Why Exelon Should Want Guaranteed Purchases for Calvert Cliffs

Julian Silk

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Note: Once again, these are my own personal views, and no other individual or group has responsibility or liability for any of them. All errors are my own.

I. My Understanding of Exelon's Views

My belief is that Exelon, which operates the Calvert Cliffs nuclear facility, has mentioned possible adjustments to the Maryland Renewable Portfolio Standard (RPS), in order to preserve the finances of the facility. I will look at three possible cases: a) a carbon tax; b) a Tier 3 category similar to the one New York has developed for its nuclear facilities (such as described in http://programs.dsireusa.org/system/program/detail/5883); and 3) a guaranteed purchase requirement, which is similar to the RPS itself. These market designs would all add costs to Maryland electricity consumers, and I will try to avoid comment on how much or whether any of the market designs would achieve the same result but cost less. This is intended to be strictly a look at what most assures the financial well-being of Calvert Cliffs.

In doing this, I will take the same framework as my article on "Valuing Flexibility" in the 2018 4th Quarter *IAEE Energy Forum*, which is currently available online at

https://www.iaee.org/en/publications/newsletter.aspx

Please note that this article has nothing to do with the IEA report, "Valuing Flexibility in CCS Power Plants", at

https://ieaghg.org/exco_docs/2017-09.pdf

That report uses a linear programming algorithm, and discusses CCS (carbon capture and storage) and what savings it can provide over decades. I have discussed CCS (adding a "U" for "utilization"), most recently in

https://www.iaee.org/proceedings/article/13261

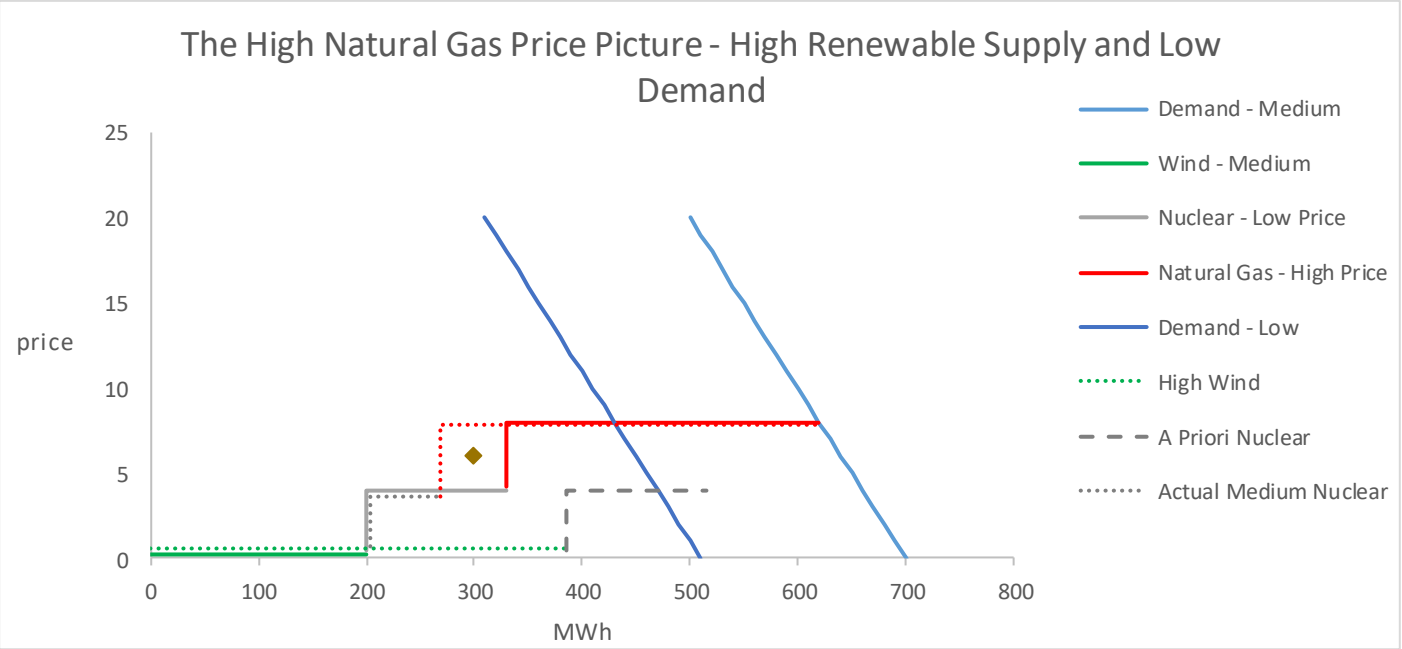
and am not mentioning it as an option here. This will just be looking at payments to various providers with current technology, although I will allow myself to make one suggestion for a possible technological effort at the end.

We will have 3 sources of electricity: a renewable provider (such as wind), which is intermittent; a nuclear facility; and natural gas. We have a market demand, provided by PJM, which can be treated as exogenous. We are looking at the order in which these three providers will be chosen, which in turn will provide information on what they earn by providing.

The crucial assumption here, as in my "Valuing Flexibility" article, is that provision is at a constant marginal and average cost up until capacity (of the market supply). This is given by the technology. We are not considering levelized cost of electricity (LCOE) *per se*, just what supply costs to the market. For the sake of argument, and to avoid reprisals similar to the comments of Professor Richard Green of the University of London to my earlier article in the *IAEE Energy Forum* in 2012, I will take the price of renewable energy from wind to be zero. That doesn't mean we want everything to be powered by wind. Wind is intermittent, and the intermittency has consequences.

II. A Carbon Tax

I reproduce my "High Renewable Supply and Low Demand – High Natural Gas Price" case from the article. I think this is the relevant case for what a carbon tax would do:



The carbon tax, if sufficient, would raise the supply price of natural gas above that of nuclear. We have two cases, high demand – the demand schedule to the right – and low demand – the one to the left. If we had just renewable energy and nuclear, and we have a gust of wind, so that wind supply unexpectedly increases with low demand, we have the situation on the bottom. Price is negative, because supply exceeds demand.

So we are going to have natural gas as a backup, because it can cope with the intermittency of the wind. The question is how much we have. In the high demand case, if that were stable, wind would be represented by the solid green line, nuclear by the solid grey line, and natural gas by the solid red line. Natural gas would be the marginal provider and would set the market price.

This is what a carbon tax, of sufficient magnitude, would also force. But what happens is that PJM, or any provider, is worried about the intermittency of the wind. They purchase more natural gas (the red dotted line) and less nuclear (the gray dotted line) than they would in a situation of certainty. The area marked by the diamond is that value, the value of flexibility for natural gas.

What does it mean to purchase less nuclear if the supply from Calvert Cliffs is constant? It means that PJM will be trying to sell the electricity provided by Calvert Cliffs outside the state as an export. It will try to sell this electricity even if there is a carbon tax on natural gas. The carbon tax would have to be so high as to overcome not just the price difference, but the value of flexibility, too, for this not to happen. Then and only then, will PJM be willing to suffer the negative prices which are inevitable with inflexible nuclear and cut back on its purchases from the natural gas suppliers.

Whether Maryland should – ethically – have a carbon tax of this magnitude or not, it is reasonable to believe, in the wake of the rejection of a carbon tax by the state of Washington, as in

https://www.vox.com/energy-and-environment/2018/9/28/17899804/washington-1631-results-carbon-fee-green-new-deal

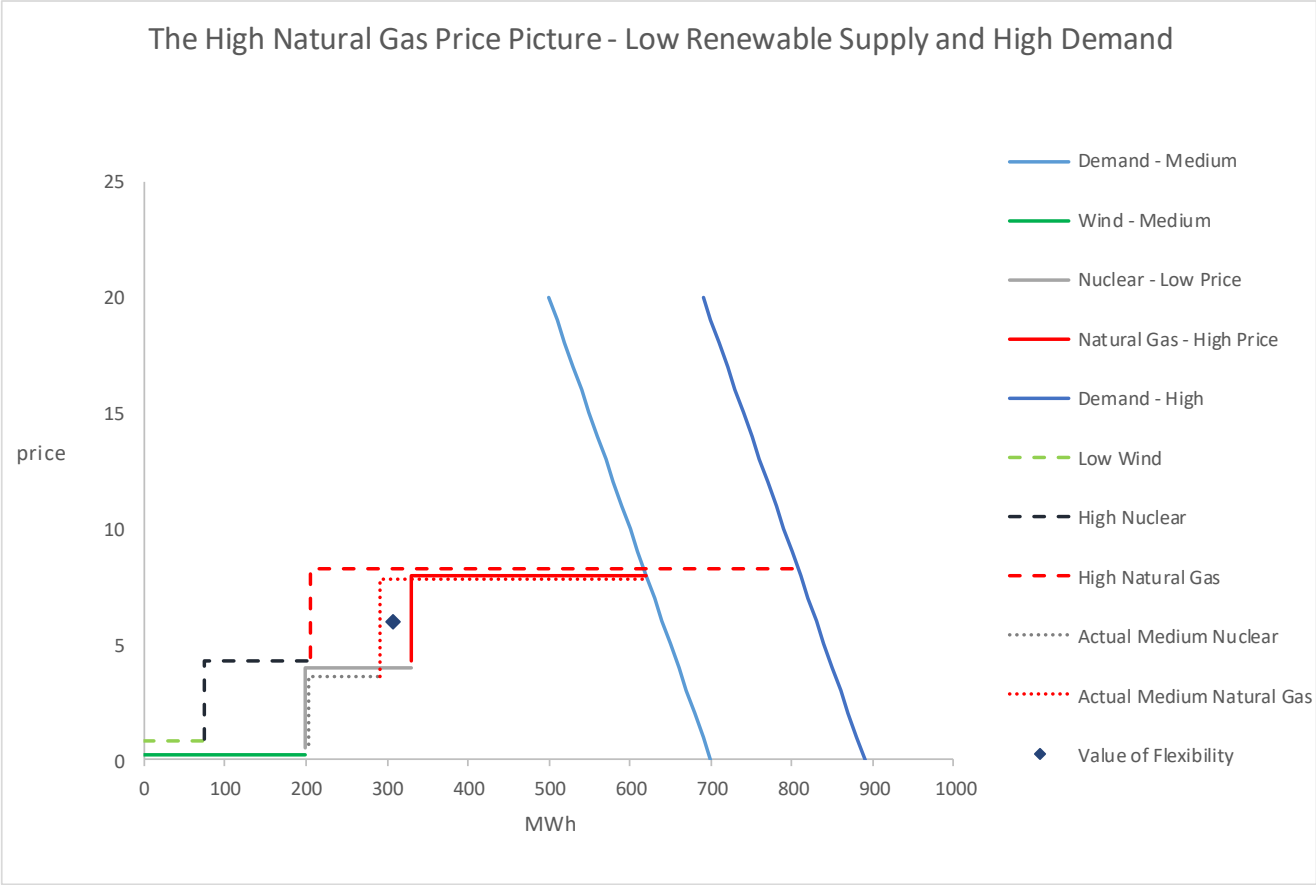
that such a tax is politically infeasible for Maryland.

III. Tier 3

Something similar to the above can be described for Tier 3 Energy Credits. The energy credits are such that nuclear is made less costly than fossil fuels by having the credits. But as above, this is not the problem nuclear really faces.

It is the inflexibility of nuclear that is the problem. For the credits to really have an effect on nuclear supply as a profit-making factor, the credits and the regulations must be such as to allow nuclear to *substitute* for renewable energy in all cases. So the 25% RPS becomes a 25% non-Greenhouse Gas Emissions (NGGE) standard, and purchasers can substitute away from the wind to nuclear energy.

Otherwise, nuclear has to be sold out of state. The problem with this is that when nuclear is sold out of state, sooner or later, Maryland will be faced with the problem of buying something from out of state to compensate for shortages. Let me reproduce one more graph from my article:



Here again, with the same sort of situation, nuclear is left holding the bag in a situation of high demand. Nuclear makes profits, yes. But because, say, Pennsylvania or West Virginia know Maryland won't buy *their* renewable energy in a case of high Maryland demand, when they have excess supply, they have an incentive not to buy Maryland excess when it occurs. After all, how do they make up the difference? So even if Maryland has Tier 3 for nuclear, they will sell natural gas to Maryland, because they can cut back and not have to make unfair deals when Maryland is a seller. That sale of imported natural gas, relative to Maryland selling nuclear, is what is represented by the dashed lines for the high demand vs. the solid lines for low demand in the graph above. Once again, for Maryland to avoid this, it has to make deals either to make nuclear a complete substitute for renewable energy in-state, or it has to pay the out-of-state purchasers enough to compensate for the flexibility *they* give up.

IV. A Guaranteed Purchase Requirement and a Suggestion

This leaves a guaranteed purchase requirement, one that basically allows nuclear to substitute one for one with renewable energy, as the only feasible policy that will protect Exelon's financial interest.

Whether such a purchase requirement is politically feasible ("It's all about jobs!") is not for me to say. But I do think that this, as usually considered, is a reactionary strategy in the sense that it is trying to maintain something against

forces which are fighting against it. It will be a very expensive proposition for Maryland consumers in any case, even if it succeeds.

Rather than just trying to maintain what exists, it would be reasonable to at least examine the possibility that Calvert Cliffs could be made to ramp up and down. The costs would probably be more, but it is a conceivable bet that the effort to innovate at Calvert Cliffs would be an easier sell politically than just trying to maintain position.

Nuclear power plants in the U.S, have not been designed for *ramping*, following load up and down. This is described very clearly by Peter Maloney, "How market forces are pushing utilities to operate nuclear plants more flexibly", by Utility Dive, hereafter "UD Nuclear" at

http://www.utilitydive.com/news/how-market-forces-are-pushing-utilities-to-operate-nuclear-plants-more-flex/427496/

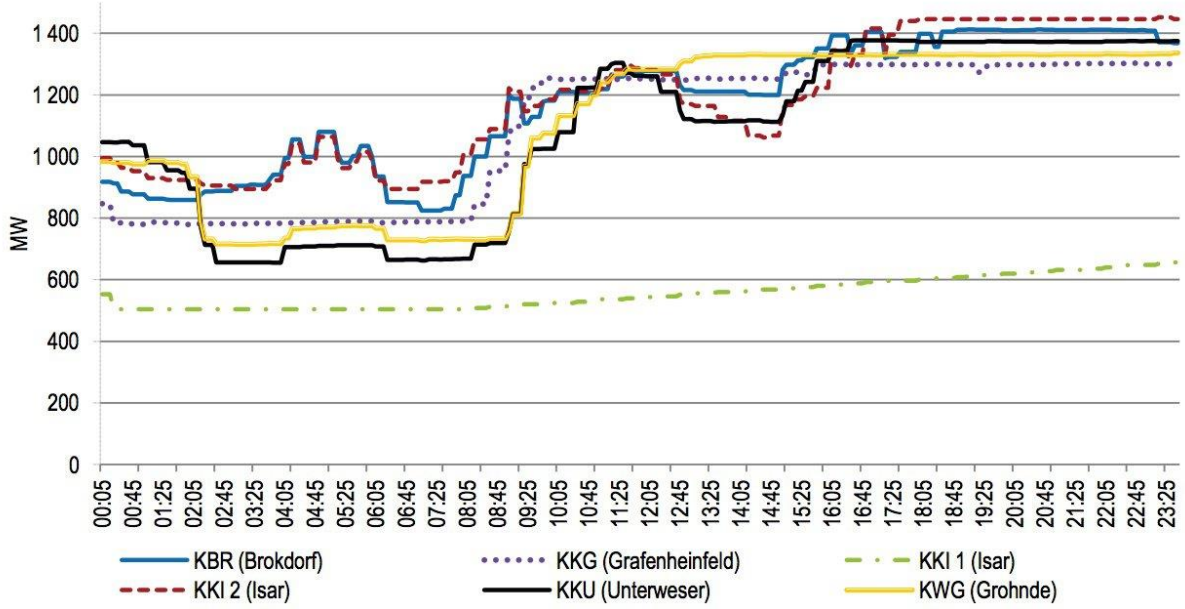
This may not work, and a skeptical view is Laurent Pouret and William J. Nuttall, (2015), "Can Nuclear Power Be Flexible?", at

http://www.templar.co.uk/downloads/0203_Pouret_Nuttall.pdf

But it would cut down on the problems nuclear has.

Germany has achieved some flexibility with nuclear power. It is displayed in the figure below (from UD Nuclear). As a practical matter, even the KKU (Unterweser) facility, which seems to be achieving about a 30% cut in output over the course of 2 hours (from 00:45 to 02:45), still might not be sufficient for ramping with the amount of renewable energy being discussed for Maryland.

Figure E.2: Example of the electricity generation with some German nuclear power plants.



Courtesy of E.ON Kernkraft

If Maryland can innovate with such nuclear ramping, *and* predictions of wind (and solar) improve enough, this at least has a chance of removing some of the problems Calvert Cliffs faces. Helping save jobs of people who don't live nearby, even if they are in-state, may not be an attractive option to the Maryland taxpayers, but a gamble, with some possibility of a positive payoff, may be.