Center for Energy & Environmental Sustainability (CEES)

Prairie View A&M University

Energy – Engineering

- Engineering
  - The creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or public works

- Energy Engineering
  - Energy engineers creatively apply their knowledge of science (physics and chemistry), engineering and economics to confront the global challenges of energy supply and demand, energy efficiency, energy services, facility management, environmental compliance and alternative energy technologies

Energy & Environment

Existing Knowledge

- Energy use is increasing
- Raw fuel reserves are limited
- Pressure on standard of living
- Global Climate Change

Proposed Solutions

- Replace coal with renewables (wind, solar)
- Sequester CO_2 Switch to biofuels
- Conservation
- Improve Efficiency
- Bring back nuclear
- Cars: hybrids, plug-in hybrids, fully electric

Energy & Environment

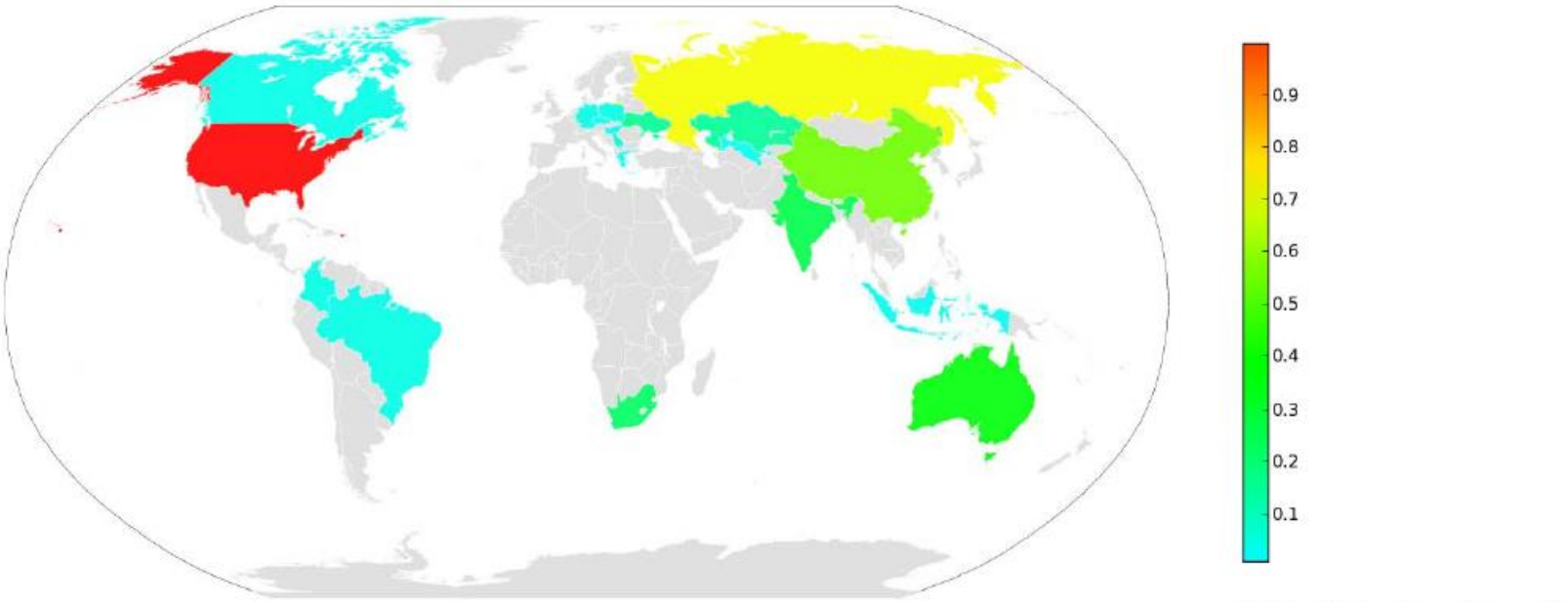
Strategy Assessment

- It's a hodge-podge
- Are all problems being addressed?
- Are alternatives compared by means of a cost-benefit analysis?
- Are we providing sufficient funds for R&D innovations?

Objectives

- Put logic and order into the energy situation
- Develop a comprehensive overview
- Learn how to measure and evaluate options
- Arm you with the knowledge to make sensible decisions

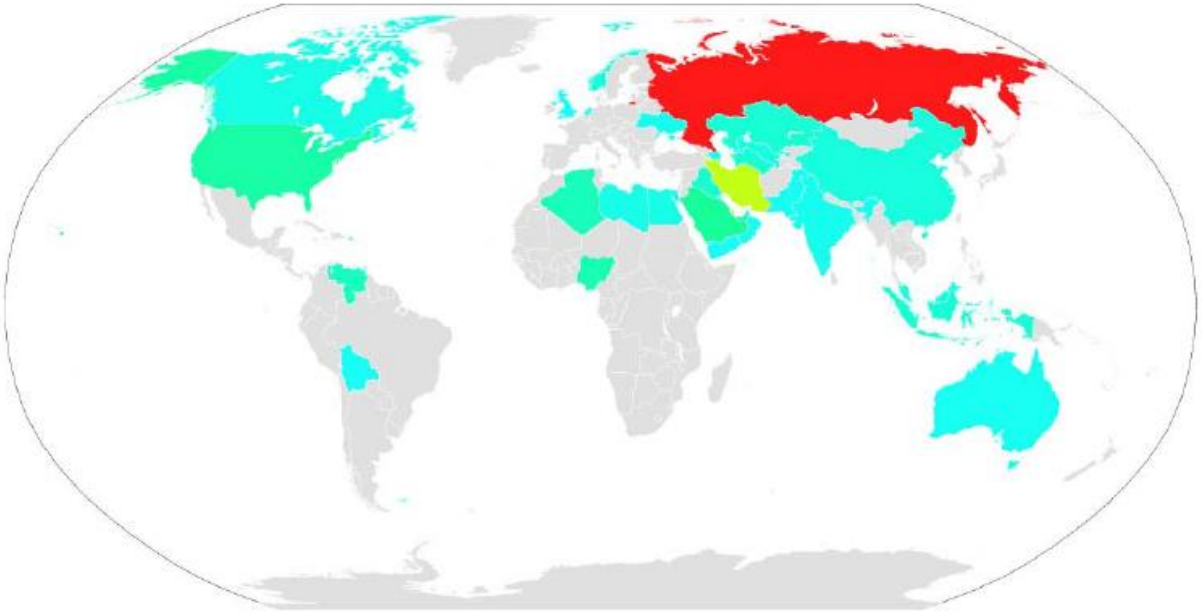
World Coal Reserves = 930423 millon short tons



[data from doe.eia.gov]

- Lots of coal in US, Russia, China, India, Australia
- Data normalized to peak value.

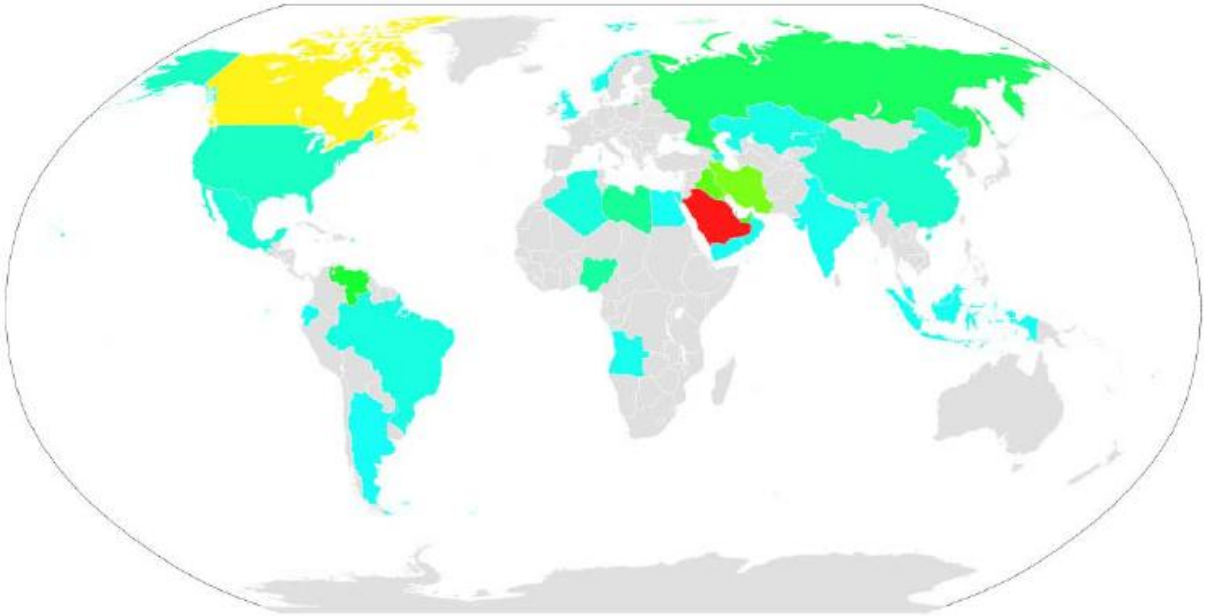
World Gas Reserves = 6189 million million cubic feet



[data from doe.eia.gov]

- Gas in Russia
- Data normalized to peak value.

World Oil Reserves = 1277 thousand million barrels

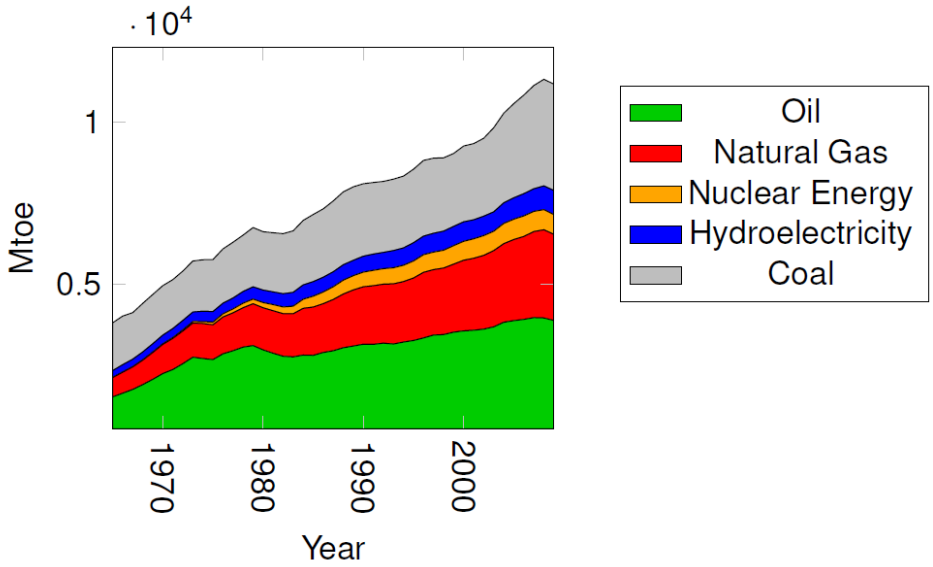


[data from doe.eia.gov]

- Oil in Saudi Arabia.
- Compare barrels, ft^3, tonnes, short tons, Mtoe

Energy Usage & Estimates

World Energy Consumption

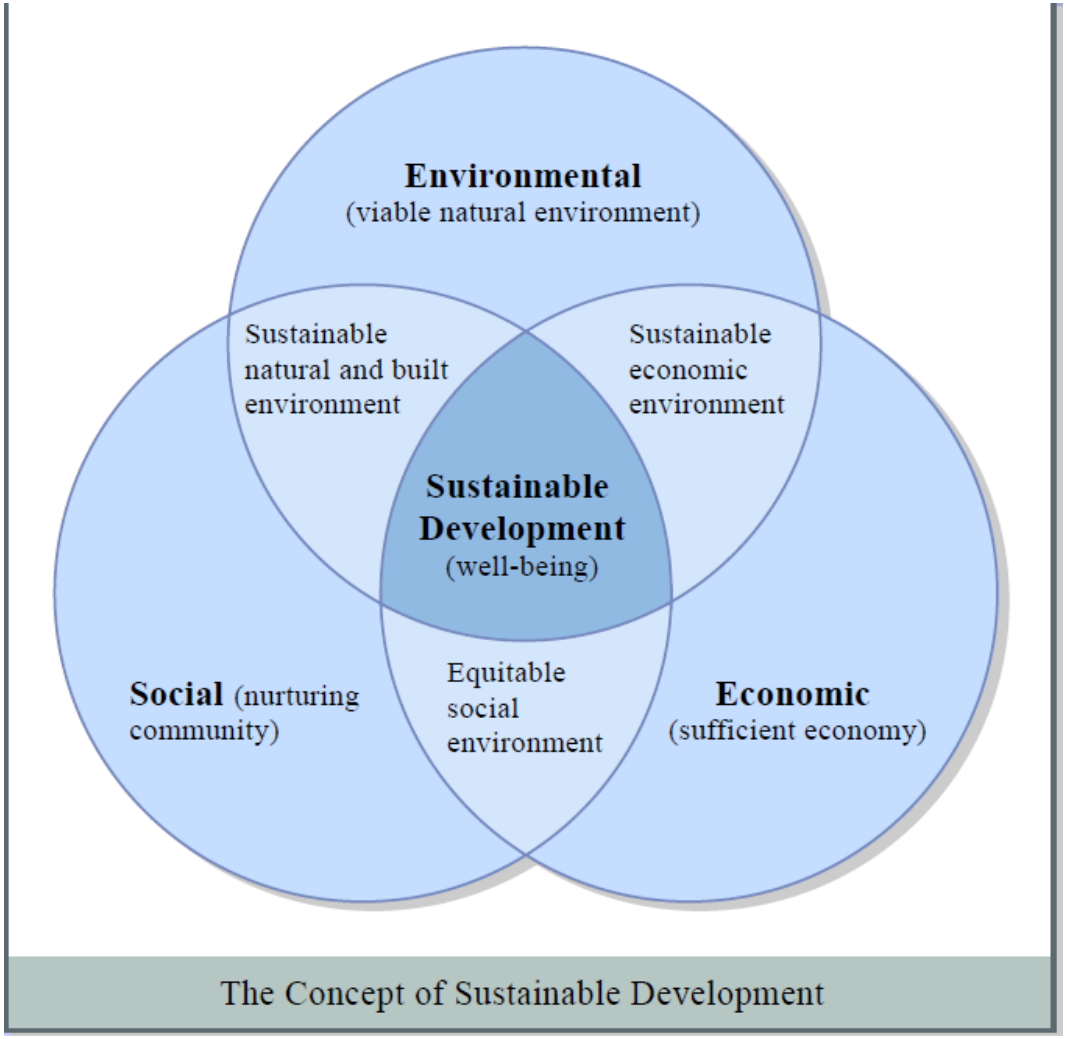


- Growth in energy usage related to increase population and standard of living
- Note recent reduction in 2008-2009.

How long will the supplies last?

- Oil and natural gas - 50 years
- Coal - 300 years
- Oil shale and tar sands - 350 years
- Nuclear fission
  - Today's light water reactors - 100 years
  - Future breeders - 10,000 years
- Nuclear fusion
  - DT reaction - 10,000 years
  - DD reaction - ∞
- Renewables - ∞

Sustainable vs Renewable



The Concept of Sustainable Development

- "Sustainable" development meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Commission 1987)
- Sustainability is determined by three different parameters:
  - Environmental,
  - Social
  - Economic
- "Renewable" energy is from a resource that is replaced or replenished rapidly by a natural process

Energy - Engineering

The Major Technologies of Interest

- Fossil fuels
- Nuclear fission
- Hydroelectric
- Renewables
  - Wind
  - Solar thermal
  - Solar voltaic
  - Biomass
  - Geothermal
  - How do these work?

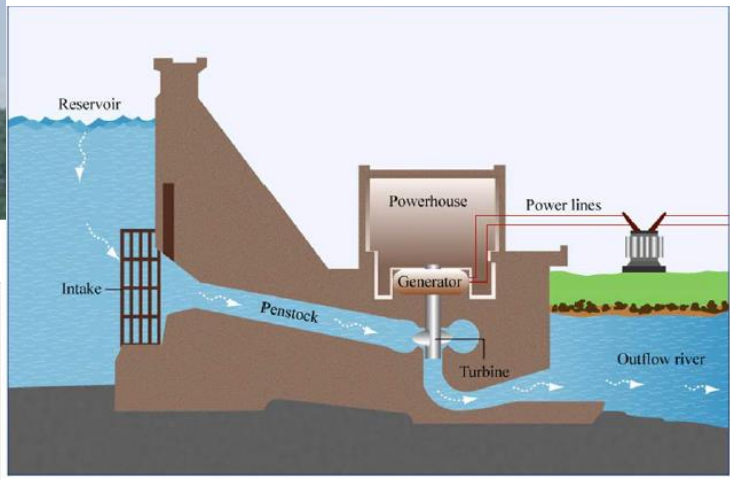
Coal

Gas

Nuclear

Wind

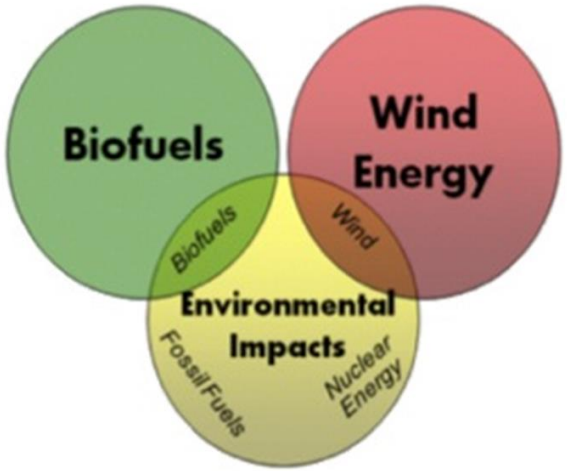
Solar



Hydro Electric

Mission

- The mission of CEES at PVAMU, is to promote a multidisciplinary approach to learning, research, and the development of strategies to address national and global challenges of energy and environmental sustainability.
- The Center's two goals are:
  - Build a nationally-recognized Biofuels and Renewable Energy research program
  - Significantly increase the number of students from underrepresented groups, who successfully complete B.S., M.S. and PhD degrees in STEM fields.



Energy Minor

- **Significance**: Energy Engineering Minor curriculum is designed to prepare students to enter directly into a wide variety of careers in the energy sector serving the Greater Houston Area, national and international community.

- All engineering majors are encouraged to enroll in courses offered through the Energy Minor program

- CEES is instrumental in developing the Energy Minor

- The focus of **CEES** is on innovative technical solutions in the arena of energy. It will engage PVAMU students on research questions that lead to science and the technological breakthroughs needed to fill critical gaps in the future utilization of environmentally responsible and sustainable energy solutions.

Energy Minor

- Engineering Focus Areas:
  - Chemical (Fossil fuel and Nuclear energy)
  - Civil and Environmental (Energy & Environment Interlinkages)
  - Electrical (Generation and Distribution)
  - Mechanical (Renewable energy sources)
- Energy Minor requirements
  - Total 18 credit hours (6 courses)
  - Max. of 6 hours (2 courses) can be technical electives from ME or CE
  - 12 hours (4 courses) should be from the Energy Minor
  - Flexibility allowed as per courses available

Energy Minor

Three Required Energy courses .....9 SCH
CHEG 3113 - Introduction to Energy Systems
CVEG 4113 - Energy and Environment
MCEG 3123 - Renewable Energy and Energy Sustainability

Three Elective courses from the following..... 9 SCH
CHEG 4103 Special Topics - Intro to Nuclear
CHEG 4103 Special Topics - Biofuels and Biomass
CHEG 4103 Special Topics – Fossil Fuels
CVEG 4103 Nuclear Waste Management
CVEG 4103 Energy and Waste Management
ELEG 4013 Electromechanical Energy Conversion
ELEG 4023 Power Systems Engineering
ELEG 4223 Photonics and Electronic Materials & Devices
MCEG 4123 Energy System Design
MCEG 4163 Special Topics – Heating, Ventilating and Air Conditioning
MCEG 4163 Special Topics - Power Plants

Energy Minor

DESCRITPIONS FOR REQUIRED COURSES:

CHEG 3113. Introduction to Energy Systems. (3-0) Credit 3 semester hours. This course introduces fundamental physical and engineering principles associated with various energy systems. Basic energy concepts will be introduced describing the magnitudes and patterns of human energy needs. Historical evolution and present status of the conventional fossil and nuclear-fuelled energy will be investigated along with others such as hydropower, biofuels, and the developing renewable energy systems. Prerequisite: MATH 2024, PHYS 2523, and CHEM 1034 or equivalent.

CVEG 4113. Energy and Environment. (3-0) Credit 3 semester hours. Introduction to climate and climate change, the carbon cycle, air and water pollution from energy systems, impacts and implications of energy use for human health, current energy and energy-related environmental policies to foster the development of sustainable energy technologies, fuels, and practices, energy alternatives for the future and their impact on the local and global environment. Prerequisite: CHEG 3113.

MCEG 3123. Renewable Energy and Energy Sustainability. (3-0) Credit 3 semester hours. The topics of various types of renewable energies, energy conversion, utilization and storage technologies, such as wind, solar, biomass, fuel cells and hybrid systems. For each source, the physical and technological principles are explained and the economics, environmental impacts and future prospects are examined. The course explores the main factors likely to influence the long-term evolution of the world's energy systems and the technologies and policies that could be adopted to create more sustainable energy systems. Prerequisite: CHEG 3113.

Welcome to Engineering at PVAMU

Questions ?