

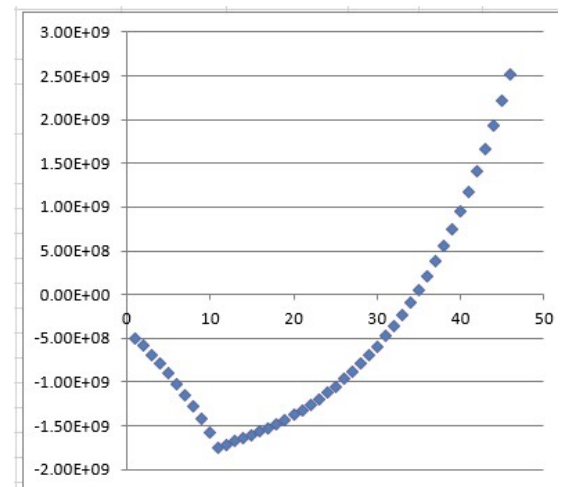
PS#8, Due in class, Monday, March 2nd

1. Please spend some time with the Excel financial model on the main class website associated with PS #7. It's not exactly a Peaker Plant, but the duty cycle is only 25% and the efficiency is that of a single cycle. What if you changed it to a NGCC... it turns out that NGCC plants cost only about \$1/W. (see <https://www.eia.gov/todayinenergy/detail.php?id=31912>). And the cost of NG? The spot price of natural gas today is about \$1.70 / MMBTU (see <https://markets.businessinsider.com/commodities/natural-gas-price>)... Remember a BTU (British Thermal Unit) is 1055 J, I estimate as a kJ. So MMBTU (a million BTU) is a GJ. A kWh is 3.6 MJ, so a GJ is about 300 kWh, meaning NG is really cheap: about ½ cent / kWh of Natural Gas. Also, you might be able to get a mortgage rate of 7% or even lower. See how low you can get the cost.

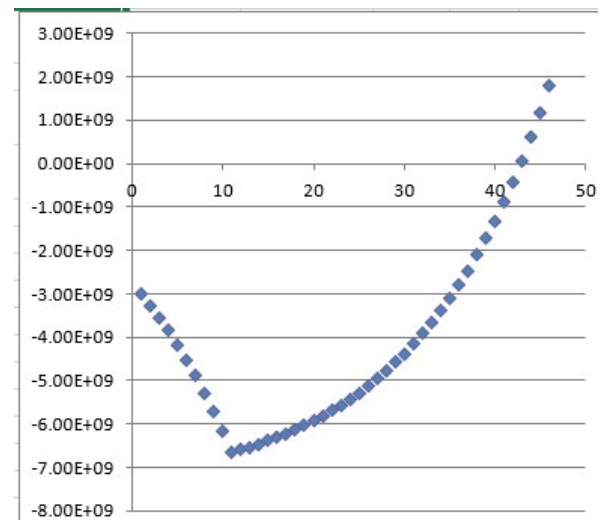
With the Present model, I'm only able to get the price down to \$0.165/kWh and break even after 40 years. Then I turned this into a NGCC with a duty cycle of 95%, efficiency of 60%, a capital cost of \$1/W, and a fuel cost of \$0.005 kWh (half a cent per kWh of thermal energy in NG), with an interest rate of only 7%. The result is that I can bring the cost of electricity down to 2.5 cents per kWh, and still break even after 20 years, making about \$2 billion after 40 years... not bad, as long as they keep buying my carbon dioxide emitting electricity!

2. Now, for the above model, make a single change: go into the revenue and put zero for the first 10 years to get an idea of what this does to your cost if you take 10 years to get a plant up and running which is often the case for a nuclear facility.

- a. Now, how low can you get the cost?
That single change alone more than doubled the cost of electricity to 5 cents / kWh, and taking me about 35 years to break even. You can see the model's output at right... getting me deeper and deeper into debt with each year until I start making money when I start selling electricity.



- b. Would this effect be greater for a nuclear facility where the capital cost is about \$6/kWh, rather than just \$1/kWh?. See: <https://www.world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power.aspx>
With a larger capital cost, the debt incurred in the first 10 years would be much greater... requiring a much higher cost of electricity. Judging from the model output at right, I get myself into a scary debt of \$7 Billion before we start generating electricity. The required cost of electricity is \$0.14/kWh in order to get me out of debt by year 40.



3. Consider population control measures. What would you endorse if you were a politician... is the topic political suicide? Please find and read an article that discusses options. What do you think we should do?

Make sure we talk about this in class Wednesday!

4. Consider the issue of society, fast fashion, and making yourself desirable to society and attracting partner for reproduction... which as above, we want to limit for society, but we accept as part of our biological drive.
 - a. What are the options to foster a society that values the ecosystems that support life as it is on this planet?
 - b. Do any of our presidential candidates provide direction here? If so, what?
 - c. What do you see as your role in these efforts?

5. *See solutions on main class website.* You replaced a kW of incandescent light bulbs (16 bulbs, 60 W each) with 100 W of LED lights (16 bulbs, 6 W each) that provide the same amount of light! You paid \$80 for the LEDs. You use these lights for 6 hours every day – or about ¼ the time.

- a) In a year, how much electricity did you use with the incandescent lights? *~2000 kWh?*
- b) How much CO₂ was produced in California in a year to power your incandescent lights? *~700 kg?*
- c) How much money do you save each year on electricity bill using the LED lights? *~\$270*
- d) What is the payback time? *~4 months?*

You're a renter and actually have to move after only 6 months. You don't take the LED lights with you.

- e) What was your cost of conserved energy? Please put answer in \$/kWh *~ \$0.09/kWh?*
- f) What was your cost of abated carbon? Please put answer in \$/Ton_CO₂. *~ - \$150/ton? This would imply that for every ton of CO₂ that you don't have to emit, you actually save \$150.*
- g) What are some of the other benefits of LED lights?