Renewable Portfolio Standards

What it means and why Virginia is *still* not ready for it in 2007

"Renewable portfolio standards" means a law that says a portion of the electricity sold by an electric company must be generated from renewable energy sources, generally wind, solar, biomass, geothermal, and hydro. On the face of it that is a good thing. It moves us away from the pollution and resource depletion associated with fossil fuels and the radiation threat associated with nuclear power. But there are also dangers.

Since I wrote the first version of this paper in February 2006, the RPS bill under consideration has become more complex. The 2007 Virginia legislature is reviewing SB 1275, which would mandate that 12% of Virginia's electric energy come from renewable sources by 2020 and that energy-efficiency measures must reduce overall consumption by 5% by the same date. It further divides the 12% renewable into three categories. Industrial wind power is included in Category 2, and is the major component of that category. Category 2 is expected to produce 8.7% of Virginia's power by 2020, the bulk of that from wind

Solar energy is almost unlimited but photo-voltaic systems are very expensive to install. Wind power is by far the next largest potential source for renewable energy in the near term. Thus, it turns out that an RPS law is largely a wind-power promotional tool. Using the current generation of wind turbines, this would require the erection of 2600 1.5-MW turbines 400 feet tall extending over 325 miles of ridgeline. Newer technology might reduce this to 1300 3-MW turbines 550 feet tall or more, perhaps requiring 260 miles of ridgeline. [see calculations and data on pages 2-3 for details]

This is a substantial reduction from the 2006 proposal and might be acceptable if wind power was a proven technology with few social or environmental consequences, as its advocates proclaim. But we know that bird and bat populations are adversely affected and that the wind power industry has not cooperated with those studying the problem. Extensive fragmentation of forest land, noise and light impacts on nearby residents, gross intrusions on pristine mountain views, and possible reductions in property values, tourism, and the local economy are all problems that require study. It would be foolish to enact any legislation promoting wind power prior to the completion of objective studies of where turbines could be located and what the actual benefits and environmental tradeoffs might be.

At this time the concept of renewable energy should be studied but it is premature to be considering any legislation, let alone enacting it into law. At minimum, a viable RPS law must contain comprehensive siting criteria for wind turbines and not leave that for future consideration with unknown results. Even given that, it would still amount to mandating their use prior to determining their feasibility. This is the classic cart-before-horse scenario.

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The arithmetic of renewable energy —

Virginians used about 100,000 GWh of electric power in 2002. Consumption has been increasing at about 2.5% per year and is forecast to continue at this rate in the future, reaching about 156,000 GWh by 2020, the target date for the present RPS proposal. If the 5% efficiency measures are fully implemented, that would be reduced to 148,000 GWh, in effect slowing energy growth by two years. To provide 12% of Virginia's 2020 projected electric energy needs from renewable sources would require over 2000 megawatts [MW] of generation operating at 100% capacity.

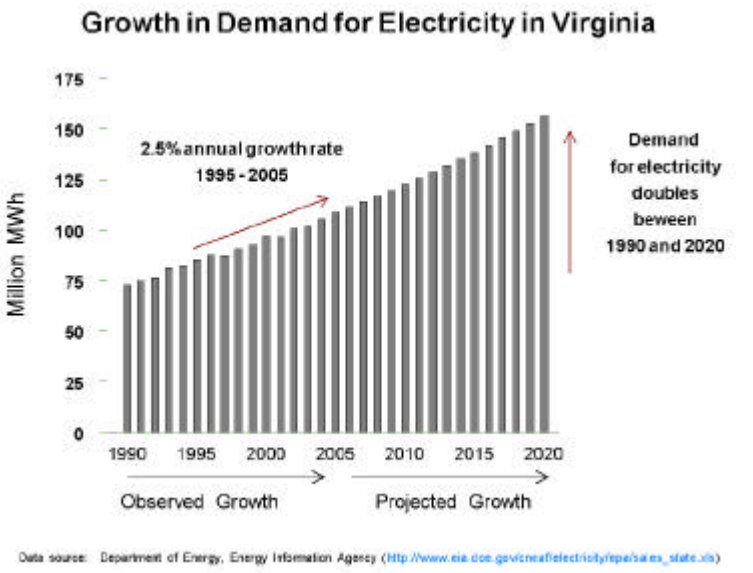

Chart courtesy of Rick Webb

According to a recent report,[1] Virginia had 1340 MW of renewable generation in 2002. Except for the last two columns on the right, the following data are from Table 1, page A2 of this report.

Renewable source	2002 Installed Capacity, MW	Generation, 2002, GWh	Capacity Factor	Percent of 2002 Usage	Percent of projected 2020 Usage
Landfill gas & muni waste	168	1106	0.75	1.11%	0.75%
Wood combustion	415	1412	0.39	1.41%	0.95%
Conventional hydro	757	868	0.13	0.87%	0.59%
Total of the above	1340	3386	0.29	3.39%	2.29%

Solar energy could provide as much as 13,000 MW through the installation of photo-voltaic panels on the roofs of existing commercial buildings, at a cost of 30 to 40 cents per kWh, five to ten times the cost of conventional power. Wind power now costs about five to six cents per kWh when the generous tax subsidies are factored in, making it the major renewable source. All other renewables, such as biomass, landfill gas, geothermal, and hydro, can provide at most a few hundred megawatts of capacity.

The Karmis report on renewable energy in Virginia, cited above, projects that renewables other than wind could account for an additional 530 MW over the next ten years and that onshore wind could provide about 400 MW, Table 1, page 19. If the new non-wind sources operate with capacity factors similar to existing facilities of the same type, they will contribute about 250 MW of real capacity. If wind operations achieve a typical capacity factor of 30%, it will yield about 120 MW of real capacity. Existing sources will add another 390 MW if they continue to operate at the capacity factors listed above. This is a total of 760 MW of existing and projected renewable capacity, which leaves a shortfall of 1240 MW needed to reach the 2020 goal of 12% renewable generation.

Where can this additional capacity come from? Onshore wind is the chief candidate. Offshore wind is much more costly to develop and the other sources are not subject to significant expansion in the near term. The 400 MW estimate for onshore wind was based on transmission limitations and environmental factors limiting siting of turbines.[2] To meet the RPS goal we can expect a flurry of new and upgraded power lines and the siting of turbines in environmentally sensitive areas. Existing and projected non-wind sources should be capable of meeting the Categories 1 and 3 goals of SB 1275 and a small part of the Category 2 goal. Wind development will probably have to handle about 7% out of the 8.7% goal for Category 2 sources in 2020, about 1200 MW of generation at 100% capacity or 4000 MW at 30% capacity.

Here is how it works out:

Projected 2020 power demand of 148,000 GWh x 7% = 10,360 GWh needed.
The most common turbines are 1.5 MW and operate at about a 30% capacity factor:
1.5 MW x 0.30 x 24 h/d x 365 d/y = 3942 MHh/y per 1.5 MW turbine [= 3.942 GWh]
10,360 / 3.942 = 2628 turbines

Thus about 2600 1.5-MW turbines or 1300 3-MW turbines are required. To avoid one turbine interfering with the wind pattern of another, these must be spaced out along a ridge top. The smaller ones are typically placed about eight per mile and the larger ones about five per mile, leading to the requirement of 260 to 325 miles of ridgeline devoted to industrial installations.

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[1] *A Study of Increased Use of Renewable Energy Resources in Virginia*, Virginia Center for Coal and Energy Research, Michael Karmis, Editor, 11 November 2005, 107 pp. Available on line at: http://www.energy.vt.edu/Publications/Incr_Use_Renew_Energy_VA.pdf [1.22 MB]

[2] *ibid*, page 16. The following paragraph is taken from this source:

> **Onshore wind energy:** 910–1960 MW of onshore wind capacity by developing Class 3 and greater (>14 miles per hour) wind sites. The lower estimate is based on *applying land use restrictions* and assuming that 20 percent of the existing transmission capacity could be used for wind; the higher estimate has no restrictions on transmission capacity or distance from transmission. In reality, an even lower amount of transmission capacity might be available. About 60 percent of the identified wind resource is relatively low quality Class 3 winds. Because of their poor economics, these resources are generally not developed for utility scale applications at the current time, although future improvements in turbine technology may increase the viability of this resource. Based on these considerations, Black & Veatch feels that the near-term (5-10 years) development potential for wind in Virginia is limited to about 400 MW. Additional development could occur if low-speed wind turbine technology improves, the transmission grid is upgraded in key wind resource areas, or a *greater amount of land is available for development* than assumed by NREL.

[*emphasis added.*] A "greater amount of land available" appears to mean limited or no environmental restrictions on development. Note that the roughly 4000 MW of installed capacity needed to meet 2020 requirements under the proposed legislation is double even the higher estimate of available wind resources. This shortfall will likely lead to development of more sensitive sites and to development of sites with lower quality winds.