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The Life and Death of the Utility Death Spiral

The so-called death spiral is not necessarily a result of disruptive competition from resources at the customer side of the meter, but from the inherent design of rate structures. This article highlights the value of the grid as a call option for consumers and suggests rate design as a cure.

Frank A. Felder and Rasika Athawale

> *Reports of my death have been greatly exaggerated!*
>
> – Mark Twain

The ''utility death spiral'' has gained widespread media attention since the phrase was used recently by *The Wall Street Journal*.[1] It occurs when additional distributed generation (DG) makes the grid more expensive for remaining consumers, and in the process makes self-generation further economically attractive. For this and related reasons, utilities have been compared to dinosaurs,[2] labeled as ''shockingly stupid,''[3] and considered too reactive in the wave of disruptive challenges sweeping them.[4] As a solution to mitigate this existential crisis, many have called for a change in the utility business model.

The death spiral is not, however, a product of shortsighted utility management or disruptive competition. Instead, it is due to rate design. Since much of the transmission and distribution of fixed costs is recovered via volumetric charges, cost recovery is threatened if there is a major decrease in volume of sales (and over-recovery of costs may occur if volumes increase). In an environment of nearly flat load growth combined with a substantial set of well-intentioned subsidies (including net metering,

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tax credits, and renewable portfolio standards to promote cleaner energy sources such as solar and other distributed generation that are on the customer side of meter), the current volumetric-based rate design will not sustain cost recovery for transmission and distribution owners. If the grid did not provide value, then its replacement with self-sufficient distributed generation would not be an issue. But the grid continues to provide value both to DG and non-DG customers alike because it is not cost-effective today or in the near future to completely bypass it. Without a grid, DG requires the ability to store electricity and balance each customer's supply and demand individually, which is more expensive. Until that changes, customers with DG rely upon the grid for necessary and valuable services at a lower cost than without the grid.

Subsidies in the electric power industry are well established; all generation sources have received subsidies.[5] Moreover, since the environmental costs of many sources of generation, in particular fossil fuels, are not internalized in their market prices, these conventional technologies have a cost advantage over non-emitting sources of power, such as solar and wind. Policymakers, not surprisingly, often use subsidies to provide incentives for new technologies because it is easier to give than to take away. It is more politically difficult to explicitly raise the cost of energy via a carbon tax or a cap-and-trade regime, or by removing fossil fuel and nuclear subsidies. If policymakers continue to rely upon subsidies as a major source of funding cleaner technologies in order to achieve a meaningful change in the electric power industry, then the unintended consequences of those subsidies need to be addressed. The utility death spiral due to DG is one important example.[6]

If the grid did not provide value, then its replacement with self-sufficient distributed generation would not be an issue.

I. The Utility Death Spiral Disease

The ''death spiral'' fear is not new. After the oil embargo in 1973, the industry faced reduced electricity demand and increased operating and capital costs, and use of the term death spiral appeared. More than a decade later, at the 51st Annual Meeting of the Midwest Economics Association on March 26, 1987, Hemphill and Costello argued that the utility death spiral was overstated.[7] They concluded:

> It is shown that the occurrence of a death spiral is based on unrealistic conditions about the response of a utility's customers to higher rates, the incentives of and constraints facing regulators regarding pricing and permitting a utility to experience permanent financial distress, and the intense actions of a utility's management to avoid financial disaster.

Increased installation of customer-sited DG, more emphasis on implementing energy efficiency measures (including policy targets for net zero-energy buildings[8]), and the declining to flat load growth experienced in the recent past (with an expectation of growth remaining near flat in the short- to medium-term future) have all led to reduced energy sales (kWh) by utilities. According to the EIA *Annual Energy Outlook 2013*, DG in the buildings sector is expected to increase from around 5 GW in 2013 to about 30 GW by 2040.[9] Solar constitutes a large portion of this capacity (approximately 3 GW), although this represents a very small share of total electric installed capacity in the United States. According to a report published by the National Regulatory Research Institute,[10] 31 states have less than 0.1 percent residential solar PV net metering customers, and only 4 states (Colorado, Delaware, Hawaii, and New Jersey) report more than 0.25 percent commercial solar PV net metering customers. Newer uses of electricity such as information technology, including data centers and

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consumer devices, and electric vehicles, however, may offset in part or in whole the effect of DG.

Nonetheless, this increase in DG capacity has been claimed to present an ''existential threat'' to the business model of regulated utilities.[11] Within the current tariff structures, any drop in utility sales further increases the tariff, especially for higher-usage consumers, thereby increasing the economic viability of DG. A report by the Edison Electric Institute concludes that the tariff for utility customers could increase by 20 percent for every 10 percent reduction in load served by the utility.[12]

In fact, some states that have net metering policies recognize it would not be economically or politically feasible to have unlimited net metering. For instance, in the state of Massachusetts, out of the total net metering cap of 665,808 kW (together for private and public establishments), the remaining available capacity for private establishments is 106,533 kW while the remaining available for public establishments is only 13,117 kW.[13] What policy the state should adopt once complete net metering cap is achieved has become a political point of debate. A bill proposed by one set of politicians calls for lifting a cap completely until year 2016. Another set of politicians proposed a bill that would impose a fee on net metering consumers and entrusts utilities with the responsibility to choose contractors through competitive bidding for building solar PV projects greater than 500 kW.[14] Some other states (such as Georgia, Kansas, South Carolina, and Virginia) have restricted the use of net metering to only certain types of DG technologies and for projects within a specified capacity limit. So the issue is not whether utilities can continue with existing rate design and net metering policies as DG increases – regulators have recognized that they cannot – but how to continue to increase the amount of socially beneficial DG without shifting the large fixed costs of the transmission and distribution system onto a smaller and smaller percentage of electricity customers.

Some states that have net metering policies recognize it would not be economically or politically feasible to have unlimited net metering.

Not everyone agrees with this line of thought that most customers eventually will reduce or even eliminate their reliance on the grid to fulfill their electricity requirements, arguing that such a move would require widespread technical feasibility of self-generation using solar or other renewable sources of energy.[15] Additional studies have demonstrated that since DG customers use the distribution network for consumption as well as production, they rely on the grid more than non-DG customers.[16] Furthermore, achieving complete independence from the grid is still expensive given the limitations of technology and may not prove economical, as pointed out by the National Renewable Energy Laboratory (NREL):[17]

> Achieving a ZEB [zero emission building] without the grid would be very difficult, as the current generation of storage technologies is limited. Despite the electric energy independence of off-grid buildings, they usually rely on outside energy sources such as propane (and other fuels) for cooking, space heating, water heating, and backup generators. Off-grid buildings cannot feed their excess energy production back onto the grid to offset other energy uses. As a result, the energy production from renewable resources must be oversized. In many cases (especially during the summer), excess generated energy cannot be used.

Increased utility investment in creating reliable and resilient infrastructure further strengthens the role of the grid as a fallback option in case of emergencies (both natural such as extreme weather events and/or man-made such as cyber attacks).[18] When the grid is unavailable, unless DG has the capability to operate in island mode so that it does not threaten the safety of utility repair crews, it is not permitted to generate power. Thus, additional investments in reliability and resiliency could further the death spiral without

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leveraging the ability of DG to provide power during grid outages. In fact, the per unit cost of transmission and distribution is expected to increase, even with minimum additions of DG, as a result of utilities' investments in rebuilding legacy infrastructure.

Still, some have tried to bring to the attention of regulators the fact that distributed generation is not always beneficial, and therefore tariff principles governing DG need a fresh look.[19] The current rate structure does not provide the most efficient combination of fixed and variable costs of network and commodity usage, thus opening up the possibility for a revised structure to charge customers for what they use in a more economically rational fashion.[20]

II. The Rate Design Cure

The existing utility business model is based on centralized generation followed by one-way transmission and distribution, compensated via volumetric rates. The total costs incurred by the utility in installing and maintaining the grid, as well as supplying electricity (which includes commodity costs), is primarily converted in a per unit ($/kWh) charge or rate.[21] Every kWh of increased or reduced sales differing from the projection creates a mismatch between the utility's costs and expected revenues. During times of growth, utilities prefer volumetric charges since they would over-recover their fixed charges due to increasing sales. The opposite is the case when growth is threatened or declining.

Volumetric charges provide the erroneous perception that the only time a consumer uses the grid is when drawing power from the grid. In fact, for all connected customers, including ones with DG, the grid provides the customer the call option to use the grid at any time and at any amount up to the grid's technical limitations. This call option has value even if the customer is not actually consuming electricity, which is almost never the case, because at a flick of a switch the consumer can increase or decrease consumption. For customers with DG, just because the electric meter records fewer billable kilowatt-hours because it spins backwards does not mean that the DG facility is using the grid less overall. It is using the grid to export excess power at times and to import power at other times.

This difference between revenues and costs is further exaggerated as a result of clean energy policy drivers (such as net metering), which compensate the consumer for self-generation at the retail rate while ignoring the fact that the utility could have sourced the same alternative energy at a cheaper rate from the wholesale market. Severin Borenstein explains this with an analogy: imagine that supermarkets might be forced to buy zucchini from customers now in return for supplying them zucchini in the future.[22] That being said, for consumers net metering is simple and easy to understand.[23] Regulators in some states (such as California, Connecticut, Massachusetts, and New Jersey) have even allowed virtual net metering, which permits consumers to bring together any number of non-contiguous sites. In effect, these consumers do not adequately pay their share of charges for usage of the grid even though they rely on the grid to export their excess power, provide supplemental power, and complete their power requirements for any period of time when the DG is not in operation due to scheduled or unscheduled outages.

A simple example illustrates the rate implications as a larger and larger percentage of users of the grid do not pay for

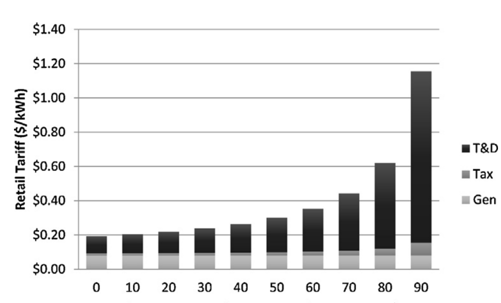

Figure 1: Impact on Rates ($/kWh) as the Percentage of Customers that Do Not Pay Transmission and Distribution Rates Increase

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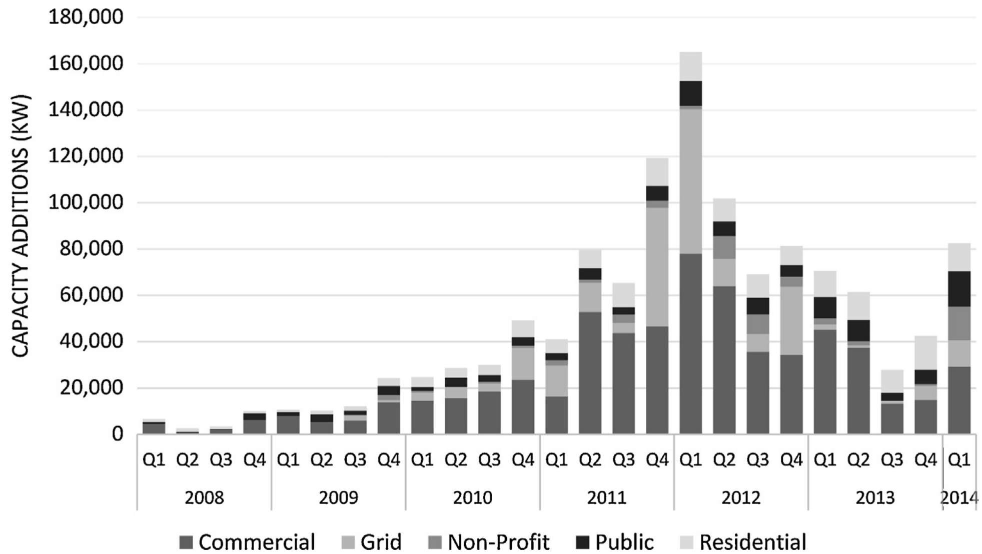

Figure 2: New Jersey Quarterly Capacity Additions in kW by Customer Type (2008 – Q1 2014)

the costs of transmission and distribution (T&D). As shown in **Figure 1**, when everyone using the transmission and distribution grid pays their share, electricity rates are $0.20/kWh; as that percentage decreases, rates increase substantially as costs from DG customers are shifted to non-DG customers.[24,25]

The death spiral also has implications for state and local governments that collect utility taxes and other fees such as societal benefit charges. Either these revenues decrease with volume or governments will have to collect more from fewer consumers. Further, if a higher-usage (kWh) consumer installs DG (and therefore does not pay for the grid), it causes even more stress on the remaining consumers. As indicated in **Figure 2**,[26] evidence from the state of New Jersey suggests that the installed solar capacity added by commercial consumers has far exceeded that by residential consumers. This would result in a transfer of costs from commercial consumers to residential ones.

Net metering may also be regressive and undercut the efficacy of other grid investments such as smart meters and energy storage.[27] If it is the case that lower-income electricity customers are less likely than higher-income customers to have solar panels on their dwellings, then they are less likely to avail themselves of the benefits of net metering and are more likely paying for the associated costs. Dastrup et al. (2011) found that in a large sample of homes in California (San Diego and Sacramento) the median income for neighborhoods with at least one solar panel system was about 84 percent higher than the median income for neighborhoods with no solar.[28] Another study for California done by Energy and Environmental Economics, Inc., found that the average median household income for customers installing net energy metering systems was $91,210, compared to the $67,821 median income for the census area served by the three largest investor-owned utilities.[29] With net metering, the incentive to use smart meters and energy storage decreases because there would be no need to keep track of hourly consumption or store electricity in response to changing system conditions.

A well-known solution that corrects this abnormality in rate design is to separate fixed costs (e.g. network costs or demand costs) and variable costs (e.g. commodity costs or energy costs) and charge them to consumers based on their usage of the grid and consumption of electricity. This mechanism can differentiate and reward such DG that generates power during utility system peak and might relieve grid congestion and avoid or postpone transmission and distribution investments. A separate fixed component recognizes the fact that the transmission and distribution

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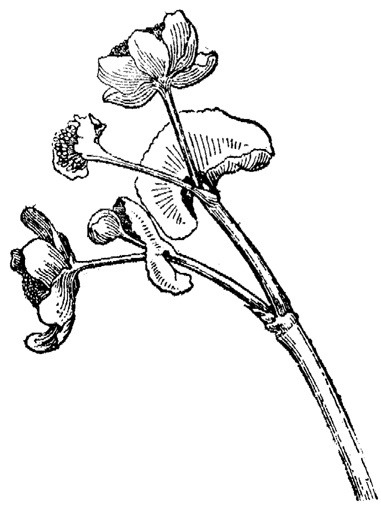
system is providing a service to DG because at any moment, the grid can export excess power from the DG or provide power to the DG host facility.[30]

One concern with such straight-fixed variable (SFV) rate design is that it may result in cost shifting from customers with above average consumption to small customers with below average consumption, and therefore results in some losers and some winners.[31] This may be contrary to ratemaking objectives of regulators, who consider equity and low-income assistance as part of their mandate. A solution to this is to only have a SFV rate for customers with DG; all other customers would continue under their current rate structure.[32] Of course, a SFV approach would eliminate the net metering subsidy, so an additional revenue stream would be needed if policymakers wanted to continue to subsidize DG at existing levels.

The death spiral is not due to disruptive competition, despite some claims.[33] Take, for example, solar panels and their rapid decrease in prices. Solar panels compete with the generation of electricity, but without storage and balancing capability it is a complement, not a competitor, to transmission and distribution facilities. While consumers may be installing solar panels, they are not disconnecting from the grid, which they need to be able to enjoy the electricity services at the level to which they are accustomed. DG also may simultaneously compete with transmission and distribution facilities when DG customers avoid or postpone transmission and distribution upgrades.

No business can survive regulatory mandates that require it to serve consumers by investing large amounts in sunk assets and



not being able to charge fees to recover its costs. Discussions about utilities changing business models, focusing on value instead of costs, or other such hand waving is not going to change the fact that under the current rate design and subsidies, utilities must provide services to DG customers and not only are not allowed to charge them for those services but must subsidize those services. If automobile companies had to pay the equivalent of taxi rental fees when purchasers of their cars were not driving them, or if home mortgage lenders had to pay the equivalent of hotel rates to homeowners were they were out of town, neither of these industries would survive.

It may be the case that policymakers and consumers do not want SFV rate designs. The proposal presented here suggests that only those with DG would have SFV rate designs, in order to avoid revamping everyone's rates. Of course, those expecting a large subsidy when implementing DG due to the existing volumetric rate design will be disappointed, but such disappointment is inevitable because the current rate design cannot economically or politically support a large cross subsidy from non-DG customers to DG customers.

III. Life after Death

Meanwhile, utilities are trying different measures to stop (and undo) pressure from customer-sited DG and other threats to utility revenue. In some states (e.g. Arizona[34] and Colorado[35]) utilities have proposed to levy a fee on residential solar consumers and are debating the criteria to determine which DG consumers should be paid at wholesale rates and which ones at retail rates. Some regulators have agreed with utilities' arguments against the payment policy for net metering consumers. Last year, the California Public Utilities Commission (CPUC) completed a cost-benefit analysis to determine the share of benefits from rooftop solar to the grid and consumers.[36] Observations from this study will be used by CPUC to make changes to the policy governing net metering and

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overall rate design. The end result might be even less favorable to the utilities, particularly if the regulator assigns values to future environmental benefits from DG and thereby allows for net metering compensation to DG consumers at more than the existing retail price. There is also a possibility that the whole death spiral issue will die down in the future as a result of achieving the full potential allowed under net metering caps.

As another strategy to minimize risk of revenue loss, some utilities have increased their investments in creating new solar capacity and in building solar-service business verticals. The Virginia-based Dominion is following a strategy deployed by British Gas in the UK, where the utility leases roof space from commercial consumers to install solar panels on their behalf. Some utilities have outright purchased solar installation companies, such as Duke Energy's investments in Clean Power Finance,[37] and the purchase of Smart Energy Capital by NextEra Energy Resources.[38] The challenge here is to create a level playing field between utility-owned and managed DG service companies on one hand, and on the other their competitors who do not necessarily have access to utility meter and consumer data and who might not get the same amount of consumer trust for handling on-site electric installations (which the utility-backed company may easily receive due to being known to the consumer).

Clearly, there are two interconnected issues. First is the near-term fear of the death spiral occurring as a result of conventional rate design. Second is the long-term disruptive competition to traditional utility structure from customer-sited DG, including microgrids. These issues lead to an important question to ponder: distributed generation can partially substitute for the purchase of electricity from the grid, but is there a complete substitute for the grid itself? Regardless of one's view on this debate, the guiding analytical light is what is the best outcome for society overall as opposed to any individual interests.■

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