BACON'S REBELLION
The Op/Ed Page for Virginia's New Economy

# Big Grid

**Monster power plants and transmission lines provide Virginians with relatively cheap, reliable electricity, but they have hidden risks and costs. It's time to transition to a system of distributed generation.**

*By James A. Bacon*

When journalists write about electric power issues, most readers' eyes glaze over. This isn't the 1970s when electric rates shot higher every year, VEPCO was every populist's favorite bogey man and "Howling" Henry Howell made a run for the governorship on the slogan, "Keep the Big Boys Honest." Today, electric rates are capped (with minor adjustments) and Virginians enjoy lower-than-average electric rates. People are far more interested in which Hollywood celebrity is adopting an African baby than in how they get their electricity. Unless, of course, the juice goes off.... in which case, you'd think the world had come to an end.

Without electricity, we're all toast -- or we would be if we could figure out how to make our toasters work without it. We need electricity for our ovens and refrigerators, our blenders and automated apple peelers, our lights and alarm clocks, our hair dryers and nose hair trimmers, our heat pumps and our big-screen TVs. We need current to recharge our cell phones and laptops, and to power our PCs. We need voltage to run the gas station pumps that put gasoline into our cars -- and to fill our jerry cans with fuel for the backup generators we maintain in case the power goes off. Without electricity, the entire edifice of our 21st-century civilization comes tumbling down.

The supply of electricity is potentially one of the great constraints on America's -- and Virginia's -- economic growth. Job-killing, misery-inducing blackouts and brownouts await those who fail to plan ahead. Therefore, as a governor's task force studies energy issues with the goal of articulating a state energy policy, it behooves us to understand what it takes to ensure an affordable and secure supply of electricity.

The electric industry in the United States is structured much as it was in the 1930s: Electricity is generated primarily in large power plants located in out-of-the-way places where they don't bother the neighbors, and it is conveyed to people through high-voltage electric transmission lines. As demand for electricity increases, the system requires (a) more large power plants based primarily on fossil fuels and nuclear energy, and (b) more transmission lines.

An increasing number of people are questioning this centralized system. "We have neglected the bigger issue of security of supply," says Saifur Rahman, an engineering professor with the Virginia Tech's Advanced Research Institute in Arlington. Relying upon a handful of giant power plants and an electric grid to connect them subjects the system to massive failure, whether due to hurricanes, terrorist attack or the kind of cascading power blackout that turned out the lights for 50 million Americans back in 2003.

The centralized system also has a number of externalities, or uncompensated social costs. Pollution tops the list. Although its worst abuses have been corrected, coal is still dirty, both in the mining and the burning. Coal combustion emits compounds that contribute to acid rain and low-atmospheric ozone, or smog, not to mention toxic chemicals such as mercury, lead and arsenic. All fossil fuels, in-

*Photo credit: Crow Wing Power*

cluding "clean" natural gas, add to emissions of carbon-dioxide, which is implicated in global warming. And the long-term disposal of nuclear fuel is a challenge that the U.S. has yet to address.

Yet another cost is the necessity of building high-voltage transmission lines through areas where they are invariably unwelcome. Such a controversy is roiling Virginia's northern piedmont right now, where Dominion wants to run a power line to import electricity from Pennsylvania to Northern Virginia. (Disclaimer: The Piedmont Environmental Council, a leading opponent to the transmission line, is a financial backer of *Bacon's Rebellion*.)

Furthermore, there is the omnipresent risk of micro disruptions. Tech-intensive businesses from server farms to hospitals are increasingly intolerant of any interruption of electric supply, no matter how seemingly brief and insignificant. To many customers, the quality of the power is as important as the quantity. As a result, more and more companies are investing in back-up generators and batteries -- a cost that is largely hidden to policy makers.

The alternative is what Rahman and others refer to as a "distributed" system for generating electricity. Such a system would be decentralized, relying upon a larger number of smaller power sources located closer to their consumers. Distributed generation, they argue, would limit the risk of systemic failure and would reduce the impact on the environment.

Writes Richard Hirsh, a Virginia Tech historian of technology and director of the multi-disciplinary Consortium for Energy Restructuring:

> It makes sense to begin moving toward a decentralized system that contains small-scale, modular, and diverse types of equipment that produce power close to cities or even within buildings that use a lot of electricity. Employing diesel generators, or better yet -- from an environmental point of view -- fuel cells, micro turbines, and photovoltaic cells, such a system would reduce the strain on the existing grid by providing power to users without depending on transmission lines at all.

A distributed energy system would reduce pollution and dampen the demand for unpopular new power plants and transmission lines through (a) conservation, (b) cogeneration, and (c) renewable energy. As a leader in electricity deregulation, Virginia actually has enacted a number of reforms needed to make distributed generation a reality -- such as net metering and variable pricing -- although additional changes remain to be put into place.

**Conservation**

Conservation may be the quickest, least expensive way to reduce the strain on the power grid. Hundreds of technologies and devices can trim electric consumption. The trick is inducing businesses and homeowners to invest in them.

That means exists: Variable pricing. Electric demand varies considerably during the day and throughout the year. Adding generating and transmission capacity to meet additional increments in peak demand is extremely expensive. Therefore, Dominion, American Electric Power and other Virginia electric companies benefit when consumers shift their electric consumption away from peak periods.

Two existing programs do that. In one program dating back to the 1990s, says David Koogler, director of state regulations for Dominion, the power company sets a three-tiered pricing structure. The highest rates are applied to the 28 peak-demand days of the year, the lowest rates are assigned to 60 days, and normal rates apply to the rest. Large customers such as manufacturers, hotels and big box stores agree to drop off-line during the 28 peak days or pay a painful tariff. They can crank up their back-up generators, change their production schedule or otherwise switch things around. In return, they get the benefit of extra-low rates for 60 days a year.

The other program, which has been around about 20 years, varies rates by time of day, says Koogler. The principle is similar to that of the time-of-year program: Customers, mostly residential, are encouraged to shift energy-intensive tasks such as washing dishes and clothes to off-peak periods of the day.

Both programs appear to have withered on the vine, however. The number of Dominion customers seeking to shave their electric bills is disappointingly small. The first program, geared toward large business customers, has 300 participants, according to Dominion spokesman Jim Norvell: The residential program has 15,000 customers: about 10,000 residential, 2,800 commercial and small business, and 2,600 government.

Why are the numbers so trivial? One possibility is that Dominion's rates are so low that the potential savings don't seem

worth the trouble. Another is the fact that the programs are blunt instruments: They have limited flexibility.

But the technology now exists to price electricity dynamically and empower consumers to conserve more aggressively. The current edition of the Federal Reserve Bank of Richmond's *Region Focus* magazine explores the impact of electricity deregulation in the fifth federal reserve district. A sidebar focuses on "smart metering," a technology that allows households to view real-time electric prices, check the running total on their monthly bills, and shift consumption of energy-guzzling appliances to less expensive times of day.

In a Potomac Electric Power Co. pilot project in Washington, D.C., reports Vanessa Sumo, each of 2,250 homes will be equipped with the smart meters that reports consumption levels every 15 minutes to PEPCO.

> Half of the participants will also receive a "smart thermostat" that can, by means of radio signals, remotely raise or lower the temperature of an air conditioner or central heating system during exceptionally cold or hot days, when the price of electricity tends to be very high. It's up to the customer to reset the temperature to a more comfortable level, but they will be warned by real-time electricity prices displayed on the thermostat that doing so will raise their bill.

Dynamic pricing of electricity would encourage Virginians to conserve by installing energy-efficient appliances: from ENERGY STAR refrigerators to compact fluorescent light bulbs, from tankless water heaters to front-load washing machines that wring out water before clothes go into the drier. Virginia Senate Bill 262, which directs the governor to prepare a 10-year energy plan, specifically charges the advisory group to take a closer look at variable rate structures.

**Cogeneration**

Cogeneration is another tried-and-true technology that could boost energy efficiency and take large loads off the power grid.

The typical coal-fired power plant converts about one-third of the coal's energy into electricity, notes Hirsh. Two-thirds is wasted -- it is expelled as waste heat. "That heat literally goes into the air. You can see the large cooling towers with the vapor." Cogeneration generates electricity by running steam through a turbine then uses the waste heat to heat (or cool) buildings. "You can raise the efficiency to 80 to 90 percent."

Capturing that energy from the fuel, typically coal or natural gas, makes cogeneration competitive with the big power plants. The challenge is finding a use for the steam. Typically, cogeneration plants are located next to large manufacturing operations that can use both the electricity and the steam for their industrial processes. But there is no inherent reason that cogeneration cannot be applied elsewhere.

Micro-turbines have gotten so efficient that cogeneration makes economic sense in settings, like shopping malls, it never did before. It's only one step away from shopping malls to supply electricity and steam heating/cooling to office parks, condominiums or any other compact array of buildings. One thing the state could do to encourage cogeneration is to survey local zoning regulations to identify restrictions that might prevent the technology from being applied outside industrial areas.

Summarizes Hirsh: "Cogeneration ... is local, it's near the source of demand, and it's economical because companies can get more than one product out of the combustion of fuel."

**Renewable Energy**

Solar energy is the ultimate distributed-generation technology. Photo-voltaic cells can be installed house by house and go straight to the consumer -- bypassing the grid entirely. Although the cost of solar electricity is not yet price competitive with fossil fuels, the cost gap is narrowing. The main obstacle right now, says Rahman, is bottlenecks in the supply of silicon, the main component of solar panels.

Virginia is not as ideal for solar power generation as, say, Arizona, but it fares pretty well, Rahman says. He's been testing a solar unit on the Virginia Tech campus in Blacksburg since 1988. "Our data shows that we can provide electricity from solar cells in that climate typically 260 days per year. Cloud coverage does exist, but it does not last for days at a time."

A potential boon to solar in Virginia is a law that allows "net metering," says Rahman. With net metering, a business or homeowner can sell excess energy on bright, sunny days into the power grid. In theory, that revenue improves the return on a solar investment. In practice, there have been few takers. To protect against imbalances being created in the grid, there is a net-metering cap of one-tenth of

one percent of system capacity. Currently, there appears to be ample room to spare.

If the installation charge could be amortized over 30 years like the rest of the house, that might make the economics of solar generation more attractive. Another potential motivation for homeowners and businesses is to insulate themselves from blackouts, brownouts and isolated, weather-based disruptions. As more people work in home offices, assuring a reliable supply of electricity is not just a matter of keeping the refrigerator running and lights on at night but of maintaining a livelihood.

From a system perspective, rooftop solar generation is attractive because it reduces electricity leakage from the transmission grid. Nationally, energy losses from power lines runs around six percent of the total supply. Installing solar arrays and micro-turbines near the consumer eliminates most of that leakage.

What is the state doing to encourage solar and other renewable energy resources? Senate Bill 262, passed this year, authorizes grants amounting to 0.85 cents per kilowatt hour of electricity produced by a corporation from renewable energy resources, and another program of grants to offset the cost incurred when installing photovoltaic property (up to $2,000), solar water heating property (up to $1,000), and wind-powered electrical generators (up to $1,000).

Another bill passed this year extends "net metering" to third parties that own the energy-producing assets and lease it back to the user. That bill was backed by Old Mill Power Company, of Charlottesville, a company that sells electricity using renewable energy sources. If you can't make a financial case for installing solar power on your roof, maybe Old Mill Power can.

What's missing from the discussion so far is an acknowledgement that Virginia's scattered, low-density human settlement patterns -- commonly referred to as sprawl -- is highly inefficient. Stringing power lines across the countryside increases electricity leakage. Strewing single-family dwellings across five-acre lots makes it impossible to even contemplate serving them with cogeneration.

To move toward a truly energy-efficient society, Virginia must embrace variable pricing not only based on season and time of day but based on location. Put another way, businesses and homeowners should pay the *location-variable* costs of electric service. The fact is, subdivisions located far from existing substations and served by miles of transmission line cost more to serve than dwellings in more compact developments. Current electric rate structures subsidize inefficiency by charging all households the same rate, regardless of location. Rate structures should reward compact development, not sprawl.

**J**oel Achenbach with *The Washington Post* recently profiled a North Carolina ecovillage, Earthaven, where the inhabitants live off the grid, drawing upon solar and hydro power and exerting great efforts to conserve energy. Few Americans would be drawn to a lifestyle of hand washing dishes, pinning garments on clothes lines and squinting in the light of low-wattage bulbs. Obsessively calculating the energy consequences of our every action to eke out a few extra watts of electricity is not how most of us would care to invest our time and creativity.

Like the residents of Earthaven, Virginia Tech historian Richard Hirsh acknowledges that our society's current path of escalating energy consumption pollutes excessively and exposes society to the risk of blackouts. But rather than embrace a self-denying "conservation" ethic, Hirsh advocates the path of "energy efficiency."

Conservation implies a diminished lifestyle: turning down the heat, wearing cardigan sweaters, accepting innumerable inconveniences. Energy efficiency means compact fluorescent lights, which use one-third the energy of an incandescent bulb and lasts 10 times longer. Energy efficiency means junking the 1970s-vintage refrigerator and buying a new one that uses one-third the electricity. "Your beer is just as cool as it was in 1970," Hirsh says. "We're not asking you to change your lifestyle."

Hirsh's view is appealing, but creating a sustainable energy future may not be so painless. Achieving deep energy efficiency also will require adopting more efficient human settlement patterns. And that, as we've discussed elsewhere in the context of transportation, will require changing Business As Usual. But until that can be accomplished, Hirsh's prescriptions are a good place to start.

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