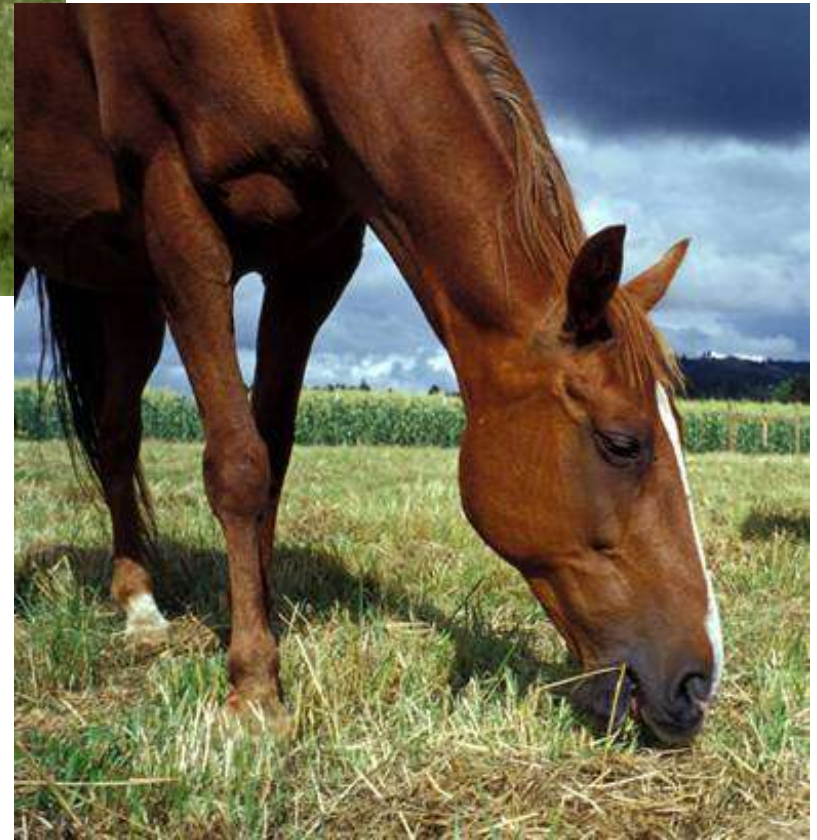




# Solar Energy For Homes and Farms

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# Solar Energy Collectors



# Solar Energy Collectors



# Harvesting Energy from the Sun



- Solar Energy Basics -- Is solar right for my situation?
- Sizing a Grid-Tied System
- Sizing an Off-Grid System
- Financing the Solar System

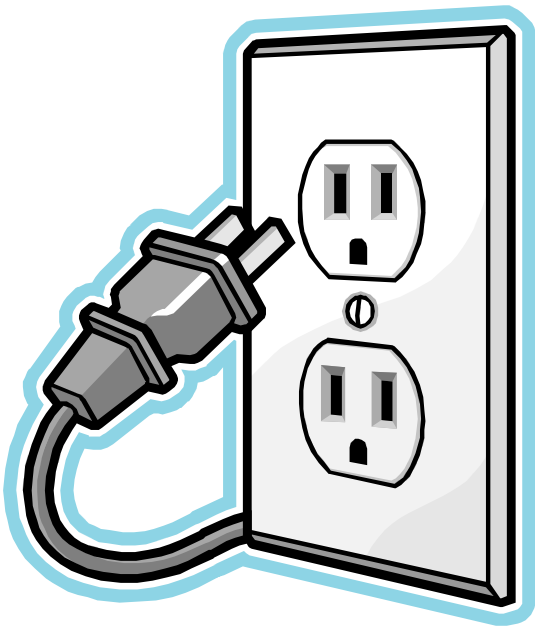
# Solar Energy Basics



- Solar energy can be used to:
  - Heat/light structures through passive design
  - Utilize hot water systems for heating (solar hot water)
  - Solar space heating (solar thermal)
  - Electrical generation (photovoltaics)

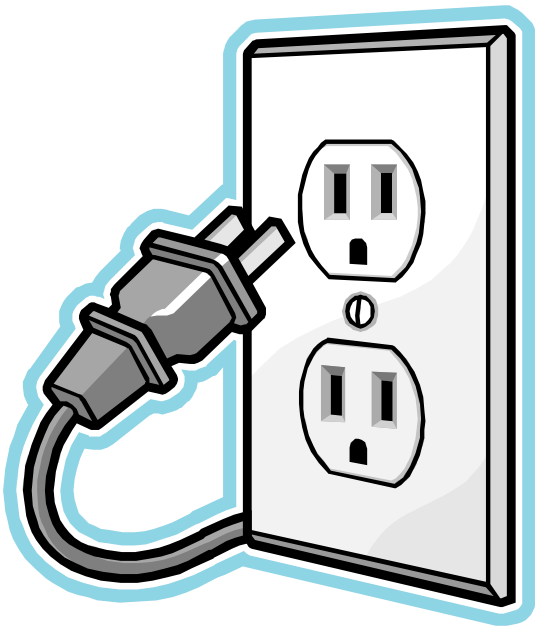
Each kWatt of PV electricity offsets 16 kg nitrogen oxide, 9 kg of sulfur dioxide, and 2300 kg of carbon dioxide

# Electrical Terms



- AC/DC –Alternating current/direct current
- Voltage—electrical pressure (water through garden hose)
- Amperage—Unit of electrical current (volume of water through hose)
- Watts— $W = V * A$ ; Rate of electricity
- Kilowatt—equal to 1000 watts

# Electrical Terms



- Energy usage—The amount of watts for a given time.
- Electrical load—The demand for electricity.
- Phantom loads—Appliances that use electricity even when turned off.

# Solar Electrical Terms



- Grid-tied—A photovoltaic system that is connected to an electrical utility grid
- Off-grid (stand-alone)—A PV system that is not tied to electrical utility



# Is solar right for my property?



- Site analysis
  - South facing roof or unobstructed area facing south (N. Hemisphere)
  - Insolation data
  - Potential shading from 9:00 am to 3:00 pm (solar window)
  - Solar data charts available from state energy offices/solar providers

# What size do I need?

- Grid-tied systems-- User can evaluate their utility bills and determine the percentage of offset by solar.
- Off-grid systems – Will need to calculate their electrical load demands and size accordingly.



# Sizing a Grid-Tied PV System

- Add up total energy usage for the year
- Divide by 365 for daily total
- Divide by 5.5 hours of solar insolation per day
- Factor in inefficiencies

OR

- Go to online calculator available at  
(<http://www.ext.colostate.edu/energy/solar.html>)

# Sizing a Grid-Tied PV System

- Example:
  - A Colorado home had a total of 8002 kWh of energy usage for a year (667 kWh per month)
    - Online calculator: 4.89 kW system
    - Estimated cost: \$39,089 (~~\$29,340~~)
    - Estimated net: \$15,391 (~~\$11,296~~) (after rebates/incentives)
    - Prices checked August, 2009 (*Hand-calculated Feb., 2010*)

# Sizing an off-grid system



- Calculate the anticipated loads (handout) for each room...compile for home
- Factor in days of autonomy
- Determine the size of the battery bank
- Determine the size of solar array
  - Depends on additional powering sources (wind, generator, or only solar)

# Sticker Shock??

- As with any renewable energy investment, best return on dollars is on demand side of the equation rather than supply side
- Becoming energy-efficient is the first step in renewable energy
- Solar systems can be expanded upon later, provided initial installation accounts for future expansion

# Financing the solar investment



- Grid-tied systems
  - Utility company rebates
  - Federal Income Tax credit (30%)
  - Colo. Governor's Energy Office (up to \$4500)
  - Local incentives (sales/property tax exempt?)

# Financing the solar investment (continued)



- Off-grid systems
  - Federal Income Tax credit (30%)
  - Local incentives (sales/property tax exempt?)
- <http://www.dsireusa.org> lists most of the incentive programs available.



# Small Scale Solar



- Solar water pumping setup
  - Panel angle set at latitude and mounted above animal level
  - DC pump switched by float relay
  - No battery incorporated
- More information available in handout.

# Questions??



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- CSU Extension energy website  
[http://www.ext.colostate.edu/energy/clean\\_energy.html](http://www.ext.colostate.edu/energy/clean_energy.html)