Homework Assignment #1: Economics of Energy 399

Due Friday, January 30

1. How much energy, in KWH, do you use taking a shower each morning? You will need to measure how long your shower is and the rate of water flow. You may assume that water needs to be heated from an average temperature of 50 F and that heating, storing and distributing the hot water is perfectly efficient. If you have a thermometer to measure your personal water temperature, that would be ideal, but otherwise you can follow some basic guidelines: a water temperature of 98 F is cool/lukewarm, 104 F is warm, 109 F is hot, 114 F is very hot. Show your assumptions and your work.

2. a. How much energy, in KWH, is required to move your body from our classroom in Stein to Cool Beans in Hogan? A typical person uses roughly 10 (little) calories per 100 pounds of body weight to walk 1 foot on a flat surface. Any increase in height is on top of this. You will need to estimate your own weight, the distance to Cool Beans, and the vertical rise. Show your assumptions and your work.
   b. At your usual walking pace, how many watts are you generating in your walk from class to Cool Beans? Show your work.
   c. Choose a single flight of stairs anywhere on campus. What is the maximum wattage and horsepower you can produce running up the flight of stairs? Show your work.

3. What is the estimated monthly electricity consumption, in KWH, in your dorm room/apartment based on your appliance ownership and usage. Show your assumptions and your work.

Appliance	Watts	Appliance	Watts
Air Conditioner (Window Unit)	1,100	Desktop Computer	80
Fan – Portable	115	Computer Monitor (Standard)	80
Fluorescent Lamp 27W	27	Computer Monitor (Flat panel)	20
Fluorescent Lamp 20W	20	Printer	180
Fluorescent Lamp 15W	15	Laptop Computer	30
Fluorescent Torchiere	63	DVD Player/VCR	22
Halogen Torchiere	300	Radio – Portable	20
Incandescent Lamp 100W	100	Clock radio	10
Incandescent Lamp 75W	75	Stereo – Component	200
Incandescent Lamp 60W	60	Television (Standard)	300
Blender	200	Television – Flat Screen	120
Coffee Maker	1,200	Electric Blanket	190
Hair Dryer - Hand Held	1,500	Fish Tank (20 gallon)	90
Humidifier (Portable)	180	iPod	2
Iron	1,000	Cell phone	2
Microwave Oven	1,000		
Mini Refrigerator (average over day)	60	Most chargers or electronics on standby use 1-5 W	

(over)

Homework Assignment #1: Page 2

4. The wind turbine at Holy Name Catholic School has a 600KW capacity and is expected to generate 1.1 million KWH per year. Over the past 25 years or so, the interest rate on low risk bonds has exceeded the inflation rate by between 2% and 4%.

   a. What is the efficiency of the turbine compared to its peak capacity?
   b. The turbine cost $1.7 million to install in 2008. The turbine should require no servicing over its 25-year lifetime. It should produce 1.1 million KWH per year beginning in 2009. National Grid currently charges medium-sized businesses like Holy Name a price of 8.936 cents/KWH. At this electricity price, what is the net present value of the turbine at the time of its construction at real discount rates of 2%, 3%, and 4%?
   c. What is the benefit cost ratio of the turbine at real discount rates of 2%, 3% and 4%.
   d. What is the internal rate of return for the project?
   e. What is the payback period for the project for each discount rate?
   f. National Grid also charges customers 5.947 cents per KWH for distribution and transmission (on top of the electricity generation charge of 8.936 cents/KWH). At this higher electricity price, what is the net present value of the turbine at real discount rates of 2%, 3%, and 4%?
   g. What are the new benefit cost ratios of the turbine at real discount rates of 2%, 3% and 4%.
   h. What is the new internal rate of return for the project?
   i. What is the payback period for the project for each discount rate?
   j. At real discount rates of 2%, 3%, and 4%, what is the price of electricity at which the turbine becomes profitable?
   k. If National Grid is installing its own new generating capacity, does the cost have to beat the 8.936 cents/KWH figure or the combined (8.936 + 5.947) cents/KWH figure? Explain. If Holy Cross erects a wind turbine, does the project have to beat the 8.936 cents/KWH figure or the combined (8.936 + 5.947) cents/KWH figure? Explain.
   l. Holy Name also received a $585,000 grant to cover a portion of the $1.7 million construction cost. Including this subsidy and using the higher rate of electricity cost, what is the new present value of the project at real discount rates of 2%, 3%, and 4%?
   m. What is the payback period for the project for each discount rate?
   n. If you expect the price of electricity to rise at a faster rate than other goods in the economy over the next 25 years, how would this affect your choice of real discount rate? Explain.
   o. Should the College of the Holy Cross build a similar wind turbine? Explain briefly.

Homework Assignment #1: Page 3

5. A typical utility consumer has the choice between two different types of light bulbs: regular incandescent bulbs and compact fluorescent bulbs (CFLs). Both bulbs put out the same amount of light.

   Incandescent bulbs use 75 watts of electricity, cost $0.50 a piece, and last for 1,000 hours. CFL bulbs use 20 watts of electricity, cost $2.50 each, and last for 10,000 hours.

   Assume the light bulb user will use the light about 2,000 hours per year (about 5 hours per day), and suppose the local utility charges consumers 15.4 cents per KWH.

   Assume that all prices and usages will stay constant over time and that the discount rate is 12%.

   a. Have we chosen a good discount rate to use?
   b. Which type of bulb will cost the consumer the least over a 5 year period? Show your work.
   c. While the economics seem in favor of CFLs, give at least 3 reasons why a person might not switch.