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Making Clean Local Energy Accessible Now

The Superior Value of Distribution-interconnected Generation

Summary: The cost of delivering energy from the point it is interconnected to the grid to the point that it is consumed by a customer can be greater than the wholesale purchase price of the energy itself. As a result, the true ratepayer cost of energy is often lower for generation that is interconnected to the distribution grid than for generation that is interconnected to the transmission grid. To understand the superior value of distribution-interconnected energy, it is vital to consider the hidden costs of transmission. This briefing will show how location and time of delivery (TOD) are key factors in determining true cost of energy from the perspective of the ultimate paying party: the ratepayer.

When we talk about the cost of electricity there is both the retail price paid by the end customer and the wholesale price paid by the utility. All else being equal, a lower wholesale price will result in a lower retail price, and a great deal of attention is therefore given to the wholesale price as expressed in the utility's power purchase agreements (PPAs).

However, the wholesale price of electricity, ie, the PPA price, only accounts for the price at the point that the electricity is interconnected to the grid; the point known as busbar. Hence, the PPA price only accounts for the visible component of the total cost of electricity. Hidden costs associated with transmission and distribution (T&D) can be a larger component of the total cost than the wholesale price.[1]

As is the case with most other goods, local delivery of electricity is substantially less expensive than electricity that is transported over long distances. Therefore, seemingly lower priced power that is offered by large central station PPAs requires additional charges to cover hidden costs that do not even exist when buying locally produced power. Hence, while the PPA price of locally produced energy might be higher than the PPA price of central station energy, the ratepayer's cheapest total cost is often derived by distribution-interconnected energy that avoids any use of the transmission grid and its significant costs.

The added and often unconsidered transmission costs associated with non-local generation include the capital investment, the operation & maintenance (O&M), and the line and congestion losses associated with transmission systems. It is worth noting that line and congestion losses are most significant during peak demand periods. In addition,

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[1] For a residential baseline customer in PG&E territory, T&D costs exceed generation costs by 6%. Depending on the location and climate zone, T&D costs for SCE and SDG&E can be even higher.

generators interconnecting to the transmission grid are reimbursed the full cost of all required network upgrades, resulting in additional hidden costs that will appear in future rate increases and are not yet reflected in central station PPA prices. It is worth noting that network upgrades on the distribution grid are paid by the developers and therefore there is no such hidden cost to ratepayers. In fact, distribution-interconnected generation results in ratepayers getting free network upgrades.

To cover the transmission-related costs, Transmission Access Charges (TACs) are applied to any energy routed through the transmission system, currently adding more than 1¢/kWh to the average cost of electricity.[2] These costs have increased over the years and are expected to continue to increase, resulting in a levelized value of 1.5¢/kWh for a typical 20 year contract. In addition, 11% of all energy purchased in California is wasted through line losses in the distance between the point of interconnection to the transmission grid and the point it is consumed by a customer[3]. All of these hidden costs are ultimately absorbed by the ratepayer; on top of the wholesale price of energy (aka the PPA price).

The hidden costs are even higher for peak power, since transmission line losses are dependent on time of delivery (TOD). Where Distributed Generation profiles align with peak load, as they largely do in the case of PV systems, CPUC studies have shown the levelized value of avoided T&D costs to increases to nearly 4¢/kWh[4]. Line losses are greatest during peak load periods due to increased congestion and heat effects. Likewise, additional transmission level grid capacity is required to carry the maximum load, capacity that is not necessary if the load is reliably met by local generation.

Total Ratepayer Cost

	Distribution Grid					**T-Grid**
PV Project size and type	**100kW roof**	**500kW roof**	**1 MW roof**	**1 MW ground**	**5 MW ground**	**50 MW ground**
Required PPA Rate	**15¢**	**14¢**	**13¢**	**12¢**	**11¢**	**10¢**
T&D costs	**0¢**	**0-1¢**	**1¢**	**1¢**	**1-2¢**	**2-4¢**
Ratepayer cost per kWh	**15¢**	**14-15¢**	**14¢**	**13¢**	**12-13¢**	**12-14¢**

In the case of traditional large generating facilities, it was often worth paying for large long distance transmission systems and accepting some transmission line losses, either to

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[2] 0.66¢/kWh CAISO HV + 0.48¢/kWh PG&E LV, 0.05¢/kWh SCE LV, or 0.83¢/kWh SDG&E LV http://www.caiso.com/Documents/RatesEffectiveJan1_2011_RevisedFeb25_2011.pdf
[3] http://www.eia.gov/cneaf/electricity/st_profiles/california.html
[4] 'Methodology and Forecast of Long Term Avoided Costs', 2004. Prepared for the CPUC by Energy and Environmental Economics, Inc, San Francisco

intentionally keep the coal, gas, or nuclear facilities a safe distance from population centers, or to access large hydro or geothermal sources wherever they happened to exist. These facilities also benefited from more significant economies-of-scale than exist with projects based on many of today's renewable energy technologies.

For renewable generation, and especially for solar PV systems, these same factors do not necessarily apply, and capturing the available renewable energy at or near the point of use is desirable. As indicated in the preceding table, ratepayer savings in transmission and distribution costs can more than offset lower PPA prices associated with large central station solar projects that are interconnected to transmission and often in highly remote and/or pristine locations.

Beyond ratepayer impacts, however, distributed generation has other economic benefits as identified in a 2010 UC Berkeley study[5]. In comparing wholesale distributed generation (WDG) against large transmission interconnected renewable generation, WDG projects results in three times the number of jobs, and substantial increases in the attraction of new private investments and State revenues. The report concludes that if the remaining 33% RPS requirements were met solely through WDG, this would attract about $50 billion in <u>additional</u> private investment compared to central station procurement approach, and result in 28,000 <u>additional</u> jobs per year. All else being equal, the superior economic benefits of WDG represent a compelling incentive for clean local energy.

California continues, through legislation and regulation, to support its commitment to increased penetrations of renewable and highly efficient distributed generation. Utilities spend billions of dollars on their distribution systems, accounting for three-fourths of their total capital investments, with about two-thirds spent on upgrades and new infrastructure.[6] It is clear that if these current expenditures are planned and directed toward supporting generation on the distribution system, we can eliminate the need for additional new and increasingly expensive transmission facilities that are projected to increase TAC charges even further, with real customer rate impacts. Today, distribution systems continue to be designed and built for one-way power flow, with limited accommodation for distributed generation. It is essential that this massive capital flow be directed to where it can be most effective and that these investments result in a distribution system that will leverage the benefits of distributed resources and serve customers in the future.

Public utilities are already embracing some of these considerations and have calculated the direct cost differences. Palo Alto Utilities estimated 1.8¢/kWh savings in transmission fees and line losses through the procurement of WDG. The total value

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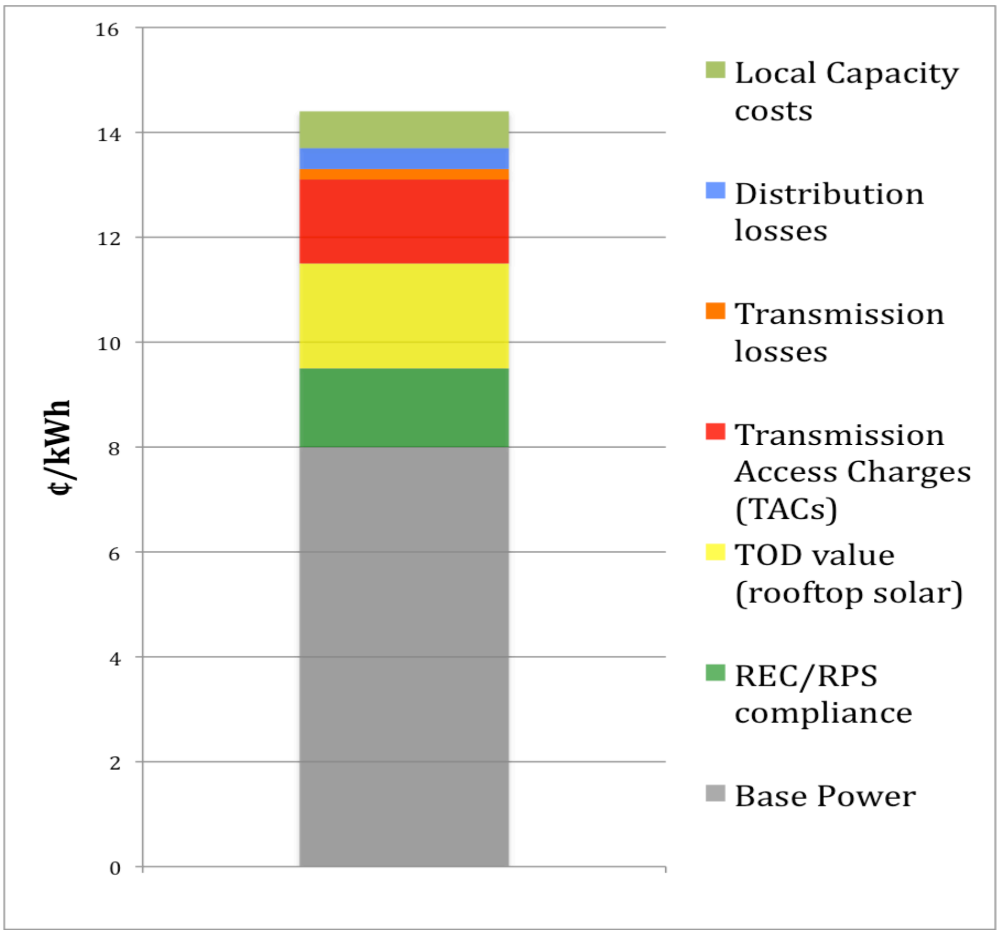
[5] 'Economic Benefits of a Comprehensive Feed-In Tariff', 2010. Max Wei and Daniel Kammen. Renewable and Appropriate Energy Laboratory, Energy and Resources Group, University of California, Berkeley.

[6] California Energy Commission, Integrated Energy Policy Report, 2007, 'Distribution System Investments' p. 155 http://www.energy.ca.gov/2007_energypolicy/index.html

includes the savings from avoided transmission fees (1.6¢), and reduced transmission (0.2¢). In the case of rooftop PV, Palo Alto also includes an additional savings of 0.4¢ from avoided distribution grid losses for a total of 2.2¢/kWh. There is an additional value (0.7¢) of "local capacity" purchases that are avoided by distributed PV related to its location and time-of-delivery.[7] Table 2 below illustrates the composition of avoided costs value of local PV as determined by Palo Alto Utilities in their initial assessments.

Table 2: Utility Avoided Cost Value of Rooftop PV in Palo Alto, CA



[7] Table 2 , 'Overview of Parameters to Consider Regarding Implementing Feed-in-Tariffs for Solar Photovoltaic Systems in Palo Alto' Memorandum from Palo Alto Utilities Department for Utilities Advisory Commission Feb. 2, 2011 Meeting

Notes:

Value of Avoided Distribution Cost
Similar to the Value of Avoided Transmission Cost, the Value of Avoided Distribution Cost also depends on the utility service territory, but the Value of Avoided Distribution Cost also depends on the climate zone in which the PV system is located within any given utility service territory. Thus, the Value of Avoided Distribution Cost for a PV system ranges from 0.200-1.389 ¢/kWh within SCE's service territory, 0.308-2.421 cents/kWh for PG&E's service territory outside of the San Joaquin Valley, 0.902-2.102 cents/kWh for PG&E's service territory in the San Joaquin Valley, and is 3.025 cents/kWh within SDG&E's service territory.[8]

It should be noted that even SCE's 2010 E3 avoided transmission cost of $22.01/kW-yr is relatively low, based on a recent survey of analyses of the cost of new transmission required to bring renewable energy supplies to market[9]. - See Mills, et al., February 2009, p. 23. Therefore the Value of Avoided Transmission Capacity could be nearly four times greater than even SCE's avoided transmission cost.

[8] ibid E3 2004
[9] Mills, Andrew, Ryan Wiser, and Kevin Porter, February 2009, "The Cost of Transmission for Wind Energy: A Review of Transmission Planning Studies," Ernest Orlando Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, LBNL-1471E. http://eetd.lbl.gov/ea/ems/reports/lbnl-1471e.pdf