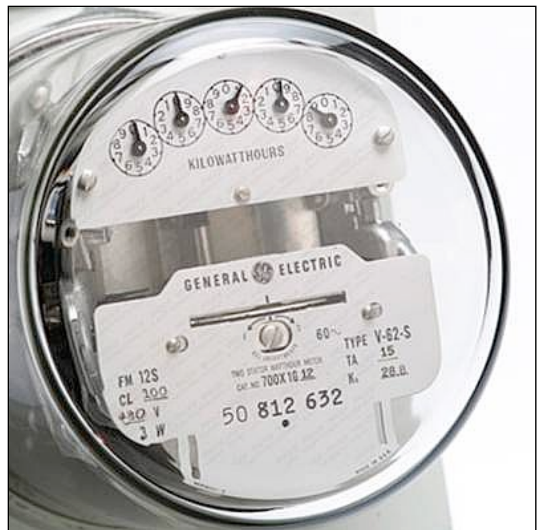
Evaluating Your Energy Use

About 550 Calories, or 25% of your daily energy requirement.

Introduction

How much energy will you use today? Do you have any idea at all? According to the US Department of Energy, total energy consumption in the year 2010 was 98,000 trillion BTU (British Thermal Unit = energy to raise one pound of water by 1°F). Let's round that to an even 100,000 trillion BTU. How much of that was your share? Let's round the US population to 300 million people. Now let's skip the boring part where we do the math, and just get to the final number: your share of the energy comes to 333 million BTUs, or 350 *billion* Joules. Still confused? Me, too. One more conversion, then a comparison: 84 million food calories. Now, obviously you did not eat 84 million calories of food in 2009. If you did, you would have had to have eaten 150,000 BigMac sandwiches (plus all the Diet Coke you can drink!). And you would have gained something like 2400 pounds.

Ok, so you consumed energy. A *lot* of energy. But not all in the form of food. You can't directly measure your total energy consumption, but you can make a very reasonable estimate using the documentation of your daily life. That 350 billion Joule figure is too high: you did not use *that* much energy last year, because the DOE statistic includes energy used commercially and industrially as well as residentially. So how much energy *do* you use?



How do you read this thing?

Objectives

- Estimate your personal energy consumption
- Distinguish between direct and indirect energy use
- Calculate your average daily energy consumption
- Determine the average cost of your daily energy use
- Gain familiarity with various units for energy and power

Equipment

- ARKLA/Centerpoint or other gas bill
- Conway Corp or other electric bill
- Grocery, restaurant, and gasoline receipts

Direct Use: Natural Gas

- Find your most recent Centerpoint Energy gas bill
- Make a table in your notebook and record the information about the energy use
- One ccf = 100ft^3 of gas
- Burning 1ccf = 100ft^3 of gas releases 100,000 BTU = 105x10^{6}Joules = 105 MJ of energy
- Calculate how much energy you consumed per day, and what it cost, using the formulas on the table below

Month	*month*	Total Consumption (Ccf)	*total*	Daily Use (MJ/day)	*energy = MJ÷days*
Billing Period	*days*	Total Consumption (MJ)	*MJ = total×105*	Your Share (MJ)	*gas = energy÷(# of people in house)*
Total Bill ($)	*bill*	Cost per MJ ($/MJ)	*cost = bill÷MJ*	Daily Cost ($)	*daily = gas×cost*

Questions

1. What does the natural gas do? Where in your house are you using it, and to do what?
2. Is the bill you are using representative of an entire year of energy use? Does your natural gas usage remain stable and relatively constant, or does it increase or decrease based on the season? Why?
3. If you are estimating your typical energy use for an entire year, does your figure for natural gas need to be revised up or down?

Direct Use: Electricity

- Try to use a Conway Corp bill from the same month as your Centerpoint gas bill
- Construct a table and record the relevant information in your notebook
- Ignore all the other stuff like water, sewer, and cable television; focus on the electricity
- One kilowatt-hour (kWh) = 3.6x10^{6}J = 3.6MJ of energy

- Calculate how much energy you consumed per day, and what it cost, using the formulas on the table below
- Remember to only include the cost of the electricity as the total bill, not the total for all services

QUESTIONS

4. What do you think is the biggest use of electricity in your house? Does this remain constant year-round, or does the pattern of major consumption change depending on the time of the year?
5. If you are estimating your energy use for an entire year, does your figure for electricity use need to be revised up or down?

MONTH	*month*	**TOTAL CONSUMPTION (kWh)**	*total*	**DAILY USE (MJ/DAY)**	*energy = MJ÷days*
BILLING PERIOD	*days*	**TOTAL CONSUMPTION (MJ)**	*MJ = total×3.6*	**YOUR SHARE (MJ)**	*electricity = energy÷(# of people in house)*
TOTAL BILL ($)	*bill*	**COST PER MJ ($/MJ)**	*cost = bill÷MJ*	**DAILY COST ($)**	*daily = electricity×cost*

DIRECT USE: GASOLINE

- If you have a gasoline credit card that you use only for buying gas, you can retrieve your purchase history by simply looking at your most recent statement
- Elsewise, you need to round up as many of the receipts for gas as you still have lying around
- If you do not have complete records, then you will have to estimate your driving habits carefully
- According to the EPA, burning one gallon of gasoline releases, on average, 113,000 BTU = 119MJ
- Calculate how much energy you consumed per day, and what it cost, using the formulas on the table below

AVERAGE DAILY MILES	*miles*	**DAILY CONSUMPTION (GAL)**	*gallons = miles÷mpg*	**# OF COMMUTERS IN CAR**	*people*
AVERAGE GAS MILEAGE (MPG)	*mpg*	**DAILY CONSUMPTION (MJ)**	*MJ = gallons×119*	**YOUR SHARE (MJ)**	*gasoline = MJ÷people*
GAS PRICE ($/GAL)	*price*	**COST PER MJ ($/MJ)**	*cost = price÷119*	**DAILY COST ($)**	*daily = gallons×price*

QUESTIONS

6. Does your car get better gas mileage in the summer or in the winter? Why?
7. Do your driving patterns change seasonally? Are your estimates above representative, or would you need to adjust your numbers up or down to reflect a more accurate annual average?
8. A hybrid Toyota Prius can get up to 50 mpg. Under the same driving conditions, however, the Lexus RX Hybrid SUV can only achieve about 30 mpg. Given the $20,000 difference in sticker price, how far could you drive with the money you would save by buying the Prius? Go ahead and assume that gas will stay at $3.00/gallon (it won't, but we can dream...).

DIRECT USE: FOOD

- Use your grocery receipts and restaurant bills to determine how much money you spend on food (if you use a VISA or debit card frequently, your most recent statement will provide you with a very good record of what you spend on food)
- Assume that you are eating exactly what you need each day: you are neither gaining nor losing weight
- Base your estimate of your calorie needs on this table
- One food calorie (a kilocalorie, or kCal) releases 4184 J of energy
- Calculate how much energy you consumed per day, and what it cost, using the formulas on the table to the right

Estimated Calorie Requirements (in Kilocalories) for Each Gender and Age Group at Three Levels of Physical Activity[a]

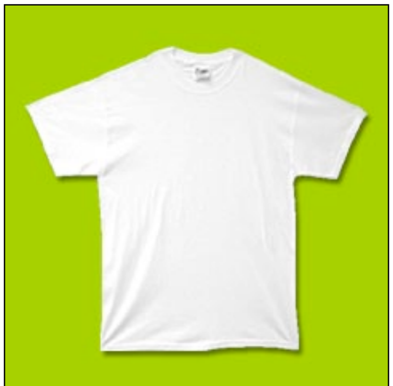
Gender	Age (years)	Activity Level[b,c,d] Sedentary[b]	Moderately Active[c]	Active[d]
Child	2–3	1,000	1,000–1,400[e]	1,000–1,400[e]
Female	4–8	1,200	1,400–1,600	1,400–1,800
	9–13	1,600	1,600–2,000	1,800–2,200
	14–18	1,800	2,000	2,400
	19–30	2,000	2,000–2,200	2,400
	31–50	1,800	2,000	2,200
	51+	1,600	1,800	2,000–2,200
Male	4–8	1,400	1,400–1,600	1,600–2,000
	9–13	1,800	1,800–2,200	2,000–2,600
	14–18	2,200	2,400–2,800	2,800–3,200
	19–30	2,400	2,600–2,800	3,000
	31–50	2,200	2,400–2,600	2,800–3,000
	51+	2,000	2,200–2,400	2,400–2,800

Source: HHS/USDA Dietary Guidelines for Americans, 2005

Questions

9. Do you spend more for your food energy than you need to? How could you get more energy for less money?
10. When you buy food, do you buy energy–dense items? Is a food item that contains many calories (hence lots of energy) always a better choice than an item with fewer calories? Is a nutrient–dense food item always calorie–dense? What's an example of an energy–dense but nutrient–poor food item?

Your Daily Calories	*calories*	Monthly Food Expenditure ($)	*food*
Your daily Energy (J)	*joules = calories×4184*	Daily Cost of Food ($)	*daily = food÷30*
Daily Consumption (MJ)	*MJ = joules÷(1×10⁶)*	Cost per MJ ($/MJ)	*cost = daily÷MJ*



How much energy did it take to produce that $5 T-shirt?

Indirect Use

Consider a plain white cotton t–shirt. You can get one anywhere for about $5. How much energy are you consuming by purchasing and wearing the shirt? The direct use: driving to the store, electricity to run the washing machine, natural gas to run the dryer. Ok, we've done those. But is that all? How much energy did it take to grow the cotton? Harvest it? Spin it into yarn, weave it into fabric, sew it into a shirt, pack it in a plastic bag, box it up with thousands of others, load it onto a truck, drive it to the port (so far everything we have done to the shirt has happened over in China; you can't get a $5 shirt that was made in America), load it into the cargo container, ship it across the ocean, unload it and truck it to the Wal–Mart, where you have been waiting all this time to buy it. How much energy did *that* take?

Questions

11. Make a list: where and how are you an indirect consumer of energy?
12. The average American consumes approximately 500MJ of energy indirectly each day. Total up your direct daily consumption from the previous sections: natural gas, electricity, gasoline, and food. Compare your direct with your indirect consumption. Do you need to go back to the previous question and add more indirect uses to your list?
13. Summarize your energy profile in a neat table:

Source	Your Daily Use (MJ)	Cost per MJ ($)	Your Daily Cost ($)
Natural Gas			
Electricity			
Gasoline			
Food			
Total	*use = total this column*	*$/MJ = cost/use*	*cost = total this column*

14. What is the most expensive source of energy on a cost per MJ basis? Is this the same source that cost you the most money per day in actual dollars? Does this surprise you? What did you expect to be most expensive on a per MJ basis? What did you expect to cost the most per day in actual dollars?