

An Economist's Dilemma: To PV or Not to PV, That Is the Question

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By Ahmad Faruqui

Electricity Policy – the website <u>ElectricityPolicy.com</u> and the newsletter <u>Electricity Daily</u> – together comprise an essential source of information about the forces driving change in the electric power industry.

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uring the past 12 months, my wife and I paid up to \$500 a month for our combined electricity and gas bills during some summer and winter months. The annual average was \$300 a month. The high bills hit the pocketbook hard. But they also caused angst.

I.

Month after month, my wife and I were told that our usage was the highest when compared to a hundred "similar" homes in the neighborhood. This was "social norming"

Ahmad Faruqui, an economist who has worked with more than a hundred clients throughout the US and globally during the past 40 years, is a principal with The Brattle Group. of behavioral economics fame at work.¹ Much of the "excess" occurred in either the summer months, when the central air conditioner was running, or in the winter months, when the gas furnace was running.

Looking at the seasonal pattern in our bills going back to 2001, I concluded that about one-third of the bill was "weather sensitive," i.e., coming from space conditioning, and the remainder was "base load" from appliances, lighting, and electronic devices such as TV's and laptops.²

¹ The undisputed leader is Richard Thaler. http://www.economist.com/node/21551032

² At one point, I had saved my bills going back to the time we moved into this house in 1988. Regretfully, those files were lost to various housecleaning exercises over the years.

It became easier to do these computations once smart meters arrived at our house sometime in 2011. Often, on summer afternoons, I would find myself standing in



Figure 1: Our one-time usage compared to our neighbors.

front of the smart meter and seeing the readings fluctuate as the central air conditioner came on and off, along with other appliances whose operations I was controlling manually.³ This became a regular habit which seemed to calm the mind and yield meditative, Zen-like benefits.

he meter would tell me how much energy (kWh) I had consumed on a cumulative basis and how much power (kW) I was demanding on an instantaneous basis. It would also tell me at what voltage the power was being delivered at. The readings were updated continuously on a 25 second basis.

http://www.goodreads.com/quotes/63388summer-afternoon-summer-afternoon-to-methose-have-always-been-the. In the next column is a graph of our average monthly usage of electricity (expressed in kWh) averaged over the years 2004-15.

The misery of dealing with \$500 bills was compounded by the fact that the focus of my professional work since 1979 had been on the efficient use of energy. The phrase, "physician heal thyself," reverberated like a dull echo in my mind. But my work would not allow me to focus on my own utility bills. I was constantly on the road, which meant being in the air an awful lot. So much so that when my family surprised me with a 60th birthday party at a Vietnamese restaurant in San Francisco, there was a commercial jetliner sitting atop the cake. But the proverbial tipping point was reached when the bills began hitting \$500 a month, not just during the summer, but even during the winter.

Our house in Danville, Calif., had been built the same year I got my doctorate from U.C. Davis, but we did not move into it until the fall of 1988. It was a 2,400 sq. ft., two-story structure with vaulted "cathedral ceilings," four bedrooms, two-and-a-half bathrooms,

Electric consumption (kWh) by month, 2004-2015



Figure 2: Our monthly usage summed over 12 years.



³ Henry James, the novelist, said that the two most beautiful words in the English language were summer afternoon.

and several windows with great views of the Las Trampas Ridge on the western side and the local hills on the northern side. There was a lovely gazebo on top of the hill that jutted into our backyard. We fell in love with it and the views it afforded.

By the two second secon

We called PG&E, the local utility, and they sent an energy auditor to check out the house. He toured the house and said it was very pretty "but you do have those vaulted ceilings and expansive windows. They are probably the cause of the high bills." He asked whether we left the gas spa on all the time and we said no, that we only turned it on an hour before we were going to use it. So he recommended that we install weather stripping under the garage door and wrap the water heater. We did both but they did not move the utility bill by much.

As the years progressed, and the bills grew with time, we switched to time-of-use rates (TOU) for electricity.⁴ PG&E sent me a letter saying that even though we would pay an extra charge of some \$3.99 a month for the new meter, we would save about 10% on our utility bills, and even if we did not change the manner in which we used electricity. A year later they showed us what our bill would have been on the standard rate versus the TOU rate, and it was indeed lower by 10%. They said that we used about 25% of our power during the expensive peak period from noon to 6 pm and if we were to lower that percentage, we would save even more. Next year we had lowered the peak share to 22% and saved something like 12%.

dditionally, we began to replace our energy- using equipment even before it had failed. The central air conditioner and gas furnace were upgraded in 2003. The roof and the windows were changed five years later. All the major appliances were changed five to eight years later, along with most of the light bulbs. We changed the big screen TV in the family room to an LED TV soon after those models were introduced. Ostensibly the change was to get better images of sporting events which our older daughter watched intently but the salesman at Fry's Electronics in Concord

⁴ This had been a topic of research for me since I joined EPRI in the Electric Utility Rate Design Study. J. Robert (Bob) Malko was my boss. With Continued on next page

Continued from previous page

his encouragement, I surveyed the results from several DOE-funded TOU pricing pilots around the country. In 1983, the results were published in a peer-reviewed journal, *Energy*, and got cited in the second edition of Professor Bonbright's canon on public utility rates. Electric rate design would continue to be the focus on my work in the decades that followed. Another survey paper, coauthored with Sanem Sergici, containing the insights from 40 pricing pilots from around the globe, was published in 2013 in *The Electricity Journal*.

convinced us to go with the LED model since it used only one-third the energy as a plasma TV (which were the rage at the time). Of course, it cost more. We bought it for the image quality. I did not bother to do a costbenefit analysis.

e converted the aging gas spa to a modern Sundance electric spa in 2002. It can seat eight but has never seated more than two since our guests have never been anxious to get into it with us. We left it in the economy mode which maintains a water temperature of 80F. When we are going to use it, we raise it to 98F the prior day. I wanted to turn the heater off but it did not have such a feature. I called the manufacturer and was told it would require a technician to turn that off; even then it could create problems, causing the filter to run continuously. The other option was to totally shut it down and drain the water. Even that I would not be able to do, since there is water inside the spa which has to be drained. Of course, if we did that, we would not be able to use it on demand, so I have left it on. The filtering cycled runs four times a day. Using some rules of thumb derived from the kW capacity of the spa, I estimated that it uses 200 kWh a month, which the manufacturer confirmed.

Besides the medium-sized fridge in the kitchen, we also have a mini-fridge in the pantry for juices and soft drinks. Then there is another fridge in the garage and an upright freezer for storing halal meat.⁵ All of that

adds to our base load, even though it all comes from new energy-efficient appliances.

II.

We were the prisoners of an enigma: empty nesters whose bills were higher than when their daughters lived with them. And that was despite the fact that we had been steadily improving the energy efficiency of our dwelling structure and the energy-using equipment inside it.

I opined to friends and family that many factors were at work here, not just the arrival of the smart meters.⁶ Probably the most obvious one was the doubling of rates in the upper energy usage tiers during the past decade, an aftermath of the energy crisis of 2001. All the inflation that had occurred since then was loaded onto the upper tiers. At one point the fifth tier came within a hair's breadth of 50 cents per kWh, possibly setting a world record.

signed up for the offered SmartRate, in which electricity prices could rise significantly up to 15 times a year but were lower during all other hours.⁷ PG&E's online portal used the customer's load profile to calculate bills under four different rate options. Mine were going to be lowest with that rate even if I did nothing, so I signed up.

⁵ <u>http://halaladvocates.org/our-resources/what-is-halal/</u>.

⁶ In 2010, some customers in the Bakersfield area had claimed that their bills had doubled due to the smart meters. That got much publicity. Even though that claim was repudiated by the CPUC, doubts persisted in the public mind.

⁷ This rate had been at the center of many of the pricing experiments I had designed, evaluated and surveyed, beginning with the now legendary Statewide Pricing Pilot in California.

I also signed up for text alerts, warning me that I was going to be moving up to Tier 3 and then up to Tier 4. That was good news and bad news. Those messages would follow me around the globe. I had the pleasure of knowing that I was about to hit Tier 3 and then Tier 4 whether I was traveling in Oklahoma, Australia, Chile or Japan, or just commuting on BART. Even when I was on a two-week vacation, and there was no one at home, I would still reach Tier 4. Dreadful doubts about the Bakersfield Effect began to surface even in my mind.



Figure 3: PG&E's Four-Tiered Rate (Jan. – Feb. 2016)

As a first step toward taming the rising bills, I gave some serious thought to putting solar on the roof. It seemed everyone was rushing to do that. A friend, who had just signed a contract with a large provider, said to me at a dinner party at my place: "Ahmad, you have nothing to lose. You don't have to put any cash down. And your new power bill will be lower than your current power bill and it will stay constant for the next 20 years, while your power bill from the local utility will continue to climb by a few percentage points each year."

ome friends who had already installed solar had told me their bills had already dropped in half and some had said their bills over the course of the year had dropped to zero. All of this sounded too good to be true.

I knew where their "savings" were coming from. Almost half of their savings were coming from people like me who had not installed solar. So the solar option was in part an income redistribution program, often transferring money from less affluent customers to more affluent customers. This was a direct consequence of net energy metering. And you got additional benefits if you bought the solar panels, since that purchase gave you a 30% credit on your federal tax return.⁸

also knew, having been involved in regulatory hearings on the subject, that the four tiered rate structure – which was not an accurate reflection of utility costs --would be flattened over the next three years into two tiers, making solar less attractive. And I knew that the cleanest form of energy was not renewable energy. It was the energy that was never produced from any source, i.e., it was energy that was conserved.

III.

So my wife and I looked into the state's energy upgrade program, which promised rebates of up to \$6,500. This had gained prominence ever since the California Public Utilities Commission announced its decision to flatten the tiers. While the four tiers were to be replaced with two tiers, "super users" would pay twice as much as the user who used just the baseline amount. A super user

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⁸ If you leased it, then the leasing company got the credit.

was someone who used more than four times the amount of the baseline user. The commissioners, in the proceedings on July 3, 2015 that led to their tier-flattening decision, said the surcharge would send a clear signal to super users. The transcript read: "Utilities will have an affirmative obligation to focus on energy efficiency support, counseling and engagement with those [super user] households." So I called the Energy Upgrade Program advisor and had a couple of phone calls and email exchanges. He advised me to contact three approved contractors, get estimates, check references, pick one and proceed with the work. We found a contractor, got what we thought was a competitive bid, checked his references, and gave him the go-ahead. The first step involved a storm door test on the house. It found an air leakage factor of 56%.

We went over the options one more time with the contractor. After much deliberation and consultation with others who had gone through similar upgrades, we decided to go with a very high efficiency 4-ton central air conditioner (SEER of 18 versus an effective SEER of 10 for the current 4-ton unit) and a very high efficiency gas furnace (an efficiency factor of 97.2 versus an effective factor of 75 for the current unit).⁹

⁹ We gave serious thought to installing an electric heat pump that would provide both space cooling and space heating. After all, I had worked for 11 years at the Electric Power Research Institute. Based on a review of expert input, we concluded that it was not the best option for us. Gas prices are lower than electric prices in California for heating purposes. The Carrier representative told me that only 5% of the equipment they sell is heat Continued on next page e also added a new wireless thermostat which we could access through the smart phone while traveling and which also showed us the outside temperature

Additionally, the air ducts were sealed to the extent possible, new R38 insulation was added in the attic, replacing the R19 insulation, a new energy efficient fan was put in the attic, replacing two older and less efficient and noisier models.¹⁰ The grand total, including \$550 for the before-and-after blower door test, came in at about \$19,000.

e also installed an insert in the fireplace to prevent conditioned air from leaking out through the chimney. The fireplace looks spiffy and it is remotely controllable.

The insert allows us to warm the family room and the adjacent dining room, reducing the load on the gas furnace. I have seen the temperature climb from 67 degrees to 73 degrees within 15 minutes.¹¹

IV.

The work is now finished. The new equipment was installed in a single day and the ducts were also sealed on the same day.¹²



Continued from previous page

pump equipment—and that it only makes sense if you have solar on the roof.

¹⁰ The major equipment comes from Carrier; the models are part of the Infinity series.

¹¹ Of course, it is a tad expensive at \$4,000 and the purchase would not make sense purely from a cost-benefit analysis perspective.

¹² The day long project gave us the perfect excuse to go to the sea and check out the elephant seals

The attic insulation was done two days later in half a day. When the contractor who led the work met me on the first day, he said he had come to "borrow" our old furnace and central air conditioner. I always liked technicians with a sense of humor. He also told me that he had never worked on a house where the air leakage was a staggering 56%.

V.

A few weeks later another blower door test was carried out. It produced some amazing results. The duct leakage dropped from 56% to 8%. And whole-house air leakage dropped by 38%. The next day, I went to the PG&E website to see if a new bill had been posted. Indeed, it had been posted and I was pleasantly surprised to see that it was lower by 30%. I believe we are going to be eligible for a rebate of a couple of thousand dollars from PG&E and a small federal income tax credit.

PG&E has introduced a new time-of-use rate, which does not have tiers. I have signed up for it and, according to the simulations on the utility's website, I should expect to save about \$45 a month.¹³

On paper, the economics of energy efficiency may not look as attractive as going solar but I believe, over the long haul, they are more

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¹³ This is the E-TOUB rate plan. Peak prices are about 40% higher than off-peak prices in the summer. The peak period runs from 4 pm to 9 pm reflecting the new "duck" shape of system load curves in a world of distributed energy resources. beneficial for us, for our neighbors, and for society as a whole.

Our heating costs appear to have gone down by a significant amount. In the coming summer we will be able to compute the savings in our cooling costs. The simulations carried out by our contractor suggest that our total bills should go down by a quarter. The in-home environment is more comfortable since multi-stage equipment is at work. And we are able to remotely control our thermostat, in case we forgot to set the correct settings for vacation.

The thermostat also displays a variety of other information, such as how much energy we are consuming daily and how much we are spending on that energy. That kind of information would have required the installation of an in-home display. If you want, you can install a picture as a screen saver. It also comes pre-wired for integration with utility demand response programs, but my wife has expressly told me that we will not be signing up for any of those.





http://ahmadfaruqui.blogspot.com/2016/02/tosea-memoir-of-point-reyes.html.

A POSTSCRIPT

Do we regret not going the solar route? Not in the least. The last thing we want to do at this stage of our lives is to enter into a 20-year lease. Plus, if you lease solar, you don't get the income tax credit; the solar provider or the lessor gets to keep it. Should we have just bought the solar panels, as some of our affluent friends had done? No. We had to make sure the house was energy efficient before worrying about how that power would be supplied. That is what my career had been all about. It was also simple common sense, as my wife (an accountant) informed me.

f course, I could hear some of my friends, both personal and professional, saying to me that I had not served my own interests well. For the money I put into upgrading my energy efficiency, I could have bought a 5 kW solar panel system. I would have earned an income tax credit of 30% plus reaped the benefits of net energy metering. The latter allows the solar customer to earn the full retail rate for the energy that he or she sells back to the grid, almost double its market value. That overpayment does not come from the shareholders of the utility, popular perceptions notwithstanding. It comes from other customers who do not have solar panels sitting atop their roofs. Many of these customers are apartment dwellers or tenants in single family homes, and many of them are much less affluent than solar owners.

Net energy metering based on payments at the utility's retail rate is equivalent to putting a regressive tax on the neighborhood. It is a terrible bias in public policy that needs to be corrected. For the money we spent upgrading our energy efficiency, we could have bought a 5 kW solar system, earned an income tax credit of 30% and reaped the benefits of net metering, which allows solar customers to earn the full retail rate for energy sold back to the utility, almost double its market value. That money ultimately comes from customers who don't have solar.