

April 16, 2015
 GEOL 1010—002 (Notes)

Lecture 16—Renewable Energy

Geology in the News

- New study shows Fukushima reactor still leaking 3 tons of radioactive water into the ocean everyday (radiation can be found in waters near California)

Renewable Energy Sources

- Lots of types being studied to help reduce fossil fuel use
- **General Points:**
 - o 1—Each has advantages and disadvantages
 - No “Magic Material” that comes without any drawbacks (contamination, pollution, etc.)
 - o 2—No one source will provide all our energy needs
 - Need a varied approach (based on location, etc.)

Renewable Energy Advantages

- 1—Abundant
- 2—Produce little pollution (no problems with CO₂ in atmosphere)
- 3—Low maintenance (as compared to nonrenewable energy)
- 4—Safe (No massive health problems arising, etc.)

Renewable Energy Disadvantages

- 1—Technology still being developed
- 2—Expensive
- 3—Infrastructure compatibility (Current infrastructure not compatible)
- 4—Acceptance by society

Solar

- Capture all the sunlight for 1 hour = a year's supply of energy
- How can we harness solar energy?

Solar Farms

- Use mirrors to focus/reflect sunlight onto a receiver (store as heat energy at large energy plants)
 - o Tower has/made of a material with high heat capacity

Solar Electricity

- **Photovoltaics (PV)**—Turning light into electricity
 - o Sunlight hits semi-conductor that knocks electrons off. The flow of electrons creates electricity

Photovoltaics

- **Photovoltaic Cells (PVCs)**—A cell that contains a semiconductor that converts light energy into electricity
 - Not efficient at converting sunlight into mechanical energy (electricity)
 - 1% conversion
 - Constantly improving
 - 45% efficiency under perfect laboratory conditions
 - New organic materials being studied
- Use ~7.5% of the Sahara desert as solar farms=provides half the world's energy needs
 - Assumes 10-15% PVC efficiency

Solar Use

- **Energy Payback (EPB)**—How much time to generate same amount of power that it took to build the solar farms
 - Talking about energy amount, NOT money
 - Since 2000, solar EPB has dropped to 2-3 years

Solar Disadvantages

- 1—Insolation Variations (Weather and Nighttime)
- 2-3—Some pollution from making older PV cells
 - Ex. Cadmium (toxic as you move up the food chain)
 - New solar cells use different materials besides Cadmium for semi-conductors
- 3—Where to put solar farms?
 - Want in SW of America (lots of government land)

Hydroelectric

- Flowing water used to turn turbines that generate electricity
- Generates 6% of all electricity in US

Hydroelectric Advantages

- 1—Doesn't pollute the water
- 2—Quick profit
 - ~5 years to recover plant construction costs via sale of electricity

Hydroelectric Disadvantages

- 1—Reservoir creation floods alter
 - Lots of people displaced and landscape drastically changed
- 2—Dams alter downstream environments
 - Kills of fish population
 - Impacts wild life
 - Water moving faster=lots of erosion
 - No place for fish to lay eggs
- 3—Site selection

- o **Efficiency**—Have to use large rivers (can't use water from small sites)
- o **Safety**—"Not in my backyard" effect

Case Study: Banqiao Dam

- Built to resist a 1,000 year flood event
- August 6-7, 1975: 2,000 year flood event
 - o 41+ inches of rain fell in 24 hours (=a full years worth of rain in 1 day)
- 700 million tons H₂O released in 6 hours
 - o Wave 6+miles wide, 20 feet high
- 171,000 people died

Hydroelectric: Tides and Waves

- Convert kinetic energy into electricity
- Old devices too complicated to do conversion
- New buoy system is just 2 components
 - o Lots of coil and copper wire used in the buoy produces a lot of electricity (using a magnet)
- Specific Advantages
 - o 1—Simple Device
 - o 2—Very consistent

Hydroelectric Buoys: Concerns

- 1—Rough Environment—Can buoys hold up long-term?
 - o Ex. Storms along coast, wildlife attacks on buoys
- 2—Changes Coastal Environment
 - o Reduces wave energy
 - o Changing one variable has a ripple effect on coastline
- 3—Some areas far from coasts
 - o Ex. Kansas
- 4—Effects on wildlife
 - o Since buoys have to be anchored down, the sound vibrations produced can cause wildlife to get confused in terms of navigation (some animals use vibrations to navigate waters)

Wind Power

- Winds generate ~5x more power than total global energy consumption
- North Dakota could provide 1/3 of US electrical needs
- **2008:** Wind generates 1.5% of global electrical supply
 - o 19% Denmark, 11% Spain and Portugal, 7% Germany and Ireland

Wind Advantages

- 1—Cost down 80% in last 20 years (disputed)
- 2—Energy payback only ~1 year

Wind Disadvantages

- 1—Not consistent in many areas