Electricity Merit Badge

Class 3 – Electric Power We Use
Alternating Current (AC)
Safety & Conservation

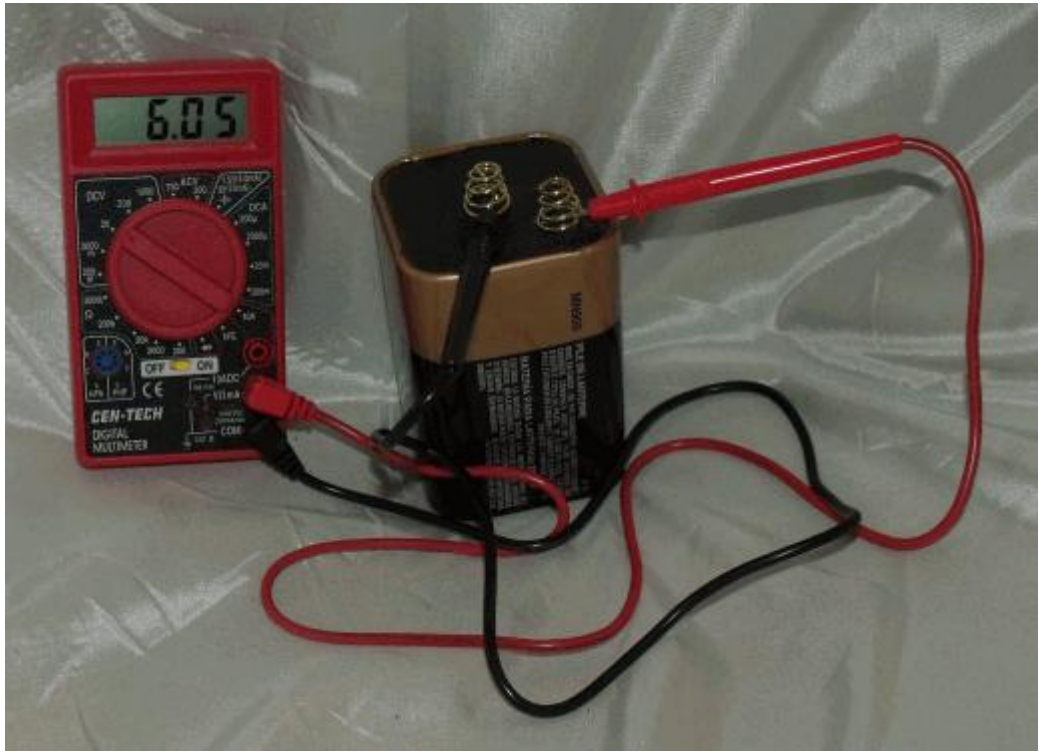
Classes

- Class 1 – Basics Electricity (shared with the Electronics Merit Badge)
- Class 2 – Magnetism
- **Class 3 – Electric Power, Alternating Current**
  - **Generating electricity**
  - **Step up and step down voltages**
  - **Safety devices**
  - **Conservation**
- Class 4 – Safety at Home

The Electricity We Use – a Quiz

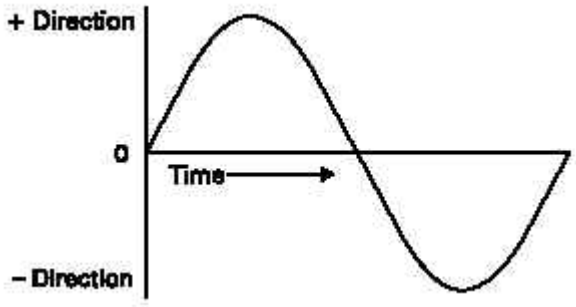
Where does the electricity come from to power these?

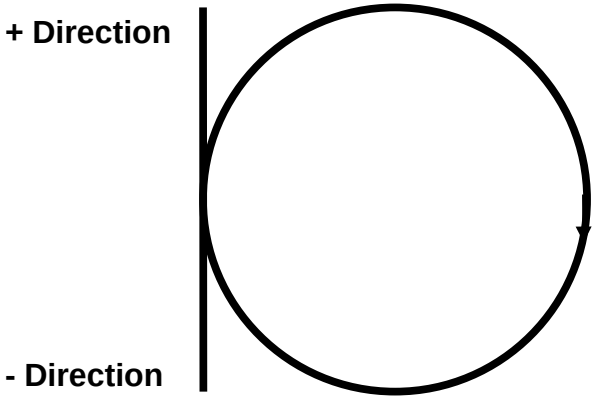
DC – Mostly Batteries



- DC means “Direct Current”
- It doesn't change much
- Hook a battery to a meter or a bulb
- See, it doesn't change much

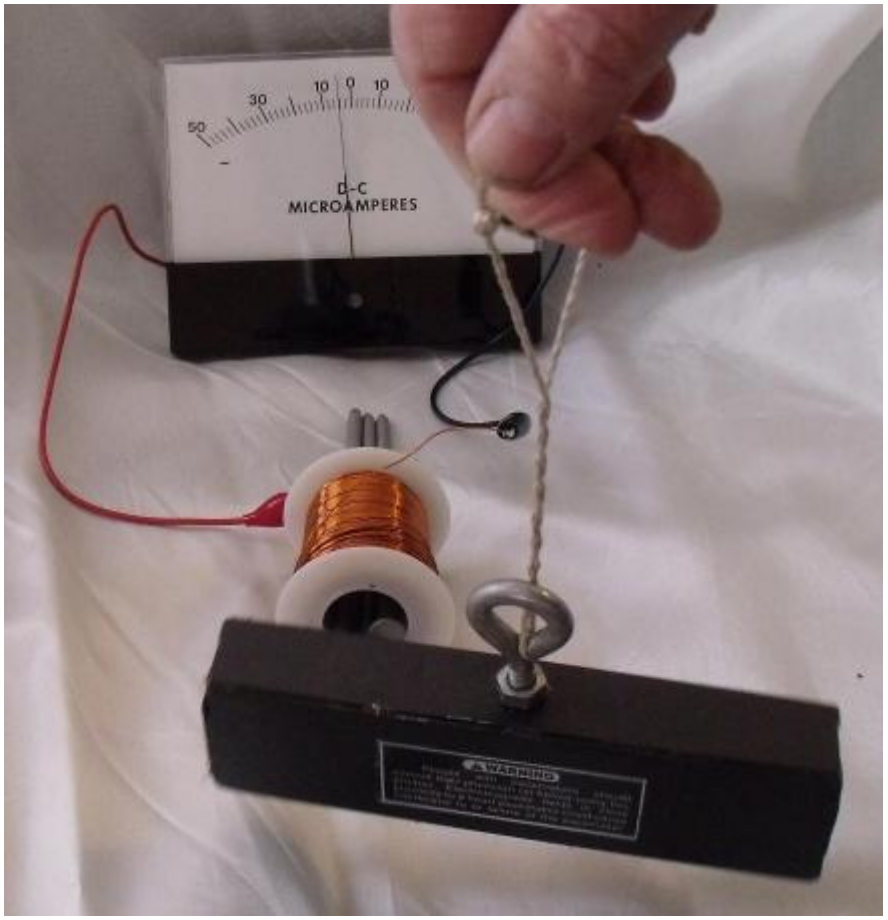
AC – What Comes Out of The Wall





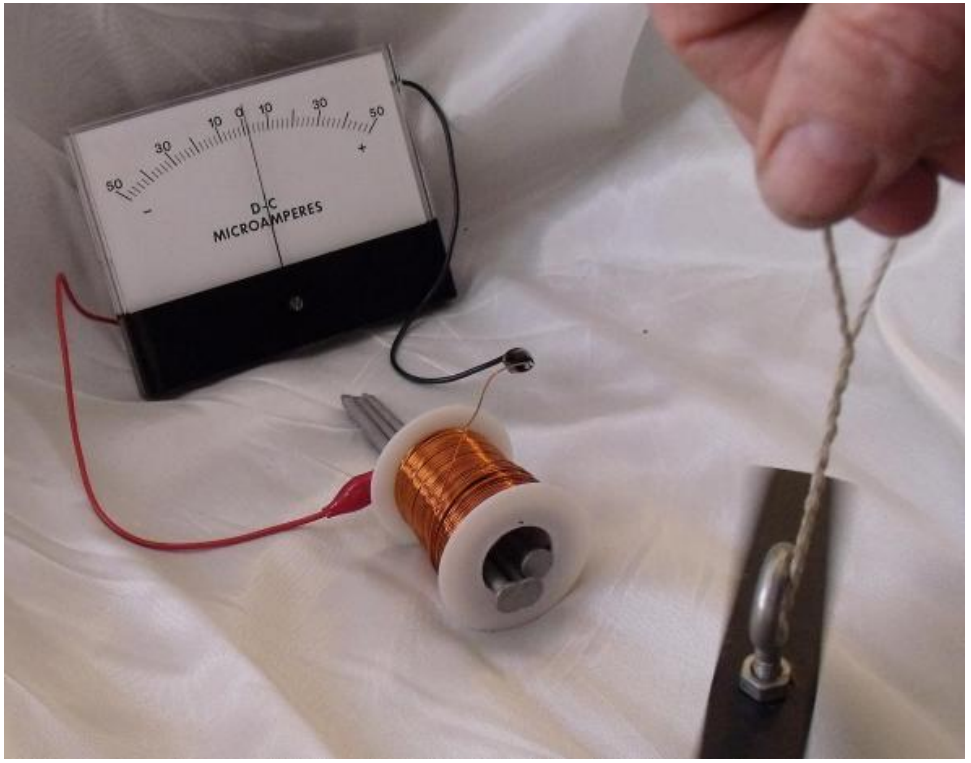
- AC means "Alternating Current"
- It's what comes out of the wall outlets
- It "alternates" from high to zero to low to zero to high... and on and on
- It alternates very fast

Generating AC



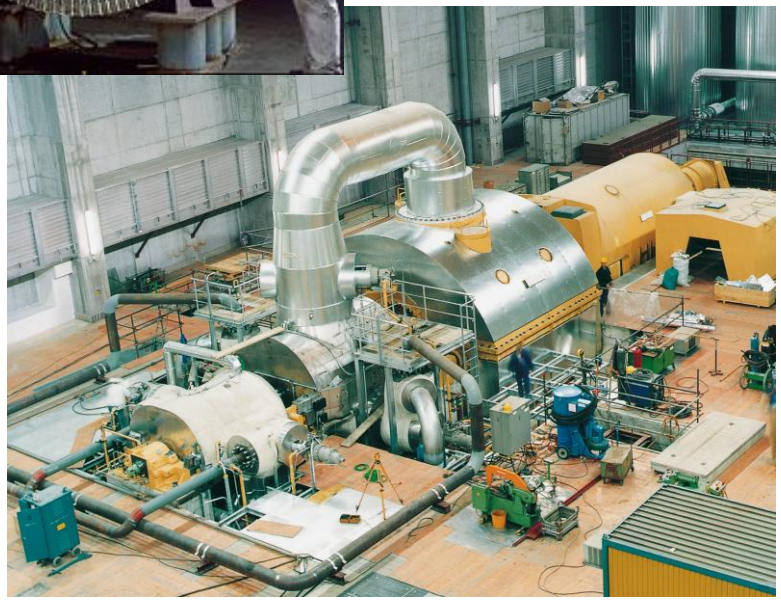
- Spin magnet near coil
- See energy go from zero to high to zero to low
- Spin speed is the “frequency”
- At home it's 60 cycles per second

Power Plants Generate Electricity



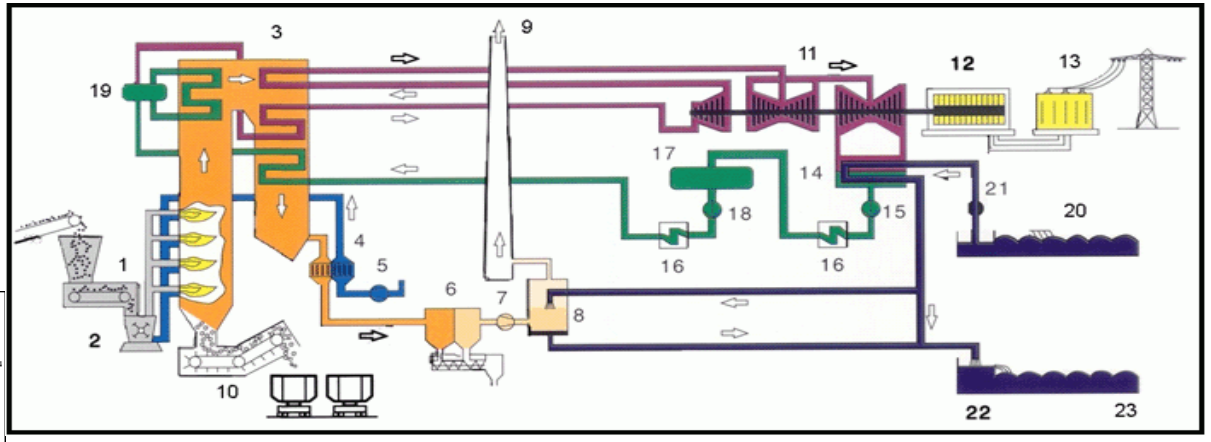
- Electric company power plants work the same way
- Spin magnets in front of three coils
- Uses steam turbine or wind or water to spin
- Coils “make” electricity that’s sent to your home

How to Spin a Generator

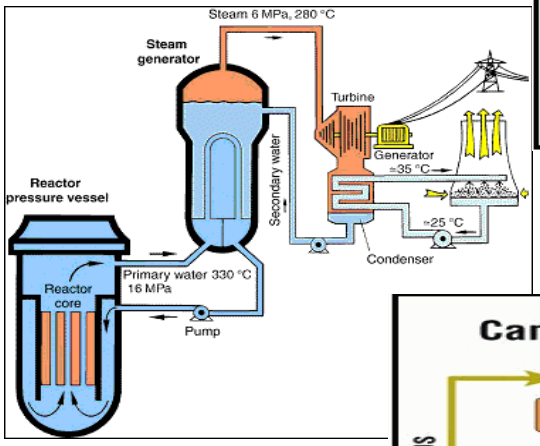


- Steam Turbine
- Spins because steam pressure presses against turbine blades
- Spinning turbine spins a generator
- Used more than any other form of generation

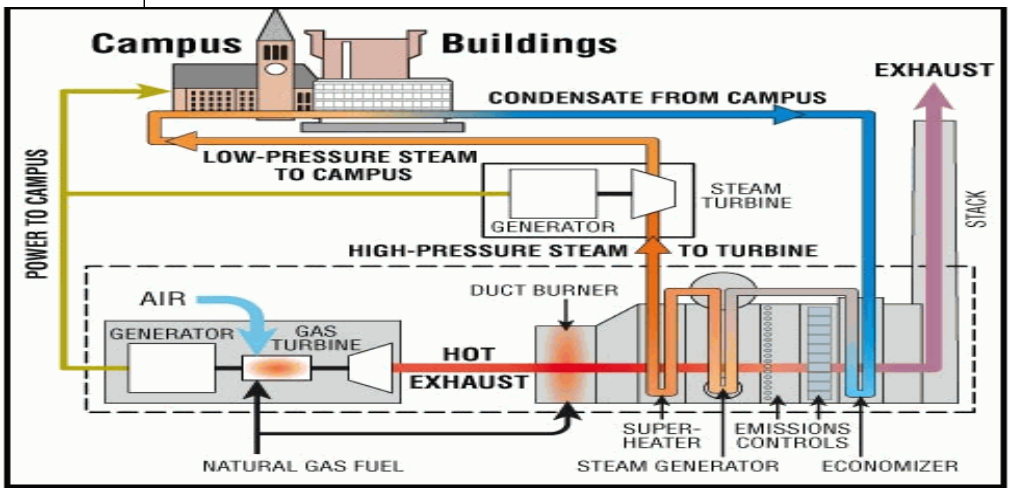
Steam from ...



Coal



Nuclear

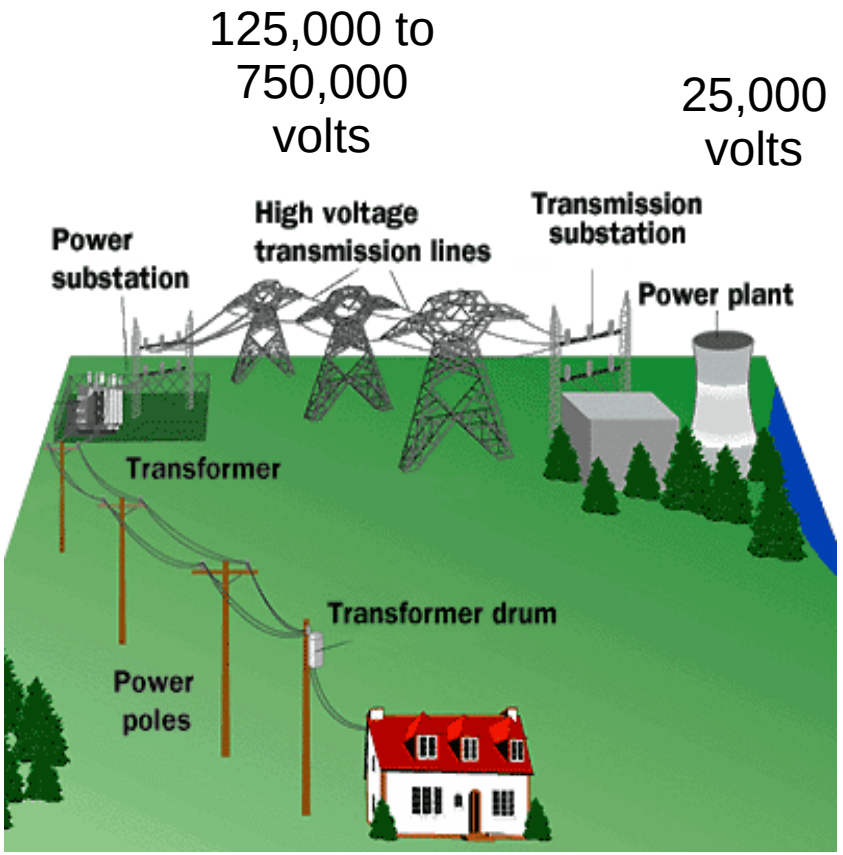


Natural Gas

Very Old & Very New Forms of Generation

- Hydroelectric, falling water
- Wind where it is windy
- Solar where there is much sun

Getting the Power to the Consumers



- Power generation plant to…
- High Voltage transmission lines to…
- Substation to …
- Distribution lines to …
- A house or business

Why Change Voltages?

Power company sends 120,000 watts to a shopping center

- At 120 volts that's:
- 1,000 amps
- BIG wires
- BIG pole to hold the BIG wires

- At 125,000 volts that's:
- 1 amp
- small wires
- little pole to hold the little wires

Remember Power Formula?

P (watts) = I (amps) x E (volts) so

I (amps) = P (watts) / E (volts)

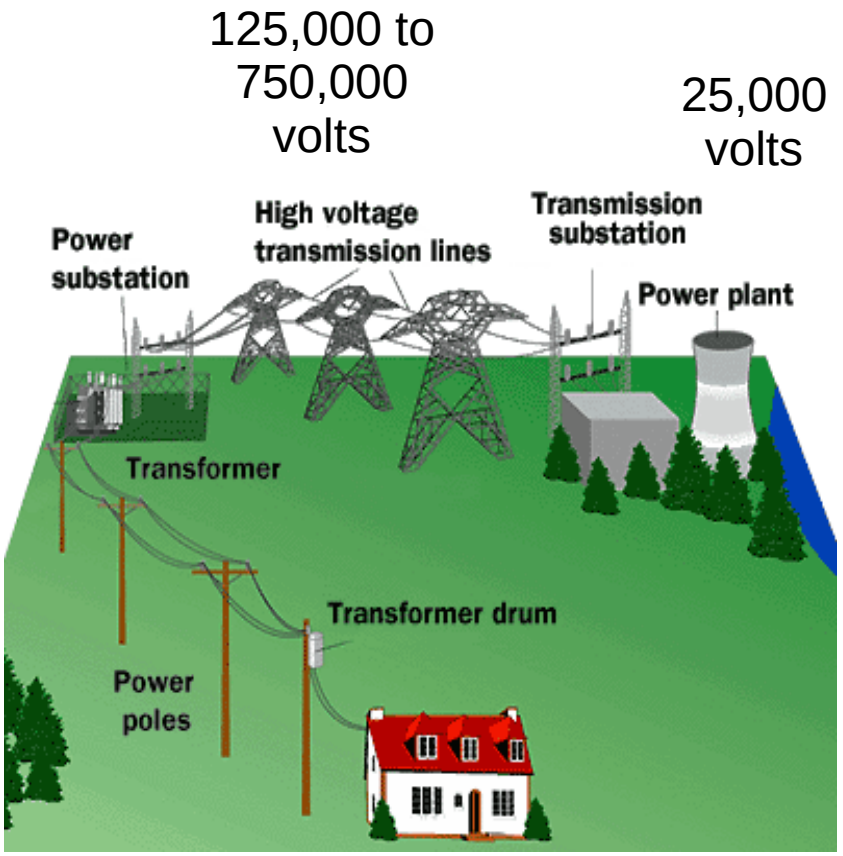
I = 120,000 watts / 120 volts

so I = 1,000 amps

I = 120,000 watts / 125,000 volts

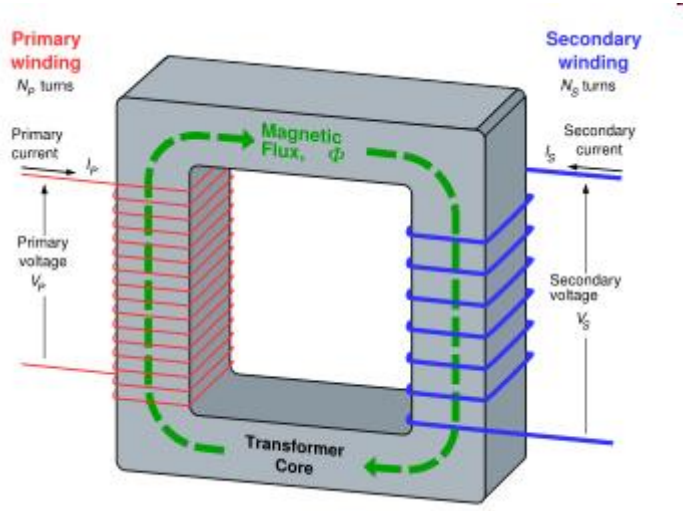
so I = .96 amps

But Not High Voltages Everywhere



- Very high voltages near people are dangerous
- Voltages are reduced closer to people and buildings
- That's what you see here

Voltage Changed by a Transformer

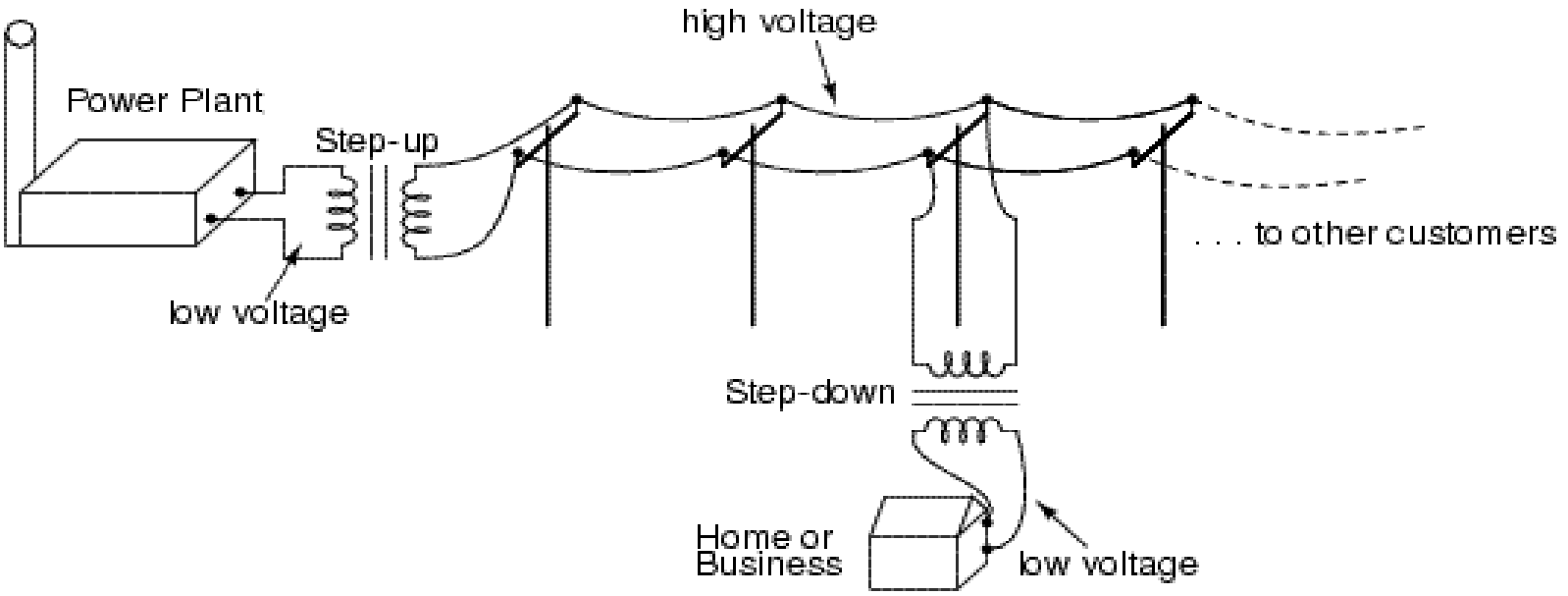


- Primary coil (windings) is input
- Secondary coil (windings) is output
- Step-up or Step-down
- Ratio of windings determines up or down voltage

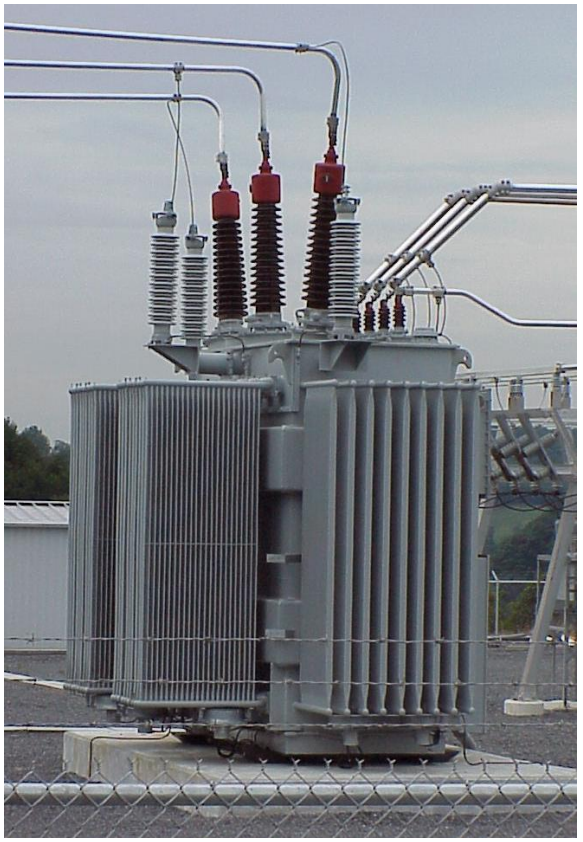
Transforming Power

- With AC, transformers change the voltage up and down
- Step up transformers increase the voltage (electrical pressure) so power companies can use smaller wires to carry the current (energy)
- Wires on the poles or underground near your house carry 7,000 to 35,000 volts
- Step down transformers reduce it to 240 volts (for your stove and A/C) and 120 volts (for your lights, TV, etc.)

Where Transformers are Found

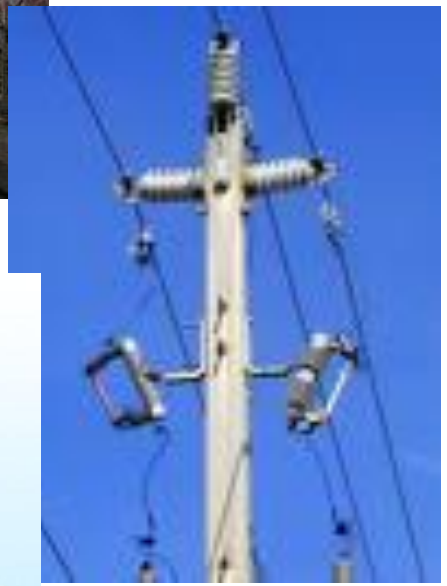


What Transformers Look Like



What Happens When Power Lines Go Bad

Preventing Power Accidents



- Too much current (amps) on the line trips:
  - Big circuit breakers in substations
  - Fuses on poles
  - Fuses in transformer cabinets
- That turns off power in the lines

How You Can Prevent Power Accidents

Why are these dangerous?

What Happens When You Touch a Power Line

Keep Safe Around Power lines Above You and Under You

Don’t let anything get near the electric wires

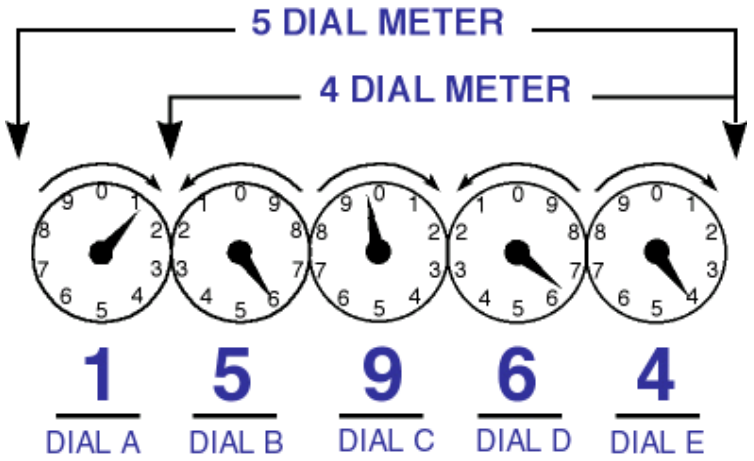
Call 811 before you dig to have underground wires marked

Marked Underground Power Line

- This man called 811 for marking
- Red stripes mark the underground line
- Dig at least 2 feet away from marked line

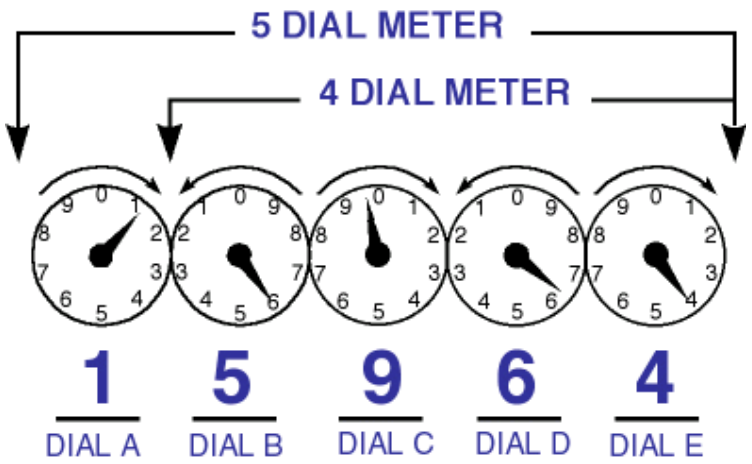
Conservation – Saving Energy

Measuring the Electricity Used



- Read meter from left to right
- Notice some numbers go clock-wise, some go counter clock-wise
- Read two months, subtract to find kilowatt hours used

Calculating Consumption

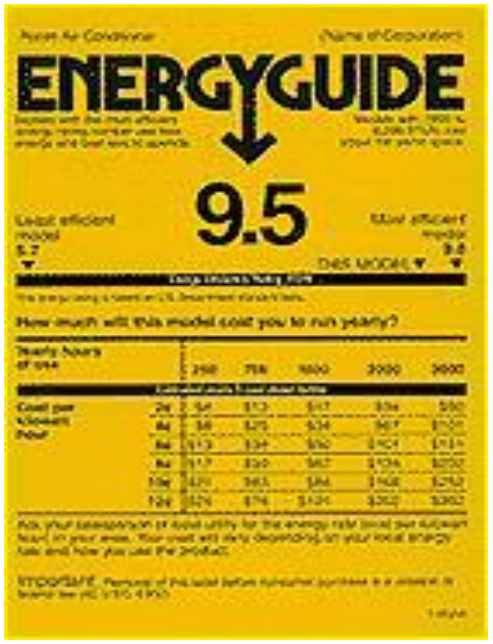


- If last month was 14840
- And this month is 15964
- Then 15964 – 14840 = 1124 kilowatts-hours used
- At $0.10 per kilowatt = $112.40
- Reduce the kilowatt-hours used and you reduce the cost

Reducing the Power You Use

- How much power do these use?
- How is a lumen different from a watt?

Finding Lower Powered Stuff



- More power consumed means more coal burned, more natural gas burned, more nuclear fuel used
- EnergyStar label on an appliance means it uses less power than others
- Check the label for power usage

Give 5 Ways Your Family Can Conserve Energy

1.
2.
3.
4.
5.

Reducing Power on the Small

- LED flashlights save batteries
- Fewer batteries means less in land-fills

What We Learned

- √ AC means alternating current
- √ AC is what we use in our homes for lights, etc.
- √ Spinning magnets near coils of wire is how power companies make most of the electricity
- √ Transformers step up and step down voltage for efficiency
- √ Electricity can burn and cause fires if not handled properly
- √ Circuit breakers and fuses prevent fire

What We Learned

- √ Stay away from power lines above and below you
- √ New bulbs can save electricity
- √ Lumens measure amount of light
- √ Watts measure the power consumed
- √ EnergyStar means less power consumed
- √ LED means Light Emitting Diode
- √ LED flashlights use less power so batteries last longer