ED-06 **Saving Electricity and Water while Reducing Pollution...**

by Keeping Porch Lights off at Night when they are not needed!

Leaving lights on when not needed wastes energy. Each kilowatt of electricity that you use requires some water to be generated (except solar and wind). Burning fossil fuels contributes to air pollution including carbon dioxide, nitrogen and sulfur oxides, mercury, and particulate matter. All outdoor lights contribute something to Light Pollution, many pollute a huge amount. This Light Pollution can effect our wildlife, plant life, human health, astronomy, and safety. See our "Wreaking Havoc" and "Dark Skies" videos as well as our brochures on our web (www.sa-ida.org) for more information.

Problem #1 - Leaving a 60 watt incandescent porch light on all night, for 10 hours each night...

How much porch light energy is used by one household each year? _____**kwh/year**

How much does this porch light electricity cost per year? _____ **$/year**

Problem #2 - Households Saving Water by keeping your porch light off when not needed...

How much Water could be saved by each household every year? _____**gallons/year**

Tucson's Savings? _____**gallons/year** All of AZ _____**gallons/year**

Problem #3 - Porch Light Electricity & Coal Savings by Tucson, Phoenix, and all Arizona.

How much energy is used and could be SAVED each year by:

Tucson households? _____**kwh/year** Saved ? _____ **$/year**

Phoenix households? _____**kwh/year** Saved? _____ **$/year**

Rest of AZ households? _____**kwh/year** Saved? _____ **$/year**

TOTAL Arizona? _____**kwh/year** Saved? _____ **$/year**

Problem #4 - Coal Power electricity generation and usage..

How much coal is required to generate the Total Arizona electricity? _____ **Tons/year**

How many railroad cars would be required for this coal? _____ **railcars/year**

Problem #5 - You can also get almost the same savings by replacing 4 incandescent lamps (60 watt) with equivalent compact fluorescent lamps. This assumes each indoor light is used 3 hours per day. So double your numbers if you do both; keeping the porch light off and changing out 4 incandescent lights to cfls (the twisty ones). Can you prove this?

Some information you will need:

1) Electricity costs $0.10 per 1,000 watt-hours (kilo-watt-hour or just kwh).
2) Coal power generation uses 1.25 lbs. of coal/kwh. Each railroad car carries 100 tons of coal. There are 2,000 lbs./ton.
3) An incandescent 60 watt light bulb uses 60 watts of energy. A comparable compact fluorescent lamp (cfl) uses 13 watts
4) Generating 1 kwh of electricity uses 7.85 gallons of water in AZ (42% coal, 26% nuclear, 19% natural gas, 7% hydro, 6% other)
5) Assume the greater Tucson area has 480,000 households, Phoenix 1,350,000, rest of Arizona 180,000

ED-06 ANSWERS - Saving Electricity and Water while Reducing Pollution...

Problem #1 - Leaving a 60 watt regular porch light on all night, assume 10 hours each night...

How much porch light energy is used by one household each year? **219 kwh/year**

Solution: 60 watt x 10 $\frac{\text{hours}}{\text{day}}$ x $\frac{\text{365 days}}{\text{1 year}}$ = 219,000 $\frac{\text{watt-hours}}{\text{year}}$ x $\frac{\text{1 kilo watt-hour}}{\text{1000 watt-hours}}$ = 219

How much does this porch light electricity cost per year? **$21.90/year**

Solution: 219 $\frac{\text{kwh}}{\text{year}}$ x $\frac{\text{\$0.10}}{\text{kwh}}$ = $\frac{\text{\$21.90}}{\text{year}}$

Problem #2 - Households Saving Water by Keeping your porch light off when not needed...

How much Water can be saved by each household every year? **1,719 gallons/year**

Solution: 219 $\frac{\text{kwh}}{\text{year}}$ (from problem #1) x 7.85 $\frac{\text{gallons}}{\text{kwh}}$ = 1,719.15 $\frac{\text{gallons}}{\text{year}}$

Problem #3 - Porch Light Energy Savings by Tucson, Phoenix, and all Arizona households...

How much energy is used and could be SAVED each year by:

Tucson households? **105 Million kwh/year** Saved? **$10.5 Million/year**

Solution: 219 $\frac{\text{kwh}}{\text{year}}$ x 480,000 households = 105,120,000 $\frac{\text{kwh}}{\text{year}}$ x $\frac{\text{1 Million}}{\text{1,000,000}}$ = $\frac{\text{105 Million kwh}}{\text{year}}$

Saved? Solution: 105 $\frac{\text{million kwh}}{\text{year}}$ x $\frac{\text{\$0.10}}{\text{kwh}}$ = 10.5 $\frac{\text{million \$}}{\text{year}}$

Phoenix households? **296 Million kwh/year** Saved? **$29.6 Million/year**

Solution: same as above for Tucson but use Phoenix number for households (1,350,000)

Rest of AZ households? **39 Million kwh/year** Saved? **$3.9 Million/year**

Solution: same as above for Tucson but use rest of Arizona number for households (180,000)

TOTAL Arizona? **440 Million kwh/year** Saved? **$44 Million/year**

Solution: add the 3 answers above 105 + 296 + 39 = 440 10.5 + 29.6 + 3.9 = 44.0

Problem #4 - How much coal is required to generate this wasted AZ electricity? **275,000 Tons coal/year**

Solution: 440 million $\frac{\text{kwh}}{\text{year}}$ x 1.25 $\frac{\text{lbs coal}}{\text{kwh}}$ x $\frac{\text{1 ton}}{\text{2,000 lbs}}$ x $\frac{\text{1,000,000}}{\text{1 million}}$ = 275,000 $\frac{\text{tons coal}}{\text{year}}$

How many railroad cars would be required for this coal? **2,750 railroad cars/year**

Solution: 275,000 $\frac{\text{tons coal}}{\text{year}}$ x 1 $\frac{\text{railcar}}{\text{100 tons}}$ = 2,750 $\frac{\text{rail cars}}{\text{year}}$

Problem #5 - Water saved by not generating electricity - by keeping your porch light off when not needed..

Tucson Water Savings? **824 Million gallons/year** All of Arizona **3.4 Billion gallons/year**

Solution: 105 million $\frac{\text{kwh}}{\text{year}}$ x 7.85 $\frac{\text{gallons}}{\text{kwh}}$ = 824.25 $\frac{\text{million gallons}}{\text{year}}$

For all of Arizona use 440, this gives 3,454 million gallons x $\frac{\text{1 billion}}{\text{1,000 million}}$ = 3.4 $\frac{\text{billion gallons}}{\text{year}}$

Problem #6 - Changing out 4 incandescent lamps (60 watt lamps) to cfls that are used 3 hours each night.

Four incandescent lamps use: 60 watts x 3 hrs/day. x 4 lamps x 365 days/year= x 60 watts

Solution: 60 watts - 13 watts = 47 watts saving x 4 $\frac{\text{lamps}}{\text{household}}$ x 3 $\frac{\text{hours}}{\text{day}}$ x $\frac{\text{365 days}}{\text{1 year}}$ x 1 $\frac{\text{kilo watt}}{\text{1000 watt}}$ = **206** $\frac{\text{kwh}}{\text{year}}$

Note to Teachers: Emphasizing that student write down the units with each number will show when part of the equation is missing and this method will almost always ensure correct answers if there arer no multiplication or other math errors.