- Where do they come from?
- What makes them useable?
- How are the resources mined/harvested/collected?



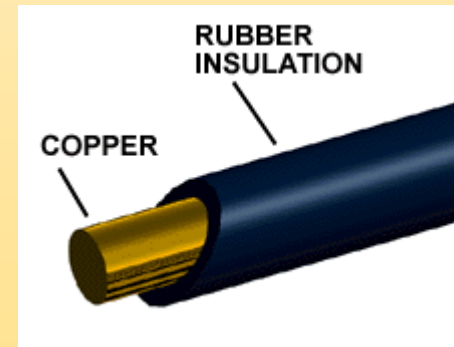
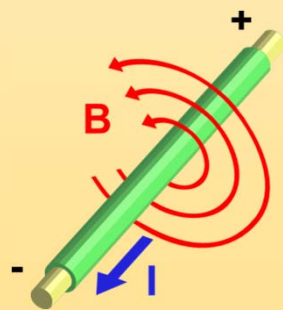
3. Energy Diversification and Utilization

- How are energy resources used?
- Transportation vs electrical power consumption
- Electrical percentage breakdown for different resources



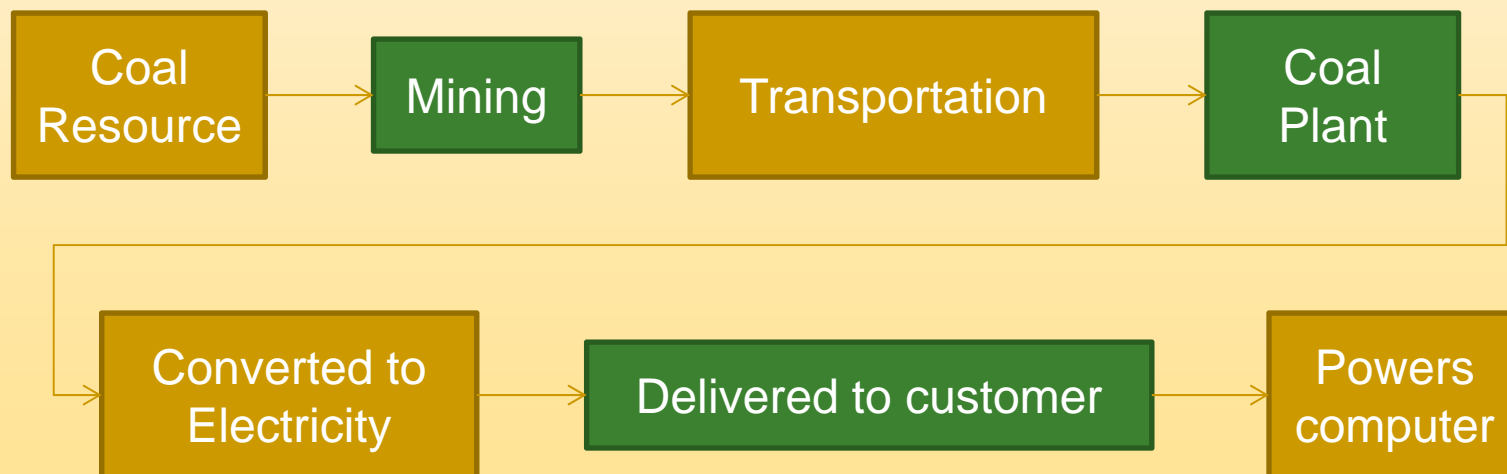
4. Electricity Concepts

- Electric field
- Electric potential
- Electromagnets
- Voltage, current, resistance
- Insulators and conductors
- Basic elements of an electrical circuit
 - Resistors, capacitors, inductors



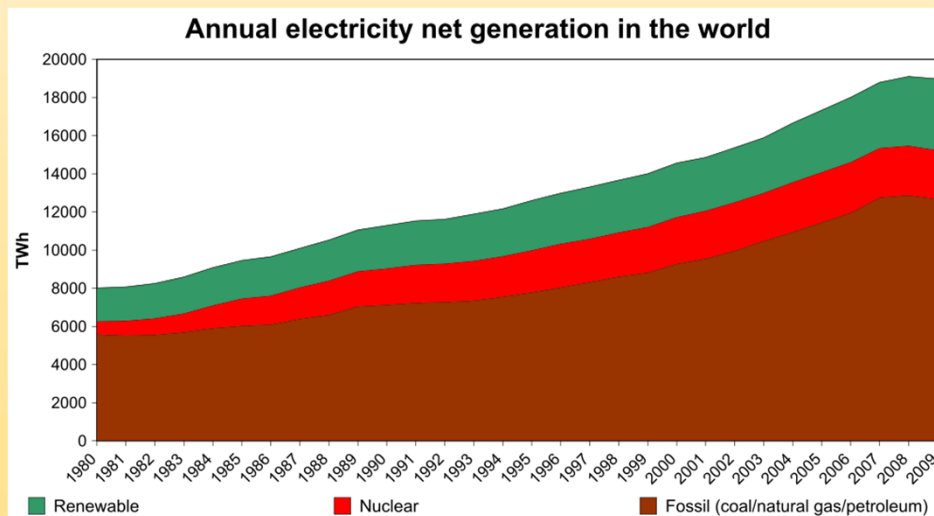
5. Energy & Electricity Delivery

- Gas/Oil pipelines
- Electrical Transmission & Distribution
- Shipping (Imports and Exports)
- Flow diagram of how a resource is collected & utilized



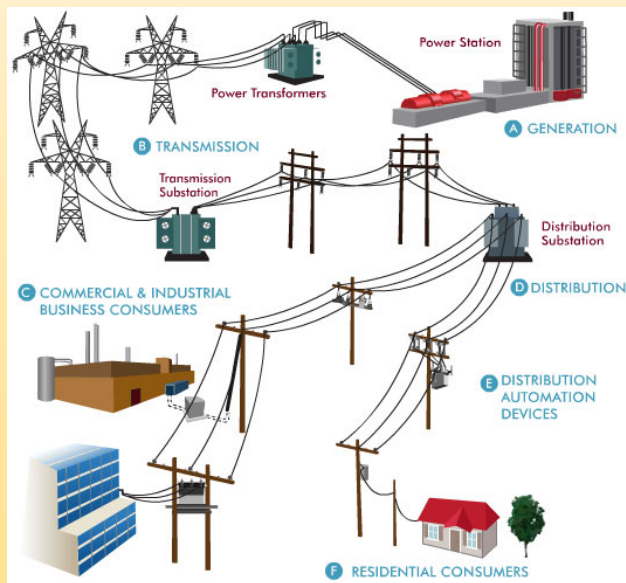
6. Electricity Generation

- Methods of generating electricity
 - Turbines
 - Photovoltaic Panels
- Cogeneration
- Production



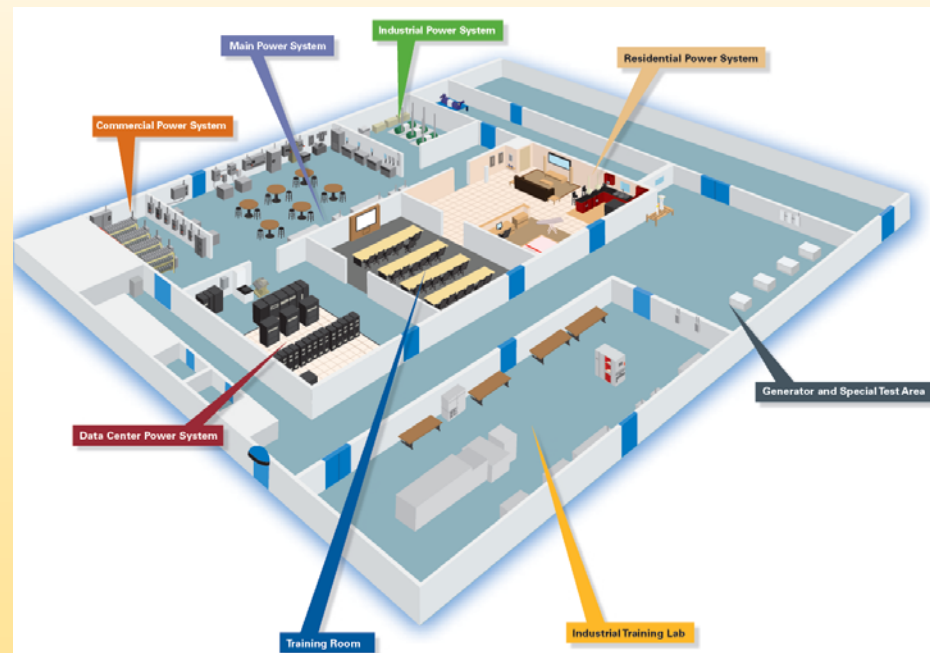
7. Electric Power Systems & Smart Grids

- Distributed renewables
- Efficiency
- End-user control (Smart phone control)
- Smart appliances



7b. Tour of Eaton and Pitt Labs

- Eaton Power Systems Experience Center (PSEC)
- University of Pittsburgh Electric Power Lab



Eaton PSEC Layout

8. Economic, Societal, and Global Aspects

- Air emissions
- Water resource use
- Water discharges
- Solid waste generation
- Land resource use



THANK YOU!
Additional Discussion

