Appendix A: Biographical Information for Ashley Brown

Ashley Brown is an attorney. He served 10 years as a Commissioner of the Public Utilities Commission of Ohio (1983-1993), where he was appointed and re-appointed by Governor Richard Celeste. He also served as a member of the National Association of Regulatory Utility Commissioners (NARUC) Executive Committee and served three years as Chair of the NARUC Committee on Electricity. He was a member of the Advisory Board of the Electric Power Research Institute. He was also appointed by the U.S. Environmental Protection Agency as a member of the Advisory Committee on Implementation of the Clean Air Act Amendments of 1990. He is also a past member of the Boards of Directors of the National Regulatory Research Institute and the Center for Clean Air Policy. He has served on the Boards of Oglethorpe Power Corporation, Entegra Power Group, and e-Curve, and as Chair of the Municipal Light Advisory Board in Belmont, MA. He serves on the Editorial Advisory Board of the *Electricity Journal*.

Ashley Brown has been at Harvard continuously since 1993. He has also taught in training programs for regulators at Michigan State University, University of Florida, and New Mexico State University (the three NARUC sanctioned training programs for regulators), as well as at Harvard, the European Union's Florence School of Regulation, Association of Brazilian Regulators, and a number of other universities throughout the world. He has advised the World Bank, Asian Development Bank, and the Inter-American Development Bank on energy regulation, and has advised governments and regulators in more than 25 countries around the world, including Brazil, Argentina, Chile, South Africa, Costa Rica, Zambia, Ghana, Tanzania, Namibia, Equatorial Guinea, Liberia, Mozambique, Hungary, Ukraine, Russia, India, Bangladesh, Saudi Arabia, Indonesia, and The Philippines. He has written numerous journal articles and chapters in books on electricity markets and regulation, and he is the co-author of the World Bank's *Handbook for Evaluating Infrastructure Regulation.*

He holds a B.S. from Bowling Green State University, an M.A. from the University of Cincinnati, and a J.D. from the University of Dayton. He has also completed all work, except for the dissertation, on a Ph.D. from New York University.

The Electricity Journal 29 (2016) 27–30

Contents lists available at ScienceDirect

The Electricity Journal

journal homepage: www.elsevier.com/locate/electr

The value of solar writ large: A modest proposal for applying 'value of solar' analysis and principles to the entire electricity market

ARTICLE INFO

Article history:
Available online 18 November 2016

ABSTRACT

The essay sets out what electric markets might look like if the pricing proposed in value of solar studies were adopted for every resource.

Distributed solar generation corporate interests and their supporters are now producing, or calling for, reports assessing the "value of solar" and calling for pricing that is reflective not of costs or market circumstances, but rather of the "value(s)" claimed.[1] Such an approach, of course, runs contrary to a long history of disciplining electricity prices by either competition in the market, or, as has frequently been the case, where market failure occurs, by cost-based regulation. Until now, the only deviation from that history was in the late 1970s and early 1980s, when some states, in calculating "avoided costs" in the implementation of The Public Utilities Regulatory Practices Act (PURPA), applied exaggerated and creative theories of value to justify calculations that often inflated, but in other cases deflated, the calculations. That deviation was largely concluded when a number of states' calculations of "avoided costs" so distorted pricing that they caused adverse consequences for consumers, for the market, and for investors, problems that were finally corrected by the federal preemption mandating the deployment of competitive market mechanisms to restore efficient pricing. It also resulted in consumers being burdened with huge stranded asset costs, once the market structure was changed.

The proponents of "value" based pricing for rooftop solar implicitly presume that only their preferred resource, distributed solar, and not any other resource, should be compensated in a way that is reflective of their subjective claims about the "value" of their product.[2] In effect, they are suggesting that while competing sources of energy are compensated based on prices derived in the market or from cost based-regulation, rooftop solar should be compensated based upon claims or theories of value. In short, the argument amounts to a claim that, while the prices of all other resources, including other renewables, are subject to external disciplines, rooftop solar should be free of such disciplines and compensated based upon subjective assertions of value that, in theory, might be delivered.

Recently, however, this "value" argument is raising its head for other electricity resources as well—notably, nuclear, which is urging its own claims, based on avoided carbon emissions and fuel diversity. In some regions, even coal is getting into the game, as states try to preserve a coal industry and coal jobs threatened by competition from natural gas.

Setting aside the fact that many of the claimed values are more theoretical than real, often closer to fantasy than fact, and, in some cases, literally impossible, it is a useful exercise, given these trends, to take the logic of "value" pricing and apply it to the industry as a whole. After all, if the logic of prices based on "value" is so compelling, there is no reason to apply it only to one resource, to the exclusion of others. In short, assuming, as advocates of "value" based pricing do, that the disciplines of costs and/or market should not apply to pricing resources, let's contemplate what pricing, without regard to markets or costs, would be like for other resources used in the provision of electric service.

[1] To be fair, although most of the value-of-solar studies are authored by rooftop solar advocates or consultants highly sympathetic to distributed solar interests, not all of the studies are biased in that direction. Indeed, a few of them conclude that solar DG has little, or, in at least one case, has negative, value. Indeed, that diversity of conclusions bears witness to the extraordinary degree of subjectivity and arbitrariness inherent in such studies.

[2] It is not always clear whether advocates of value-of-solar" pricing are pushing for prices set by their claims of value, or are simply trying to claim that retail net metering, a method by which rooftop solar producers are compensated at the full retail rate for the energy they produce, does not constitute a substantial cross subsidy. Regardless of the objective, they are advocating for the use of subjective claims of value to the exclusion of the more rigorous price disciplines of competition or cost-based regulation.

http://dx.doi.org/10.1016/j.tej.2016.10.009
1040-6190/

Indeed, the advocates have given us a list of criteria by which we can ascertain value. These criteria include:

1. Grid management benefits (e.g. dispatch, congestion, line losses, and ancillary services);
2. Grid capacity benefits;
3. Generation benefits (including generating capacity);
4. Carbon and other environmental benefits;
5. Jobs benefits;
6. Fuel and price hedge benefits.

Applying the principles of value pricing to all resources is made much simpler by adhering to the following characteristics found in most, although perhaps not all, of the value of solar studies that have been conducted:

1. System costs, as well as social costs (e.g., job losses associated with higher prices for electricity, socially regressive rate-making), can be largely ignored or substantially diminished so as not to offset the "value" claimed.
2. The fact that many of the values claimed can be obtained, often at lower cost, or on a more cost-effective basis, from other sources, can simply be ignored.
3. The fact that value pricing provides little or no incentive for improving productivity and efficiency can be ignored.
4. Granularity of and precision in analysis (e.g. identifying which generators are actually displaced to accurately ascertain the amount of emissions reduction actually occurring, impact location of assets and times of operation) in assessing delivered value is unnecessary.
5. All values claimed need not be actually delivered, only theoretically possible.
6. Economic analysis of value should be done on a levelized basis over the anticipated life of the asset, and it should be assumed that long term energy and fuel price forecasts are correct, regardless of the fact that history has proven otherwise. It is not necessary to consider the fact that variations that are almost certain to occur during that time frame.
7. Levelized projections of value should be compared with current costs, neglecting any way in which costs may increase over time.
8. For purposes of setting prices for energy produced, it can be assumed that the simple provision of energy is entitled to the same compensation as is paid for the fully delivered price of electricity, without regard to whether the energy source being compensated did anything to actually deliver the energy.
9. The consideration of externalities is subject to the arbitrary inclusion of some and exclusion of others.
10. Distinguishing costs and benefits in terms of which are private and which are socialized is of no consequence and need not be considered.
11. The impact of value prices on competition or cost containment need not be considered.
12. Impact on other goods and services is of no consequence.
13. The impact on the efficient use of electricity need not be considered.
14. The only price discipline, if any, is the retail price of electricity, not the price of the product actually delivered. The fact that a product may not be capable of delivering retail electricity on its own is irrelevant.
15. Tax subsidies and other public assistance (e.g. REC markets) used to financially support particular assets should not be considered as costs that in any way affect the value calculation.
16. The fact that carbon emissions levels may be subject to state regulation (e.g. in RGGI states and in California) cannot be considered as internalizing carbon emissions. Indeed, the perverse economic consequences of superimposing resource preferences on a carbon trading regime are to be fully ignored. Moreover, sweeping generalizations are in order in calculating carbon emission reductions, as opposed to a granular, detailed look at what generation is actually being displaced.
17. The unintended consequences of poor and non-transparent price signals for energy and capacity efficiency and demand inherent in most "value" calculations are not worthy of mention.
18. Hedge premiums should be recognized and paid regardless of how the hedge is priced and without regard to whether or not the hedge is real or phantom. The question of whether the price of competing resources might in fact decline significantly should not be considered.
19. The risks of misallocating capital to less efficient resources, or failing to send price signals that incentivize energy and capacity efficiency should be disregarded.
20. All costs should generally be presumed to be variable, regardless of the fact that some costs are fixed and do not vary with use.
21. Cost causation is largely irrelevant to setting prices.

What follows below is a notional exploration of what the power sector would look like in a market whose prices were determined by subjective notions of "value." The discussion is not exhaustive; indeed, is not intended to be so, but it will serve to illustrate notable features of the application of value based pricing to the power sector writ large.

1. Grid management benefits

"Value of solar" advocates frequently claim additional value for rooftop solar based on its location on the distribution grid, arguing that, to the extent that this power stays at the distribution level, it reduces the amount of energy that must travel over the grid, resulting in less congestion and fewer line losses. This is theoretically possible, but the actual impact of DERs on grid congestion depends on the time, location of assets, and the particulars of energy flow on the grid at any given time.[3]

Just as it is possible (but not inevitable) that DERs can reduce congestion on the grid, so, too, it is possible (but not inevitable) that production from large-scale plants can reduce congestion—depending on where the additional power is added to the grid, it can reduce congestion in other places. All resources, of course, including solar DG, can also increase congestion, but given that most value of solar studies either ignore or discount such possible costs, any consideration of that can simply be disregarded.

Therefore, following the principles discussed above, "value" credit should be awarded to all resources for the potential to reduce grid congestion—large-scale wind, hydro, and solar, thermal, and nuclear plants can all potentially, in the right circumstances, provide grid management benefits and costs, just like rooftop solar, the only difference being that they have little in the way of distribution effects

Furthermore, additional value should be attributed to all kinds

[3] While it is certainly true that distributed resources, including solar, do not access the transmission system, that does not mean that existence of DG resources, *per se*, reduces congestion on the high voltage grid. It is possible that they do, but it is also possible that, for a variety of reasons, they might adversely, albeit perhaps indirectly, increase congestion. That could occur, for example, when less energy demand on a particular distribution node results in less energy being stepped down at the sub-station, or when there is a surge of energy through the sub-station when cloud cover appears over a particular distribution system. Large amounts of DG at a location could exceed demand and put additional power on the grid that is not helpful, as well as creating problems on the distribution system.

of generation involving spinning turbines (coal, gas, hydro, and wind), because of the reliability advantages provided to the grid by the sheer physical inertia of their operation, which helps to maintain grid frequency even in the case of interruptions in plant generation activities. Under current markets, this value is provided along with energy generation at no additional charge; but this would need to change under value pricing.

In organized markets, of course, impacts on the grid resulting from time of production and location of assets are considered in pricing, and compensation for ancillary services is provided upon actual delivery of the service, not upon being theoretically capable of providing the service on some occasions. However, "value" pricing should allow all plants connected to the grid to be unleashed from these constraints and compensated without consideration of time and location.

Additionally, since all of these assets have the theoretical possibility of providing grid enhancement services, actual delivery of such system benefits as ancillary services need not be a requirement for compensation. In the case of rooftop solar, for example, the value of potential provision of frequency regulation by advanced inverters is often attributed to rooftop solar in general, whether or not advanced inverters are actually installed or used. In fact, not only is actual delivery not required for compensation, but factors such as location of assets and time of production, which have a major impact on congestion and dispatch, need not be factored into the compensation, or even payment for use arrangements, since few, if any, value of solar analyses take these factors into consideration. In fact, planning in order to try to optimize grid operations is of little importance, as locational considerations are not relevant to calculating system benefits under the theories advanced in most, if not all, of the value of solar analyses.

2. Grid capacity benefits

In keeping with typical "value of solar" analysis, there should be a very strong presumption that new generation avoids the need for new capacity, even if we are looking at intermittent and/or off peak resources. While transmission capacity avoidance credits might be scaled back a bit to reflect non-baseload characteristics, capacity avoidance is presumed. The lumpiness of large transmission investments and the fact that maximizing scale when obtaining new right of way is highly desirable can simply be ignored. Therefore, it can be presumed that even very small scale investment offsets pieces of large scale investments, almost like "just in time" arrangements, regardless of such logical considerations as economies of scale and optimization of resources over the long run.

Extending value analysis beyond rooftop solar, what would happen if grid investments themselves were compensated by consumers, not based on cost but rather based on "value?" The value of grid investments would include the costs end users were able to avoid by not having to invest in self-generation, batteries, and whatever other resources a customer would have to acquire in order to meet his/her own needs, unconnected to the grid. This theory of avoided cost, of course, is derived from same line of reasoning found in most, if not all, of the value of solar studies, which suggest that intermittent solar should be credited for avoidance of costs related to the provision of reliable, non-intermittent resources. Indeed, taken to its logical conclusion, such reasoning suggests that there is little reason to distinguish between capacity and energy, since intermittent resources should be credited for avoiding the costs of both.[4]

3. Generation benefits

To treat all resources consistently, all generation should also be recognized as having "capacity" value, with no penalty for failure to produce when called upon to do so.

And in keeping with "value of solar" treatment, all resources should be subjected to "levelized" value analysis—the cost of energy should be projected over 20 years, averaged, and then current-year payments should be based on the levelized value identified. All such calculations, of course, are, as noted above, fully reliant on long-term energy price projections. The fact that they are notoriously unreliable need not cause any worries, as most of the value of solar studies do not take such uncertainties into consideration.[5]

4. Carbon and other environmental benefits

Some "value of solar" proponents argue that environmental externalities, particularly carbon emissions, need to be an explicit part of "value" pricing. What is not calculated is how cost-effective rooftop solar is in reducing emissions in comparison to other resources. Large scale solar and wind, which do not receive the benefits of retail net metering, are more cost effective. Nuclear, and to a very real degree, natural gas displacing coal, have great value in reducing emissions. Perhaps energy efficiency has even greater value in doing so. The cost effectiveness consideration, however, has been excluded from "value" pricing schemes being offered up. Thus, to make "value" pricing work system wide, carbon reduction value must explicitly be recognized in pricing each and every resource, without any regard to the relative costs of obtaining those benefits from other sources. In fact, the failure to do so is likely to misallocate capital away from efficient and more toward inefficient resources.

5. Jobs benefits

If job impacts are an externality to be factored into pricing, then it is very important to disregard any secondary job effects, such as those caused by paying higher electric rates in order to calculate the value propositions and remove the price constraints imposed by competition or cost based regulation. While those job losses may be real, they should not be allowed to detract from the value proposition of any given resource. Similarly, no comparisons between the nature of jobs being displaced or those being created is in order. In short, the displacement of high wage union jobs with jobs paying minimum wage or slightly above is a positive jobs gain. If one looks at resources in terms of the jobs preserved or enabled, coal, with its labor intensity and mainly domestic presence, as well as its economic value in extremely poor regions, such as Appalachia, is probably, from a purely jobs point of view, our most valuable resource. If we see value in "green jobs," as advocated by proponents of "value" pricing, then we should recognize the same value for coal.

6. Fuel and price hedge benefits

The fact is that all forms of generation offer hedge value. Coal provides a hedge against volatility in the natural gas markets. Complementarily, of course, natural gas acts as a hedge against coal prices. Renewable and nuclear resources, with their zero, or near zero, marginal costs, provide those who own them with a hedge

[4] These considerations are relevant to generation as well as transmission.

[5] To be fair, at least one value-of solar-study, in Minnesota, does recognize that long-term price forecasts are less than fully reliable, and calls for annual adjustments to reflect market changes.

against all fossil prices. Indeed, the grid itself, with its reach across broad swaths of geography, offers a hedge against locality specific high costs and/or monopoly rents. In fact, the highest hedge value of all is probably energy efficiency, which hedges against buying energy from any source. While, under market-based prices such values are internalized into the prices, value pricing requires that they be explicitly monetized and used to either help determine the price or to justify an above-market price.

Since we are using "value" pricing here, it is important to note that the "value" of each energy resource increases whenever any other energy resource becomes more expensive. If the "value" of coal is determined in part by how much money we don't have to spend on natural gas when we use it, coal's value increases right along with natural gas prices. The beauty of "value" pricing, for its recipients, is that consumers pay for hedging value and they also pay for the increased value of the resource when the price of competing resources goes up. In effect, consumers are paying for a hedge that does not exist, or, in a very real sense, are having to pay hedge prices that exceeded the risk being hedged against.

At this point, the attentive reader will be asking herself how, in a value market, the benchmark value of generation is established. "Value of solar" analyses peg the value of avoided generation to the cost of the marginal resource avoided by the use of rooftop solar power. But if all resources are being compensated at "value," how can the baseline value of generation be established?

Consumers can serve as the standard of value here. What is the value of electricity service to consumers? Another way to ask this is, how much can we charge consumers before they decide they would rather not have electricity service, or would rather provide this service for themselves? This is the value of electricity service—a price which would normally only be available under monopoly conditions. Taken to its logical conclusion, "value analysis" replaces competition and cost-based regulation with theoretical, highly subjective notions of "value," derived from highly speculative, largely undisciplined assertions which, used as a standard for pricing, would impose maximum costs on consumers. Is this really a road we want to walk down?

Ashley Brown is Executive Director of the Harvard Electricity Policy Group (HEPG) and a former Commissioner of the Public Utilities Commission of Ohio and former Chair of the National Association of Regulatory Commissioners Electricity Committee. The views expressed in this article are his alone, and not representative of the views of HEPG or Harvard University.

Ashley Brown is Executive Director of the Harvard Electricity Policy Group (HEPG) and a former Commissioner of the Public Utilities Commission of Ohio and former Chair of the National Association of Regulatory Commissioners Electricity Committee. The views expressed in this article are his alone, and not representative of the views of HEPG or Harvard University.

Ashley C. Brown (Executive Director)
Harvard Electricity Policy Group (HEPG), United StatesE-mail address: ashley_brown@harvard.edu (A. Brown).

Available online 18 November 2016