Solar Analytics and Procurement

Placing a Value on Distributed Solar Generation

August, 2013

Key Points:

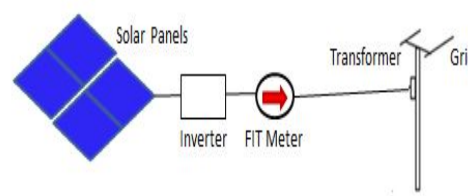
- **When it comes to distributed generation, your utility is also your business partner**
- **Feed in Tariffs contribute electricity to the grid, but it's difficult to get the price right**
- **Net Energy Metering lets you use onsite generation, but system-wide impacts are unclear**
- **Austin Energy introduces a new hybrid approach: the Value of Solar Tariff**

Modern-day electric power grids were designed to move power - safely and reliably - from large, central generators to individual customers, via the transmission (high voltage) and distribution (lower voltage) systems. The notion of distributed generation ("DG") turns this model on its head, requiring the grid to accept and transport power fed from small disparate systems, typically connected to the distribution grid (e.g. from solar panels installed on your rooftop).

Some proponents of DG point to the inefficiencies of generating power far from where it is needed. According to EIA data, national, annual electricity transmission and distribution (T&D) losses average about 7% of the electricity that is transmitted in the United States. Opponents often raise the concern that the distribution level grid is not designed to take in generated power from local sources and utilities must be careful in allowing interconnections. The DG paradigm shift has numerous implications in terms of system design, safety, and operational stability; this paper will primarily focus on the economic implications.

In much of the world Electric Utilities operate as regulated monopolies. The practical implication of this model is that local utility regulations will generally determine whether you can generate your own power and, if so, to whom you can sell it and for how much. Even if your only goal is to produce power for your own use, there are significant advantages to being interconnected to the grid. This is especially true for renewable energy sources, where there is often some degree of mis-match between when you use power and when it's being generated by your system. Therefore, until the cost of electricity storage drops to where it is an economically feasible means of shifting your source to meet your demand as needed, your local utility is going to be a key business partner in your distributed generation project.

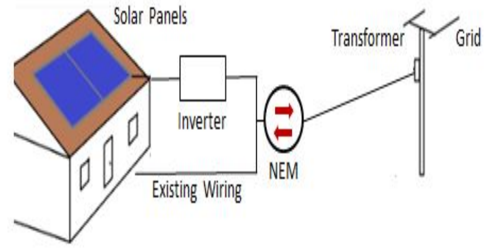
There are two prevalent models for connecting distributed generation systems to the grid. The first is a Feed-in Tariff (FIT), which generally involves selling the entire output of the distributed generation system to the local utility at a (sometimes incentivized) set rate via a long-term contract. Notice that electricity only flows in one direction (to the grid) and that the meter is not directly associated with any onsite electricity usage.



Feed-in-Tariff Meter Connection

"FITs are even starting to make a comeback in the U.S., having been recently re-branded as CLEAN (Clean Local Energy Accessible Now) programs"

The second model is Net Energy Metering (NEM), whereby electricity flows to the grid whenever onsite generation exceeds onsite consumption and electricity flows from the grid whenever onsite consumption exceeds onsite generation. This essentially allows the customer to use the grid as a battery and a back-up (or incremental) power source, to the extent that the onsite generation system does not meet all the customer's electricity needs. Customers typically get credit for electricity produced at their retail rate (per kWh), off-setting their usage, and end up paying only for the "net" electricity consumed. Notice that there is a single meter that flows in both directions, recording both the energy produced and the energy consumed at a given location.



Net Energy Metering Connection

Feed in Tariffs

The first FIT was developed in the United States by the passage of the Public Utility Regulatory Policy Act (PURPA) in 1978, which required utilities to purchase electricity "fed into" the grid from renewable energy systems (so-called "qualifying facilities") at their "avoided cost" rates. In fact, most utilities still have this authority, but complex power regulations in the U.S. and confusion about the definition of "avoided costs" hampers interest in such programs. PURPA was also seen by some utilities as a threat to their monopoly, by encouraging non-utility generation.

Ironically, the FIT concept has become the dominant paradigm for incentivizing distributed generation outside the U.S., even as its popularity within the U.S. waned. FIT programs have been implemented in 23 European countries and more than 60 places worldwide. Germany has perhaps the most well-known program, with total installed solar capacity to date exceeding 32 gigawatts (GW). Japan's aggressive program designed to promote renewable energy sources in the wake of the Fukushima nuclear meltdown has also received a lot of media attention and created a PV solar boom in the region. Meanwhile, FIT programs are being scaled back in places such as Ontario, Spain and the U.K., even as new programs are being developed or expanded in places such as China, Turkey, and Thailand. FITs are even starting to make a comeback in the U.S., having been recently re-branded as CLEAN (Clean Local Energy Accessible Now) programs, or alternatively called standard offer programs or renewable energy production incentives. The disparate nature of local and regional power grids in the U.S. and the non-cohesive regulatory framework renders development of a national program infeasible; instead we see a growing variety of state, utility, and municipal FITs.

FIT programs generally consist of guaranteed access to the grid, long-term contracts with a utility for the electricity produced, and purchase prices that are fixed for individual contracts (purchase prices may decline for new contracts as adoption rates increase). The concept is attractive in its simplicity

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and because customer behavior does not change, since they continue to use and pay for their electricity consumption needs as before, while the participating utility effectually adds renewable power to their generation mix. The FIT rate itself and how program costs will be passed through to ratepayers and/or taxpayers are the main areas of potential controversy. These debates are not trivial, since establishing the "correct" rate and capacity for a FIT program requires consideration of numerous factors including power system design, age and condition, prevailing electricity prices, the mix of other available generation sources, and current installation prices for renewable generation. If the rate is set too high, it can create winners and losers in terms of who pays for and who benefits from the program, as well as set the stage for boom and bust cycles that create challenges for a developing industry. If the rate is set too low, the goal of facilitating adoption of renewable energy may not be met, as the low economic returns of DG projects will drive away potential program participants. History is rife with examples of the difficulty of setting up a sustainable FIT program; especially for solar, as installation costs have significantly declined in recent years.

Net Energy Metering

In lieu of widespread adoption of FIT programs, Net Energy Metering (NEM) programs have become the backbone of distributed electricity generation policy in the U.S. The Energy Policy Act of 2005 required regulated utilities (excluding most municipalities and electric cooperatives) to offer net metering to their customers. Currently, 43 states and Washington DC allow for some form of net metering. Policies vary state-by-state in terms of system size limit, total program capacity, accrual and payment of net excess generation credits, and whether credits from one account can be applied to charges on another account (so-called "virtual net metering"). Most NEM laws involve monthly rollover of kilowatt-hour (kWh) credits (similar to mobile phone rollover minutes), a small monthly connection fee, monthly payment of deficits, and an annual settlement of any residual credit (often at prevailing wholesale, not retail rates). Since most modern generation electricity meters can accurately record flows in both directions, NEM can be implemented solely as an accounting procedure without requiring any special equipment. While conceptually more complicated than a FIT, it is administratively much simpler.

As with FITs, utilities are concerned about NEM programs encroaching on their monopoly status and ratepayers are concerned about who will bear the "costs" of such programs. The typical argument against NEM is that solar customers are being subsidized by non-solar customers, because the NEM arrangement doesn't adequately cover utilities' costs to manage and maintain the grid, which the solar customers still benefit from (i.e. when the sun is not shining). Advocates cite a wide variety of benefits (discussed below) and claim that NEM is a convenient and inexpensive way of providing due compensation to generation owners. The debate over NEM is becoming increasingly contentious, as participation in some utility districts approaches the established program caps, and decisions must be made about the future of such programs. Some studies conclude that NEM provides a significant net benefit to ratepayers, while others contend that the costs outweigh the benefits. The assumptions and methodologies for quantifying the economic impacts of NEM vary significantly. However, most studies consider – at a minimum - the following set of factors

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Costs & Benefits of Net Energy Metering

Benefits to the Utility:

- Avoided Energy Costs/Purchases
- Avoided Capacity Costs/Purchases
- Lower T&D Line Losses
- Reduced Investments and O&M Costs for T&D facilities
- Environmental Benefits / Avoided RPS Purchases

Costs to the Utility:

- Lost retail rate revenues / NEM Bill Credits
- Program Administration Costs
- Integration Costs

While a rigorous quantitative evaluation of NEM is beyond the scope of this paper, a qualitative discussion highlights some of the salient points.

Utilities benefit from NEM because excess solar energy is most likely to be fed to the grid during times of peak system-wide demand, when electricity prices are highest. This not only means less energy that the utility has to provide, but may also mitigate the need to utilize or build expensive "peaker" plants that typically run only on the hours or days when system-wide demand is highest. The presence of generation at the source of consumption not only avoids T&D losses, but may - in some cases - forestall the need for grid upgrades by the utility. Encouraging customers to own renewable generation can help utilities meet their Renewable Portfolio Standard (RPS) or avoid the costs (penalties) of not meeting it. Participation in voluntary green power purchase programs, hosted by some utilities, demonstrates that consumers are willing to pay more for renewable energy, indicating that it has greater value than non-renewable energy. Distributed generation may also provide a degree of system reliability by diversifying the location and source of generation resources.

When considering costs, it is important to note that in many states, the allowable size of NEM projects is limited to the capacity required to meet onsite electricity demand. This results in little - if any - net excess generation. Furthermore, customers utilizing NEM typically still pay certain fixed fees (such as customer/account charges). Commercial/industrial customers, in particular, often still pay demand charges as well. Utilities may incur additional administrative costs from NEM, since enterprise software systems are often incompatible with processing such a billing arrangement. This particular cost impact may be non-linear in such a way that it poses additional expense at first, but once it becomes business as usual the cost per customer is minimal. There may be cost impacts that show the opposite trend, such as "system integration" issues that need to be addressed with intermittent

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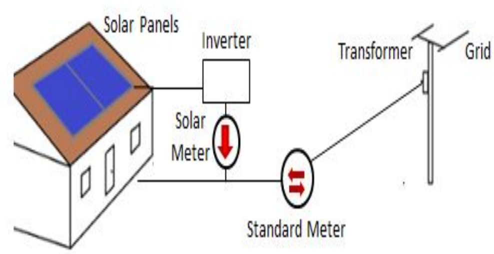
resources, but only when relatively high penetration rates are reached. In addition to penetration rates, an accurate assessment of the integration costs depends on the design and condition of the current infrastructure, as well as the location and characteristics of other generation resources available on the system.

At the heart of the issue lies the fact that, as regulated monopolies, utility rate structures are not based on cost of service. Unlike most businesses, where volume discounts often apply the more of a product you sell, utilities earn an allowable "rate of return" on assets, with their earnings "decoupled" from power sales. This has been done, with good reason, to remove incentives for excessive and irresponsible power consumption. Unfortunately, tying the value of distributed solar generation to retail electricity rates via NEM really muddies the waters. Without valuing solar energy correctly, it is impossible to quantify the true system-wide costs and benefits.

Value of Solar Rate

Austin Energy, a municipal utility serving the city of Austin, TX, recently introduced the Value of Solar (VOS) rate, which replaces their residential NEM program. It is essentially a hybrid of NEM and FIT programs, utilizing two meters – a solar PV meter (comparable to FIT meter) and standard two-way revenue meter (comparable to a net energy meter). This arrangement allows Austin Energy to separately meter the energy taken from the grid and the energy delivered to the grid, as well as the total energy produced by the PV System. The total energy consumed at the location is therefore the energy generated by the PV System, plus the net energy delivered by the utility (from the grid).

Like FIT programs, this arrangement enables separate and distinct valuation of the energy used by the customer and the energy produced by the customer-owned generation. The customer continues to pay for total consumption at the prevailing retail rates, including any applicable taxes and fees, while receiving a credit for solar production that is calculated separately, using the "Value-of-Solar" algorithm. It is similar to NEM in that it allows solar energy to be used at the point of generation, when available, to meet demand. The primary difference is that the "netting" function is performed on the basis of dollars, rather than kWhs. It is similar to a FIT in that the value function for the solar energy produced is separate and independent of retail rates.



Value-of-Solar Meter Connection

Confident Decisions. **Definitive Returns**

"This new model presents a variety of benefits not seen together in one program before"

The VOS rate incorporates the utility's avoided costs from distributed generation, including the production of the electricity itself, the marginal costs of adding generation to meet peak load demand, and transmission and distribution (T&D) line expansion for new power plants. These avoided cost calculations incorporate fuel prices associated with the operation of traditional power plants. Therefore, the VOS rate is not set in stone, but is adjusted annually by the utility to reflect fluctuating fuel costs. The algorithm also considers the efficiency of producing electricity at the point of consumption (no T&D losses) and environmental factors, based on customer willingness to pay more for green power.

	FIT	NEM	VOS
Power used onsite:	No	Yes	Yes
DG metered separately:	Yes	No	Yes
Value of electricity:	Program Fixed Rate	Prevailing Retail Rate	Calculated VOS Rate

This new model presents a variety of benefits not seen together in one program before. It decouples solar value from consumption charges, thereby retaining the price signals to encourage efficiency among solar-generating customers, while enabling the utility to recover the cost of services that they still provide (back-up power, grid maintenance, billing, etc.). It reduces customer cross-subsidization because solar customers' rates do not change. Those with solar still effectively pay their original utility bills, but they are also compensated for producing electricity. The VOS pricing model also decouples solar value from incentives and incorporates an annual market-based adjustment, making it a potentially more sustainable approach as solar moves toward grid parity and high penetration rates. A significant downside of this model is that the future value of the power is uncertain, which makes project revenues more difficult to predict. This may deter potential system owners and make it more difficult to obtain project financing.

Putting it All Together

For the sake of discussion, this paper addresses "typical" NEM and FIT program models and one hybrid model (Austin Energy's VOS rate). In reality, there are numerous variations within NEM and FIT program design even with in the U.S., and there are many potential hybrid approaches that the VOS metering arrangement could allow. FIT programs can have an escalating or declining payout rate or feature time-of-delivery multipliers, rather than using a fixed rate over the contract term. Rates can be indexed to market signals (such as wholesale electricity prices) or be determined by an auction-based mechanism. NEM programs have different project size limits and program capacity limits. They also vary in terms of treatment of NEM credits and compensation for net excess generation.

"Perhaps the key advantage of the VOS approach is that it leaves the utility business model largely intact"

However they are designed, traditional feed-in tariffs (FITs) and net energy metering (NEM) have significant programmatic disadvantages. If a FIT rate is set too high, it can increase energy costs for everyone. If the rate is set too low, it may not attract many participants to install solar. The interconnection costs also tend to be higher with FITs, since a separate tie-in to the grid is required. NEM faces potential issues with cross-subsidization, because retail electric rates do not accurately value customer generation. Tiered rate structures also make net-metered solar power worth less to some users than to others. For example, when utilities charge higher rates for higher usage (designed to encourage conservation), net metering policies can actually dis-incentivize conservation in favor of renewable energy generation. Also, commercial and industrial users on demand-heavy rate structures – those based more on peak power demand (kW) than energy consumption (kWh) – benefit less from NEM because they can only offset a portion of their energy charges. Unless utilities also allow for Virtual Net Metering, NEM has the distinct disadvantage of being tied to existing customer load. This can give rise to missed opportunities for solar. For instance, multi-tenant dwellers and renters are often excluded from participation in NEM because they do not have exclusive control of their roof. Alternatively, land that may be suitable for solar but is not associated with a significant source of electric load could not be utilized.

Perhaps the key advantage of the VOS approach is that it leaves the utility business model largely intact, while effectually adding distributed generation resources to their portfolios through standardized power purchase agreements with customer-generators. While only applicable to residential customers for now, Austin Energy's new Value of Solar rate represents a thoughtful and innovative attempt to address the inequities inherent to NEM and traditional FiTs. Versions of the VOS rate concept have already been proposed by San Antonio's municipal utility (CPS) and Minnesota legislators. Time will tell if this is just a footnote in the history of distributed generation, or perhaps the leading utility business model going forward.

About Alta Energy

Alta Energy is a solar analytics and procurement company that enables commercial property owners to identify and complete cost-effective solar projects with confidence. As an objective third party, Alta Energy helps owners of retail, industrial and office buildings evaluate the business case for solar using a consistent, comprehensive model, and then monitors market and policy conditions for the best solar deployment opportunities. Alta Energy's multiple bid process ensures that property owners select the right solar vendors and the best terms for each project. Alta Energy's proprietary solar analysis tools and auction-based procurement process are vendor- technology-, and financing-neutral. As a result, property owners get an unbiased view of their solar options across all properties and all markets, and can choose the most cost-effective, timely installation for every property in their portfolio.

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