IssuesLetter

Distributed Resources

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There has been rapid change in electric generating technologies for both large and small power units. Not only have large central station technologies advanced considerably in recent years due to use of jet engine technology developed for military use, but small-scale technologies have developed rapidly as well. Like the large combustion turbines, many of the new small power units also originated and are being commercialized outside the electricity industry for use in the aerospace, defense and automotive industries.

However, unlike large power plants which are constructed on site, usually over a period of years, the small power stations are manufactured at a factory and shipped out for installation a process that may take only months or even days. These mass manufacturing economies have the potential to bring unit costs down quickly, thus presenting the possibility of on-site generation being as common as air conditioners, clothes washers and lawn mowers.

For utility regulators, the most important thing to know about distributed resources is that realizing the potential cost, reliability and environmental benefits that they offer depends on how distribution companies the monopoly portion of our electricity networks are regulated. For this reason, utility regulators are pivotal to the deployment of cost-effective distributed resources. There are two sets of issues that utility regulators need to think about in relation to distributed resources the elimination of interconnection barriers (both technical and contractual), which are often outdated, unnecessary and burdensome and the removal of financial disincentives posed by regulation to distribution utilities and to customers. This Issuesletter considers the second of these two problems the relationship between regulatory policy decisions, utility profitability and the competitive deployment of distributed resources.

Why Should Regulators Care about Distributed Resources?

There are five reasons regulators should care about distributed resources deployment. The first four are compelling enough. They can save money, improve reliability, reduce pollution, and give customers service and choice (thus ameliorating market power).

The fifth reason is particularly critical and is the focus of this report. Only regulators can implement the reforms needed to allow distributed resources to compete fully and fairly, in service to the public interest.

1. Save Money

The first and probably the most important reason that regulators and customers should care about distributed resources is that they offer opportunities to save money. What was once thought to be a bright line between generation on the one hand and transmission and distribution (T&D;) on the other, turns out to be not so bright after all. Distributed resources deliver the full array of generation services (all with lower line losses); they can also substitute for T & D system investment. The type of distributed resource, where it is installed, and when it operates all influence the benefits the resource provides.

Remarkably, in ten of 11 utility studies, the value of distributed resources that flowed from reduced investment in T&D; and from enhanced system reliability exceeded the capacity and energy savings of these resources.

2. Improve Reliability

Increasingly important to regulators and consumers are the many ways distributed resources can improve reliability. Recent experience in New York and Chicago shows that reliability is a T & D issue, and it is here that distributed resources can help.

> Energy efficiency is also a distributed technology. Efficiency programs offer many of the same benefits as small-scale generation and face similar regulatory impediments. Efficiency, however, is further burdened by additional market barriers not faced by other distributed resources technologies. The special problems of efficiency, although not as well known to many utility regulators as they perhaps ought to be, are not covered in this Issuesletter.

3. Reduce Pollution

Distributed resources can reduce pollution. Though some distributed resources, such as reciprocating engines, may produce more pollution, and in some cases substantially higher emissions than state-of-the-art combined cycle gas-fired facilities, many distributed resources, such as photovoltaics and fuel cells, produce significantly less pollution than new central station technologies. Still others, such as microturbines, provide opportunities to reduce emissions especially if they are used in combined heat and power applications.

4. Enhance Customer Service and Choice

Some states are moving ahead with electric industry restructuring, while others are waiting to see if retail competitions promises of lower costs and improved service will be realized. But with or without retail customer choice and whatever the structure of a states electric sector, distributed resources give customers more ways to meet their energy needs, improve the reliability of their service, and lower their costs. Distributed resources also provide a valuable and important check on utility market power.

5. Regulators Public Interest Role

Distributed resources can be cost effective, reduce pollution, and enhance customer choice, but existing regulatory practices unintentionally discourage the use of these resources. If the use of distributed resources is unprofitable for a regulated utility, we should expect barriers to their deployment to be erected and maintained. If, on the other hand, the deployment of distributed resources is made profitable to the utility, barriers that currently exist are likely to be quickly overcome with the active assistance of the utility.

Regulatory Policies Affecting the Use of Distributed Resources

The need for state regulators to focus attention on distributed resources has become increasingly apparent regardless of the extent or pace of competitive restructuring. All commissions must address the distributed issues because these technologies are now entering the market and may be deployed by customers, distribution utilities, or others in every state with or without retail competition. Failure to address distributed resources issues may result in long-term cost implications for both the distribution utilities and their customers.

Distribution Rate Regulation

Distribution utilities will continue to be regulated monopolies into the foreseeable future, and the way in which distribution utilities are regulated will have a significant effect upon the deployment and use of distributed resources. Most distribution utilities, whether or not they are vertically integrated, continue to be regulated on a traditional cost-of-service basis with revenues for distribution services collected on a per kWh basis. Some utilities which are regulated on a cost-of-service basis have also been placed under a rate cap which freezes rates for a specified period of time, commonly for three to five years. (Rate caps may include productivity adjustments as well as adjustments for specific exogenous factors.) For all cost-of-service regulated utilities, including those under rate caps, the following is true:

$$\text{Profits} = \text{Revenues-Costs}$$

To increase profits, a utility must either increase sales, decrease costs or both. Unfortunately for distribution companies costs are independent of sales, and revenues are not. This means that any action, regardless of cost, that reduces sales revenues hurts distribution utility profits. Thus, while very cost-effective distributed resources installed on the customer side may be desirable, the fact that distributed resources installed on the customers side of the meter depress kWh sales means utility profits will be depressed as well. Distribution utilities can be reasonably expected to discourage customer use of distributed resources unless their revenues become dependent on some factor other than kWh sales. (This is true even if the utility has an affiliate in the distributed resource business, as the profits from the sale of a distributed resource will not make up for the loss of revenue due to the loss of distribution services sales.)

Looking for Reliability

Three interesting recent applications of fuels cells highlight customer interest in reliability as well as power costs:

The First National Bank in Omaha, Nebraska, a major credit card provider, has installed fuel cells backed up by diesel generation to insure a constant level of high quality power for its electronic transactions. This has permitted the bank to take a portion of load off the grid entirely, thereby eliminating back-up rates for that load.

The New York City Police Department has installed fuels cells at its Central Park Station and cut itself off the grid, avoiding the need to replace antiquated distribution lines in the center of one of the world's busiest cities.

The Harvard Medical School is studying the replacement of its older diesel generators with fuel cells to insure a reliable source of the very high quality power needed to support sensitive modern bio-medical research equipment.

The solution is straight forward. A utility receiving its revenues for distribution services on a revenue cap (fixed revenues-per-customer) will not worry about maintaining a high level of kWh sales across its wires. From a utilitys perspective having a revenue-per-customer cap is the same as recovering all of its distribution costs through a fixed monthly customer charge. However, it is important to note that revenue cap regulation does not require a rate design that charges customers a fixed monthly fee for distribution services.

Revenue Cap Mechanics

Revenue caps derive from the total revenue requirement (as determined by a rate case and assigned to the customer classes by allocators of cost responsibility) divided by the number of customers in each class in the test year. The resulting revenue-per-customer figures are used in annual "true-ups" which compare the revenues actually collected by the utility in each year to the allowed revenues based on the revenue-per-customer cap times the actual number of customers. Any difference is used to adjust prices during the next year. To the utility, a revenue cap approach makes retained revenue appear as though charged on a fixed-per-customer basis, while customers, in fact, continue to be billed and pay charges on a per kWh basis.

Charging a single fixed monthly rate for all distribution services has a number of economic and practical problems. Fixed charges shift costs from high users to low users; they ignore high marginal cost in areas in need of upgrades or expansion; they are inconsistent with the way costs would be recovered in a fully competitive market; and they undermine the long-run marginal cost price signals that naturally support the efficient functioning of distributed resource markets. These drawbacks mean regulators should approach proposals for fixed monthly charges with caution and skepticism.

Deaveraged Distribution Rates

The cost of distribution services varies a great deal within a distribution system. Average distribution rates are about 2.5 per kWh, but in high-cost areas such as where rapid expansion or upgrading is occurring, distribution costs are as high as 20 per kWh. It is in these high-cost areas that distributed resources make sense. In theory, regulators could simply de-average distribution prices, requiring the utility to charge something approaching zero in areas that have excess distribution capacity, and something near 20 in areas with constrained distribution facilities. Such prices would send the right price signals to consumers and would likely cause distributed resources to be installed precisely where they make the most sense. Moreover, if all distribution prices were exactly reflective of local marginal distribution costs, the deployment of distributed resources would have a very different, positive impact on utility profits. De-averaging prices along these lines, however, is undesirable for compelling practical and equitable reasons.

> The role of the distribution utility in distributed resources is a hotly debated topic which we address solely in the context of de-averaged distribution prices. Absent de-averaged prices, distribution utilities will be the only entities that know where the high-cost distribution areas are, and they are the only entities positioned to benefit from cost savings related to distributed resource deployment. If retail prices are not de-averaged and utilities are allowed to own distributed resources, policies will have to be developed to insure that competitors are treated fairly. Because distribution system savings are an important part of the economics of distributed resources, utilities could end up with an unbeatable competitive advantage if they are the only parties in a position to make money from their use. Failing to address this problem will likely deprive the public of the innovation that would come from a vigorous competitive market for distributed resources.

De-averaged distribution credits are an alternative to de-averaging all distribution prices. Under a program of geographically, de-averaged distribution credits, the utility could establish financial credits for distributed resources installed in a given area. The credit amount would be a function of the distribution cost savings generated by the distributed resources. Credits would be limited in duration and magnitude in order to match the timing and need for distribution system reinforcements. For example, credits might be available to the first 20 MW of distributed resources installed in the next year, because after that loads are expected to grow to make a distribution line unavoidable. The dollar amount of the credits should, at most, equal the value (savings) derived from deferring the distribution upgrade. Credits would also vary by location of the distributed resources. They would be highest in areas of greatest need and zero in low-cost areas. For example, customers in an area with 20 distribution costs might be offered a 15 credit. This would certainly produce a strong economic incentive for customers and others to invest in distributed resources. Because the credit is 15 instead of the 20 the utility would incur to upgrade facilities, there is an opportunity for savings to be shared.

Because a revenue cap decouples sales from profits, a utility subject to revenue cap regulation will have the incentive to identify these high-cost areas to avoid more expensive investment in lines, poles and other distribution plants in an effort to keep its costs down. De-averaged distribution credits can be a very effective means of getting distribution resources deployed in these areas as cheaply as possible.

Environmental Issues

Lastly, a word of warning about the environment. Distributed resources can offer significant environmental improvement, but not all distributed resources are created equal when it comes to environmental impacts. Because of the their small size, many distributed generating units are not subject to the same environmental laws that apply to larger, central station generators. For example, diesel generators, which currently make up 40,000 MW of this countrys installed distributed resources, are far less efficient and far dirtier than new, gas-fired generating stations. It is important for state and federal environmental regulators to address the need for efficiency and emission standards for small-scale power plants before the rapid proliferation of the less efficient, more polluting technologies creates a serious and unexpected new source of air pollution.

References

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What Are The Distributed Resources?

Distributed resources are small generators (1 or 2 kWs to about 10 MW), located within the local electrical distribution system. They can be installed at most locations within a distribution system on either the utility or customer side of the meter. Distributed resources include both supply- and demand-side technologies. Regulators may have some familiarity with demand-side, energy efficiency technologies such as efficient lighting, variable speed motors and improved building commissioning, but many are probably less familiar with small-scale generation technologies, including micro turbines, fuel cells, reciprocating internal combustion engines as well as photovoltaics and wind generators. In the largest sense, all of these technologies compete with each other and with large station generation options. In a narrower sense, however, each is aimed at specific and often different market segments. Market suitability is determined by a number of factors with the most important being cost, including capital and fuel, operating and maintenance costs. Site, size, weight, emissions and noise are also considerations. Here are some examples:

Combustion Turbines

Combustion turbines (CTs) are an established technology ranging in sizes from several hundred kilowatts to hundreds of megawatts. CTs produce high quality heat that can be used to generate steam for additional power generation (combined cycle) or for industrial use or district heating. CTs can burn natural gas, a variety of petroleum fuels or can have a dual fuel configuration. Emissions can be controlled to very low levels using dry combustion techniques, water or steam injection, or exhaust treatment. Maintenance cost-per-unit of output is among the lowest of the small-scale generators. They are a good fit for commercial or industrial applications larger than five MW.

Microturbines

Microturbines or turbogenerators are very small combustion turbines with outputs of 30 kW to 200 kW. Individual units can be packaged together to serve larger loads. The systems are generally capable of producing power at around 25-30 percent efficiency. When coupled with heat recovery accessories to produce, for example, hot water, efficiencies may exceed 60 percent. Like larger turbines, these units are capable of operating on a variety of fuels. Microturbines are simple reliable machines often with a single moving part. They are air-cooled, and some even use air bearings, thereby eliminating both water and oil systems. Turbogenerators are appropriately-sized for commercial buildings or light industrial markets for cogeneration or power-only applications.

Fuel Cells

Fuel cells work like a battery; they produce power electrochemically by converting fuel directly to electricity. Unlike a storage battery, however, where power is produced from stored chemicals, fuel cells produce power when hydrogen fuel is delivered to the negative pole (cathode) of the cell, and oxygen in the air is delivered to the positive pole (anode). The hydrogen fuel can come from a variety of sources, but the most economic is steam reforming of natural gas -- a chemical process that strips the hydrogen from both the fuel and the steam. Like a battery, fuel cells produce direct current (DC) that must be run through an inverter to produce alternating current (AC). Today's fuel cell efficiencies range from 35-40 percent, and efficiencies of up to 60 percent are under development. Fuel cells are quiet and clean running. Current high costs mean that fuel cells are best suited to environmentally-sensitive areas and for customers with power quality concern.

Photovoltaics and Other Renewables

Photovoltaic power cells use solar energy to produce power. Photovoltaic power is modular and can be sited wherever the sun shines. These systems have been commercially demonstrated in environmental sensitive areas and for remote (grid-isolated) applications.

Reference

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