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The Case for Promoting Utilization of West Virginia's Vast Renewable Resources: Co-Firing Biomass with Coal to Generate Electricity

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Background: An Energy and Sustainability Roadmap for West Virginia

Policymakers in West Virginia are being forced to face a future where the national economy is less dependent on the coal industry. While electricity generation in the U.S. traditionally has relied on coal for about one half of its fuel source, that dependency has declined dramatically in 2012: as older coal generating plants are retired in the face of more stringent regulations of emissions by the U.S. Environmental Protection Agency (EPA), and global demands for coal continue to raise the domestic price to levels that threaten coal's cost-competitiveness compared to other fuel sources for electric generation, such as natural gas. West Virginia coal production is also entering a period of marked decline of almost 30% by the end of the decade, one that will force the State to shore up its economy in unfamiliar but proven ways. West Virginia policymakers can take a number of steps to prepare the state for this new energy future. This series of Discussion Papers examines some of these options.

One such option is adoption of measures that would promote development of the state's considerable renewable resource potential. West Virginia has tremendous untapped potential for biomass energy, for example, that could be developed pursuant to policies designed to stimulate investment in this industry. Research has been conducted in West Virginia University's Forestry Department to quantify the energy and economic benefits of developing a robust biomass industry in the state, based on the vast forests that could be sustainably harvested to produce a long-term feedstock for biomass-fired electricity generation.[1] Biomass can also be effectively combined with coal in existing coal-fired generating units—referred to as "co-firing"—to reduce the dependence on coal and achieve a gradual "greening" of the energy supply.

There are currently no state policies in effect, however, that encourage development of biomass resources. Developing these resources could result in a cleaner supply of electricity, achieve resource diversity that would reduce dependence on ever-more-costly coal generation, and stimulate jobs and economic development in new areas of the economy, thereby diversifying the state's economic base away from heavy dependence on fossil fuels. This Discussion Paper

[1] JINGXIN WANG ET AL., W. VA. UNIV., BIOMASS RESOURCES, USES AND OPPORTUNITIES IN WEST VIRGINIA 1–3 (Sept. 10, 2007), *available at* http://www.wdscapps.caf.wvu.edu/biomatwurctr/files/wvbiomass09102007.pdf.

will examine policies that West Virginia should consider to stimulate development of biomass resources within the state

The Case for Promoting Development of West Virginia's Biomass Resources

Biomass, or bioenergy, uses the energy from plants and plant-derived materials. Wood is the largest biomass energy resource; other sources of biomass include food crops, grassy and woody plants, residues from agriculture or forestry, oil-rich algae, and the organic component of municipal and industrial wastes.[2] Biomass can be used for transportation fuels (biodiesel and biofuels), electricity generation, and to make products that would otherwise be made from fossil fuels.[3] Of particular interest in West Virginia is the use of biomass for generation of electricity.[4] Biomass can be used to generate electricity either through direct firing (by burning bioenergy feedstocks directly to produce steam, which in turn drives a turbine that spins a generator to convert the power into electricity) or through co-firing, which involves mixing biomass with fossil fuels in conventional power plants.[5]

According to the U.S. Department of Energy (DOE), one of the "most attractive and easily implemented" uses of biomass is co-firing in existing coal-fired boilers.[6] Through co-firing, biomass can substitute for up to 20% of the coal used in the boiler, and the biomass and coal are combusted simultaneously.[7] Using biomass as a supplemental fuel in an existing coal boiler produces benefits in the form of lower fuel costs, reductions of various air pollutants (sulfur dioxide, nitrogen oxide and greenhouse gases), and avoidance of landfills and associated costs.[8] These benefits will be discussed in further detail below.

A DOE report on the feasibility of using biomass to co-fire at coal-fired plants states that

> the best opportunities for economically attractive cofiring are at coal-fired facilities where all or most of the following conditions apply: (1) coal prices are high; (2) annual coal usage is significant; (3) local or facility-generated supplies of biomass are abundant; (4) local landfill tipping fees are high, which means it is costly to dispose of biomass;

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[2] *Learning About Renewable Energy: Biomass*, NAT'L RENEWABLE ENERGY LAB., http://www.nrel.gov/learning/re_biomass.html (last updated May 30, 2012) [hereinafter *Biomass*].

[3] *Id.*

[4] Next to hydro-power, more electricity is generated from biomass than from any other renewable energy resource in the U.S., OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY, U.S DEP'T OF ENERGY, FEDERAL TECHNOLOGY ALERT: BIOMASS COFIRING IN COAL-FIRED BOILERS, 8 (May 2004), *available at* http://www1.eere.energy.gov/femp/pdfs/fta_biomass_cofiring.pdf [hereinafter DOE BIOMASS ALERT].

[5] *Biomass*, *supra* note 2.

[6] DOE BIOMASS ALERT, *supra* note 4, at 1.

[7] *Id.*

[8] *Id.*

and (5) plant staff and management are highly motivated to implement the project successfully.[9]

Most of these conditions are present in West Virginia. First, coal prices are relatively high in the state, given the near doubling in prices over the last decade.[10] Second, West Virginia is the largest coal producer east of the Mississippi River and accounts for more than one-tenth of total U.S. coal production.[11] In 2009, West Virginia produced over 144 million tons of coal,[12] and 94% of the coal consumed in the state was used for the generation of electricity.[13]

The third condition, the abundance of local supplies of biomass, is worthy of further discussion. West Virginia is the third most heavily forested state in the United States.[14] It has a total of twelve million acres of forestland, covering over 78% of the state, with over 260,000 forest landowners.[15] Of the forestlands, 98% are timberlands, or land capable of growing more than twenty cubic feet per acre per year of wood.[16] Among the total timberlands in West Virginia, 79% are privately owned, 9% are forestry owned, 8% are national forest, and 4% are owned by other public entities.[17] The forestry industry is present throughout the state; it is the only natural resource industry present in all fifty-five West Virginia counties.[18] McDowell and Webster

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[9] *Id.* at 2.

[10] American Electric Power's (AEP's) residential electric rates in West Virginia increased from 5.5 cents per kilowatt-hour (kWh) in 2000 to 9.2 cents/kWh in 2011. It should be noted that AEP's residential rates are artificially low, in that they do not reflect $311.8 million of "legacy fuel expenses" that AEP is proposing to recover through securitization. AEP has a pending filing before the West Virginia PSC to issue $422.3 million in bonds for a term of ten to thirteen years to recover these "legacy fuel expenses" and various other charges, including financing costs. Mary Powers, *West Virginia Utilities Ask Regulators to Securitize Legacy Fuel Charges*, Platts (Aug. 24, 2012, 1:37 PM), http://www.platts.com/RSSFeedDetailedNews/RSSFeed/ElectricPower/6585989. AEP's residential rates will be 3.3 % higher during the term of the bonds to recover these costs; its residential rates would increase by 0.0309 cents/kWh. Joint Application, Pub. Serv. Comm'n of West Virginia v. Appalachian Power Co., No. 12-1188-E-PC (W. Va. Aug. 22, 2012), *available* at http://www.psc.state.wv.us/scripts/WebDocket/ViewDocument.cfm?CaseActivityID=351760&NotType='WebDocket. FirstEnergy's residential electric rates increased from 7.2 cents/kWh in 2000 to 10.0 cents/kWh in 2011. *Form EIA-826 Detailed Data*, U.S. Energy Info. Admin, http://www.eia.gov/cneaf/electricity/page/eia826.html (last visited Apr. 10, 2013). Average rates are obtained by dividing residential revenues ("$") by residential sales, in megawatthours (MWh)..

[11] W. VA. DIV. OF ENERGY, ENERGY BLUEPRINT 9 (MAR. 2012), *AVAILABLE AT* HTTP://WWW.WVCOMMERCE.ORG/APP_MEDIA/ASSETS/DOC/ENERGY/WV_ENERGY_BLUEPRINT.PDF [HEREINAFTER ENERGY BLUEPRINT].

[12] *Id.* at 10.

[13] *Id.* at 11.

[14] WANG ET AL., *supra* note 1, at 1–3.

[15] *Id*. at 6.

[16] *Id.* at 1.

[17] *Id.* at 6.

[18] *Id.*

Counties are the most heavily forested counties, with 93% of forest coverage.[19]

West Virginia produces 2.41 million dry tons of wood residue annually, including 1.34 million dry tons of logging residue and 941,868 dry tons of mill residues.[20] Moreover, this level of wood waste is sustainable; the 2005 Forest Inventory and Analysis (FIA) data for West Virginia showed a net annual growth to removal ratio of 1.08 for all species combined, suggesting that the annual growth is greater than the annual removals of growing stock.[21] These large amounts of wood residue from logging operations and mill waste are currently underutilized in West Virginia and are potentially available for bioenergy production. Even though 68% of mill residues were used in 2006, most of the logging residues, the largest proportion of wood residues, were underutilized.[22]

In addition to the extensive forests in the state, West Virginia has 3.6 million acres of farmland.[23] In West Virginia,

> annual agriculture residue production is 903,826 dry tons including 101,000 dry tons of grass seed residue, 10,618 dry tons of corn stover, 131,440 dry tons of corn silage, 1,585 dry tons of soybean residue, 3,731 dry tons of all wheat straw, 3,838 dry tons of switchgrass, 2,593 dry tons of short rotation woody crop, 662,780 dry tons of animal manure, and 26,241 dry tons of solid wood material from the construction and demolition waste.[24]

Combining the wood and agricultural residue, the total annual biomass production potential is 3.32 million dry tons in West Virginia, which could produce 47.06 trillion BTUs.[25] The forestry sector produces 72.7% of the total residue biomass in the state while the agriculture sector provides the rest, or 27.3%.[26]

Given this level of biomass production, one study concluded that "West Virginia has the potential to produce at least 5.4 billion kWh of electricity from biomass, which would be enough to supply power to 543,000 average homes, or 61% of the state's residential needs."[27] Despite this enormous potential, biomass currently accounts for only about 0.5% of energy produced in

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[19] *Id.*

[20] JOSEPH MCNEEL ET AL., WOODY BIOMASS SUSTAINABILITY FOR BIOENERGY PRODUCTION IN WEST VIRGINIA 1, *available at* http://www.ncfap.org/documents/BEADII/WVUBiomassGChallengeBEADII.pdf.

[21] *Id.*

[22] *Id.* at 1–2.

[23] WANG ET AL., *supra* note 1, at 6.

[24] *Id.*

[25] *Id.*

[26] *Id.*

[27] JOSEPH MCNEEL ET AL., *supra* note 20, at 8.

the entire state; in 2001, West Virginia consumed 1,255 trillion BTUs of energy, among which only 1% was produced from biomass.[28]

The remaining two conditions for co-firing feasibility identified in the *DOE Biomass Alert*—the avoidance of costs for disposing of biomass and highly motivated plant staff and management—are probably not drivers in West Virginia. Tipping fees for disposal of biomass are very much in line with the national average.[29] And in the absence of any public policies that would provide an incentive for the deployment of biomass co-firing in West Virginia, it is not clear that management or plant staff would be highly motivated. This Discussion Paper presents possible public policies that may provide this incentive, but it does not currently exist in West Virginia.

As noted above, co-firing biomass in existing coal-fired generating facilities can provide a number of benefits. First, if inexpensive biomass fuel sources are available—and the inventory described above suggests that they are in West Virginia—co-firing can produce savings in overall production costs through lower fuel costs.[30] Second, emissions of acid rain precursor gases—sulfur dioxides (SO_X) and nitrogen oxides (NO_X)—can be reduced by replacing coal with biomass.[31] Biomass has nearly zero sulfur content, so SO_X reductions occur on a one-to-one basis with the amount of coal offset by the biomass.[32] Third, co-firing results in reduction in greenhouse gas (GHG) emissions. Sustainably grown biomass is considered a GHG-neutral fuel (*i.e.*, it results in no net carbon dioxide (CO_2) in the atmosphere).[33] As in the case of SO_X reductions, GHG emissions are reduced on a one-to-one basis with the amount of coal offset by the biomass. The American Coal Council, for its part, recognizes that biomass co-firing with coal can be an effective emissions reduction strategy, as it "has the potential to reduce emissions from coal-fueled generation, without substantially increasing costs or infrastructure investments."[34]

Fourth, biomass co-firing is more attractive than some other renewable resources (*e.g.*, solar, wind, or hydro) because the generating resource is "firm" rather than intermittent or variable. The higher capacity factor of co-fired coal generating facilities means that more power is produced per unit of installed capacity, thereby improving the attractiveness of the capital

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[28] WANG ET AL., *supra* note 1, at 2.

[29] West Virginia's average landfill tipping fee in 2009 was $46.02 per ton. W. VA. SOLID WASTE MGMT. BD., ECONOMIC IMPACT OF MUNICIPAL SOLID WASTE MANAGEMENT IN WEST VIRGINIA 9-3 (2011), *available at* http://www.state.wv.us/swmb/RMDP/2011StatePlan/Chapter9.pdf. The national private landfill tipping fee average in 2008 was about $42.50. *Tipping Fees Vary Across the U.S.*, WASTE & RECYCLING NEWS (July 20, 2012), http://www.wasterecyclingnews.com/article/20120720/NEWS01/120729997/tipping-fees-vary-across-the-u-s.

[30] DOE BIOMASS ALERT, *supra* note 4, at 8.

[31] *Id.*

[32] *Id.* In other words, displacing 10% of the coal supply with biomass will result in a 10% reduction in SO_X emissions.

[33] *Id.*

[34] *Biomass Co-Firing With Coal as an Emissions Reduction Strategy*, AM. COAL COUNCIL, http://www.americancoalcouncil.org/displaycommon.cfm?an=1&subarticlenbr=162 (last visited Mar. 14, 2013) [hereinafter AM. COAL COUNCIL].

investment.[35] Fifth—and this is of particular interest in West Virginia, given our heavy reliance on coal-fired generation—the ability to integrate an additional fuel source (biomass) into the coal supply diversifies the fuel mix and provides a hedge against price increases.[36] And biomass can be economically blended in with the existing coal supply; according to the American Coal Council, biomass "can use the pre-existing infrastructure investments for fossil fuels,"[37] and the addition of biomass to a coal-fueled boiler is not likely to have negative impact on generation efficiency (or, at worst, "only a minimal negative impact").[38]

Finally, co-firing in West Virginia could stimulate the development of a locally based fuel supply to complement coal production, thereby producing economic benefits. Linking biomass collection and transportation to economically generate raw material for bioenergy can potentially create new, high-skilled jobs for people specializing in engineering systems, computers, economics, and international trade while providing new opportunities for forest managers, biologists, and engineers.[39] Co-firing could stimulate a very large market for biomass fuel. Co-firing a 1000 MW coal-fired power plant at a 5% rate, for example, would require about 245,000 tons of biomass per year, which in turn would require about 50,000 acres of high-yield production.[40] One study performed by Penn State University calculated that if 5% of the fifty-seven million tons of coal used to generate electricity in Pennsylvania were replaced with biomass, it would require production of 4.4 million tons of biomass per year, nearly tripling the current rate of biomass use for energy in that state.[41]

Recommendations

Policymakers in West Virginia should consider revisiting, and substantially revising, the state's Alternative and Renewable Energy Portfolio Standard (AEPS). Unlike virtually every other portfolio standard adopted in the thirty-nine other states, West Virginia's AEPS does absolutely nothing to stimulate the development of renewable energy resources. By defining "alternative" energy in a manner that would include thousands of megawatts of existing coal-fired generation in the state and by allowing the procurement obligation imposed on utilities to be completely satisfied with "alternative" energy sources to the possible exclusion of any "renewable" resources, the measure is of virtually no value as a policy tool to stimulate development of renewable resources in the state. The utilities' compliance assessments, filed with the PSC

[35] DOE BIOMASS ALERT, *supra* note 4, at 8.

[36] *Id.*

[37] AM. COAL COUNCIL, *supra* note 34.

[38] *Id.*

[39] Kristiina A. Vogt et al., *Societal Values and Economic Return Added for Forest Owners by Linking Forests to Bioenergy Production*, J. FORESTRY, Jan./Feb. 2005, at 21, 21–27.

[40] DANIEL CIOLKOSZ, PENN STATE UNIV., RENEWABLE AND ALTERNATIVE ENERGY FACT SHEET, CO-FIRING BIOMASS WITH COAL (2010), *available at* http://pubs.cas.psu.edu/freepubs/pdfs/ub044.pdf.

[41] *Id.*

annually, confirm that they have to do absolutely nothing to meet the obligations imposed on them by the AEPS; the existing "alternative" generation capacity within the state is nearly three times greater than the required 25% by 2025.

The state's current renewable standard deprives the state of the economic and environmental benefits that could be captured if the AEPS actually operated to stimulate the development of the state's considerable renewable resource potential. West Virginia has vast quantities of biomass available that could be harvested cost-effectively and used to co-fire in the state's existing coal-fired electric generating plants. Developing a biomass industry in the state would produce economic benefits, diversify the state's economy and, if co-fired with coal, could play a valuable role in maintaining the viability of the State's coal industry through improving the environmental footprint of existing coal-fired generation as a result of the reduced emissions associated with biomass. Policymakers should consider revising the state's AEPS to create a specific "carve-out" of the procurement obligation geared toward co-firing biomass with coal. For example, as a subset of the existing procurement obligation of 25% of alternative and renewable energy by 2025, the AEPS could be amended to require that some small percentage—say 2 or 3%—of the state's electricity supply be generated with co-fired coal and biomass generation, with "co-fired" defined to require no less than 10% biomass content. That would create a separate procurement obligation on the utilities to obtain a portion of their electricity supply from biomass co-fired generation, which would effectively stimulate the development of a durable biomass market.

Other Elements of the Energy and Sustainability Roadmap

Based on these and similar analyses, these Discussion Papers[42] will result in a number of policy recommendations to be considered as West Virginia embarks on an energy future that will be – and needs to be – far different from its past. It will be a blueprint, or a roadmap, for a sustainable energy future for West Virginia. These Discussion Papers are intended to stimulate the thoughtful discussions that are necessary to place the State on a foundation that is sustainable, not only from the perspective of a "cleaner" energy supply but also in the resilience of a more diversified economic base that is better positioned for the future.

[42] In December 2012, the Center issued its Discussion Paper on "The Case for Integrated Resource Planning in West Virginia," available at http://energy.law.wvu.edu/r/download/148340. In March 2013, the Center issued its Discussion Paper on "The Case for Energy Efficiency Investments in West Virginia," available at http://energy.law.wvu.edu/r/download/155988. In September 2013, the Center issued its Discussion Paper on "The Case for Promoting Utilization of West Virginia's Vast Natural Gas Resources: Combined Heat and Power (CHP) Facilities." Subsequent Discussion Papers will examine the following topics: "The Case for Revisiting West Virginia's Renewable and Alternative Energy Portfolio Standard"; "The Case for Policies Stimulating Development of West Virginia's Vast Renewable Resources: Geothermal Energy"; and "The Case for Promoting Utilization of West Virginia's Vast Natural Gas Resources: Natural Gas Vehicles."