Competitive Electric Utility Analysis

BY DOUGLAS B. REYNOLDS

Douglas B. Reynolds is a professor of petroleum and energy economics at the University of Alaska Fairbanks. He can be contacted at DBReynolds@Alaska.edu

In the 1990s much discussion occurred over how electric utility monopolies had overbuilt their supply of power generation capacity and did other inefficient actions that were "wasting money." The thinking was, along Chicago School lines, that utilities would be more efficient if there were competition. That way uneconomic generation would go out of business even while new, low-cost generation would come into the mix. Theoretically, new, small and low-capital cost natural gas generation would lose less money than large, high-capital cost coal generators in a competitive game theoretic interaction, which would result in the cheapest generators staying in business. Nevertheless, understanding how exactly such a competitive grid works is a challenge.

One way to analyze it is to compare competitive electric generators on a grid as analogous to a city's road system. Both the grid and the roads are transportation networks: the roads for people and the grids for electricity. With city roads you are connecting people to homes and businesses, and where those businesses can compete with each other and be located at optimal locations and with optimal sizes all over the city. Generators on a grid can also be located anywhere. The people on roads drive to and from their residential housing, which are akin to electric power consumers on a grid, again located in many locations and where the people can then drive, or ride, from their residences to businesses in order to work or shop.

Within this discussion is a debate similar to what transpired in the 1930s between the ideal of free markets creating an economy, and the ideal of a planned engineered economy, sometimes called technocracy but loosely based on Communism. After all, considering how the Great Depression showed intractable problems with market mechanisms, technocracy (or communism) looked appealing at the time. Similarly, it would be good to compare the ideal of an electric power market to other types of competitive markets to judge its effectiveness. Issues such as congestion, qualitative competition and technological advancement can be taken up.

Competitive Types

According to the principles of Economics there are four economic structures with varying degrees of competition: Perfect Competition, Monopolistically Competitive, Oligopoly and Monopoly.

Recall the conditions for Perfect Competition include, perfect information, easy entry and easy exit, many small firms, such that no one firm has any kind of market power, and a single well known market price. None of that exists for the electric power market. First, there is no easy entry and easy exit for electric power generators, which are often some of the most environmentally controversial facilities there are, requiring permits, long lead times and more often than not court actions just to get set up. Then there are usually economies of scale that determine the cheapest generator, not just for base power, but for peak power as well. Also most generators, (if not compelled to do so by regulation), keep their costs and strategies hidden so that they can make more money. So there is no naturally occurring perfect information.

Price often varies due to daily market changes. Theoretically, the supply and demand transactions happen when the operator dispatches the lowest cost provider to the grid at an instant of time, although not necessarily charging a price equal to the average cost at that instant. Plus, when there is a price change, many purchasing customers do not even bother to react to it. And even if a customer sets up smart grid techniques to turn on a water heater say at a low price interval, cannot such techniques be used equally as easily by a utility monopoly as well?

One ideal in competition is to allow generators to sell directly to load paying customers based on offering a low price, long run contract to various customers. So, again that is not by definition close to a perfect competition ideal where everyone can buy at the lowest price, not just a few strategic partners. That all suggests that power markets are not perfectly competitive. But maybe, power markets are monopolistically competitive.

For a monopolistically competitive market to exist, it still has to be the case that each generator has easy entry into and easy exit from the market, which again does not exist. You also have to have many small generators, anyone of which cannot have any kind of market power, which also normally does not exist. Most strikingly, monopolistic competition implies differentiation of the product by quality, but since it is all only electricity you are selling, there is no differentiation of the product, only differentiation of quantities and possibly prices if you are allowed direct long term contracts, but then that would not be exactly monopolistic competition.

So the power market is not perfect competition, it's not monopolistically competitive, and since we are creating the market out of thin air, it cannot be a monopoly. Therefore, by definition, it has to be oligopolistic competition. So, what does the ideal of oligopolistic competition look like?

Basically, oligopolistic competition is a game

between relatively large players in comparison to the individual market. The players normally have the economies of scale not only to create the cheapest average cost generators, but the economies of scale to actually go through the environmental and regulatory gauntlet to even build a generator in the first place. Small solar generators are often allowed in the market by regulatory fiat, which therefore suggests a lack of easy entry and easy exit. Thus, it usually takes deep pockets to get into the market and deep pockets to win, i.e., make a profit, by undercutting competition. The oligopolist cuts prices in order to put its competitors out of business, or it buys out the competition, and then raises prices. The only alleviation of that type of cut throat competition to swallow up competitors is: (get this) regulation!

Wait, the whole point of the exercise was that regulation was not working and that's why we needed competition in the first place. If unfettered oligopolistic competition would end up in a Rockefelleresque monopoly, then it can't provide cheap electric power, (by definition of game theoretic oligopoly power) and not work either, then we are back to regulation. It is like saying regulation works better than regulation.

Congestion

Keep in mind the physical differences between a power grid and a road system. Can they be compared or are they different? Consider Congestion.

A road system and a power grid both have congestion. The road system's commuters for example get into traffic jams at rush hour and it can take an extra hour maybe to get home, although if you do that enough, you might vary your commuter timing or vary where you live or even vary where you work or shop. With a power grid, since power production and consumption are instantaneous, then if there is congestion, the electric power is not storable on its journey; and so if the power cannot get through at all it will be lost. That is, a road transportation system is for storable items, the commuter or the cargo items in a truck, which all will eventually get through. The power grid, if it is congested, cannot store the power and the electric power can generate heat losses on the line or may not get through at all.

While this may sound like a small loss for the power system, it actually means that when a road system engineering planning mistake is made, it will only add a waiting time to the delivery moment of a storable transportable item. For the grid system, an engineering planning mistake will create loses to the system that could continue until the congested node is built out or built around. So, how do you plan? For both systems, the engineer looks at congested nodes and starts to plan expansions around them. However, since the grid system is supposed to be designed to add and subtract power in many locations, and instantaneously, the solution is often to simply over-build the entire system to be able to take extra power from anywhere at any time.

Whereas the road engineer will have a two lane road in rural areas, the electric power generator may need a four lane highway equivalent (not including high voltage transmission), just in case someone big moves in. And where as the road engineer will have a four lane highway in the suburbs, the electric power generator needs to have the equivalent of eight lanes to make sure the instantaneous power gets through. Then in down town areas where ten lanes will do, the power engineer builds twenty or thirty lanes equivalent to keep competition open.

That is an interesting concept: over-building a system. No one ever talks about how over-building a grid is by definition "inefficient" in the so called "efficient" market grid system. On the other hand, a planned monopoly system would place generators strategically so as not to have to over-build power lines. Therefore, not only is the number of power generators going to end up being more than necessary in an oligopolistic competitive market in order to insure competition (creating a game theoretic interaction), but the grid itself will have to be over-built to allow the implementation of this relatively inefficient oligopoly game to play out.

Then on top of that you are going to allow prosumers (customers that both use and produce electric power) to produce their own small electric power output and sell it to the grid which can add to synchronous zone problems and other engineering problems for the grid's stability. It is hard to imagine how the oligopolistic, prosumer, over built grid is making competitive cost reductions to the average consumer. But wait, according to EIA (2019) statistics, it isn't. Inflation adjusted average costs of power are down a bit over ten years, but much of the reductions happened early on when natural gas prices were in decline.

Nothing Qualitative to Compete Over

In a city with businesses situated along a road system, the usual way to compete is not so much with lower prices, but with better service, higher quality items and maybe convenience. That is you compete qualitatively not with price. Even the discount stores add a qualitative edge to their discounts to compete. But all that doesn't work in a competitive electricity generator market where it is exactly the same product, electricity with a standard voltage, phase and frequency, that is being sold and indeed the electricity is wanted instantly when it is needed and at the lowest possible price. That leaves no room for firms to make a profit by marketing their quality. So electric utilities are not like restaurants or automobile producers with varying degrees of quality, styling and performance, they are just providing one simple commodity: electricity. The only way to make money in such a framework is to undercut competition and buy it out, or make agreements with each other (tacit or formal) to not undercut each other and keep prices high.

Moreover, generators have economies of scale.

So, bigger generators are, over the long run, cheaper than smaller generators. That means even if a small intermittent generator, like a solar panel, takes away market share from a large generator, then that large generator becomes more cost inefficient, especially if it is required to turn on and off causing its turbines to degrade. But also generators can be set up to specialize in peaking needs, i.e., close to central peaking power demand locations to reduce line losses, or set up for base power needs, i.e., for efficient 24 hour generation, all of which can get destroyed with oligopolistic competition. Basically, power utility competition is like trying to fit every square, base-power, peg into a round peaking-power hole and that reduces cost cutting specialization abilities.

Then on top of all that you allow small time residential solar and wind generators to surge in and out of the mix so that the changing supply reduces effective planning over when to turn on and off generation at specific times during the day. It reminds one more of having too many cooks in the kitchen, than of an efficient market. Therefore, it is hard to make a profit. And if it is hard to make a profit, there is not going to be a lot of competition.

Technology

The real issue here is technology. The thinking is that this inefficient oligopoly set up, no matter how convoluted it is, at least causes leaps and bounds in technological changes. But really it hasn't been normal competition that has created the bulk of better wind and solar technology, but simply government subsides. Government R and D is certainly to be applauded but let's keep the record straight and acknowledge that it isn't exactly the competition that has created all the renewable technological changes at all, but government outlays. Carbon taxes could also be a factor but again that will be a factor no matter the utility configuration.

So, then you say that with AI (artificial intelligence) it should be possible, like the cell phone networks, to create an all-powerful planning mechanism. But cell phone users have the lea way to locate anywhere within a few miles of a cell tower and the tower can fairly cheaply be over-built for excess capacity at a small cost. Plus the planning of each cell system is done by the head of the company, not by competition. There are cell competitors, but that would be like having power grid competitors, not competitive generators. By contrast a power grid needs a physical connection and built to specifications to each generator, high-voltage transformer, low voltage substation or paying customer and where they cannot move or place too large of a load or supply capacity into that grid connection. This suggests that a planned monopoly would be more conducive to implementing AI and technological innovations than oligopolistic competition.

Basically a power grid cannot create nearly the flexible changes to traffic that a cell phone grid can or a road system can which means you need central planning to make a truly efficient power utility using economies of scale for generation capacity, economies of scale and planning for gird connections, and if need be economies of scale for carbon emission reduction strategies, i.e., you want to have a natural monopoly.

Conclusion

So then the question is, if prosumers, emission mandates and oligopolistic competition in power does not really create competitive efficiency, then what would? Probably it would have to be a planned system. It would not necessarily be a government monopoly, where there is a tendency to under-invest or over-invest due to a lack of appropriate incentives; or it would not necessarily be a regulated private monopoly, which tends to use gold platting (using high cost options instead of low cost options) to gain a return; but maybe it could be an incentivized management system. An incentivized management system would be kind of like how a private company is run by a CEO with stock options. But instead of stock options, as Reynolds and Zhou (2019) show, a socially optimal bonus mechanism, not based on the utilities value but based on price and cost reductions for customers and other social benefits, might work. At least a bonus mechanism might add better planning and least cost options into the mix but it would also create true transparency.

Interestingly, the real point of the competitive market is probably not to reduce prices, but to reduce transparency. For example, high cost carbon reduction policies can more easily be hidden using a complex market mechanism rather than a simple monopoly. If there were true transparency, though, then that would cause political resistance to the high costs of actually trying new renewable technologies. Indeed, it may be the lack of transparency of the so called competitive power grid system that everyone likes so much, not the cost reductions. In that way everyone can claim the power grid is doing all things for all people: empowering consumers, reducing carbon emission and creating new technology, when in fact it is just a boring old electric utility that simply produces electric power, distributes it where needed and covers its costs. You would like an electric power utility to be as exciting as rockets to Mars, but it just isn't that exciting.

References

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