April 22nd, 2010

To: John Paul
From: Tom Hewson
         John Stamberg
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Subject: Evaluation of Pennsylvania Expansion of Tier 1 AEPS to 15%

A number of faulty assumptions regarding renewable energy's future cost and job creation potential skew the results in Black and Veatch's *Assessment of a 15 Percent Alternative Energy Portfolio Standard*, which analyzes Pennsylvania House Bill 80/Senate Bill 92. SB 92 would increase Pennsylvania's Tier I Alternative Energy Portfolio Standard (AEPS)[1] from 8% to 15% of retail sales by 2022 with a special 3 percent solar set-aside. The AEPS expansion would also include a new 3 percent of retail sales requirement to be supplied by coal plants retrofitted with carbon capture and sequestration (CCS) technology.

Major Findings:

Renewable Cost and Generation

- The Black and Veatch study dramatically understates Pennsylvania's wind and solar PV renewable production costs and thereby significantly understates the ratepayer costs to expand the AEPS.

- The report incorporates an escalating carbon penalty starting at $18/ton CO2e in 2012 and reaching $50/ton in 2026. By adding a large carbon penalty to conventional coal and natural gas-fueled generation, the study increases conventional costs by 34 percent[2] making wind, solar and other renewables appear more cost-competitive but still much higher cost.

- B&V calculates that increasing the AEPS would increase cumulative present value costs by $1.6 billion from the assumed Fossil Fuel Only (FFO) prices over the course of the forecasting period (2010-2026). By using a discounting cost analysis and spreading the

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[1] Signed in 2004, Pennsylvania's existing Alternative Energy Portfolio Standard (AEPS) requires the state's 11 Electric Distribution Companies[1] (EDCs) to derive 18% of their total electrical generation by alternative resources by 2020. The AEPS divides the alternative resources into two tiers. Tier I sources must reach 8% by 2020 and include solar, wind, low-impact hydro, geothermal, biomass, bio-gas, coal-bed methane and fuel cells. Tier II includes waste coal, distributed generation (DG) systems, demand-side management, large-scale hydro, municipal solid waste, wood pulping and manufacturing byproducts, and IGCC coal technology. The AEPS also includes a solar set-aside that reaches 0.5% by 2020.

[2] Over the study period (2010-2026), the carbon penalty adds $6.4 billion to the conventional power costs (Table 6-3 pg 6-14).

back loaded costs over the entire 17 years generation, Black and Veatch projects only a 0.6 % increase ($0.055/MWh) over the average 2007 Pennsylvania retail electricity price of 9.08 cents/kWh. Without discounting, the ratepayer expanded AEPS compliance cumulative cost will reach $6.3 billion ($12.7 billion without carbon penalty) or an average price increase of $2.27/MWh.

Job Creation
- B&V projects that the expanded AEPS policy would create 129,000 job-years of new employment over the study period (2010-2026). Using cumulative job-years in lieu of average annual construction and operation jobs misrepresents the actual job impact. If averaged across the 17-year study period, the projected 129,000 cumulative job-years translates to only 7,571 sustainable jobs—65 percent are attributable to ongoing construction jobs.

- B&V significantly overstate the policy's overall job creation impact by 260 percent. Relying on published DOE studies, EVA's independent estimated employment from an expanded AEPS policy would create only a net 2,084 sustainable direct and indirect jobs. Major differences between the two employment estimates are attributable to differences in burden labor costs,[3] the proportion of project costs associated with labor (B&V judgement vs. published DOE studies) and B&V's inclusion of "induced jobs[4]".

- B&V significantly understates the Pennsylvania employment impact from coal generation. By excluding labor associated with coal mining, coal transportation and byproduct disposal. This flaw results in underestimating fossil fuel employment and overstating net employment gains from the expanded AEPS.

The first section of this report will analyze the renewable production cost assumptions and generation totals used in Black and Veatch's report. The second portion will compare B&V's job creation totals with EVA's own projections.

Evaluation of 15% AEPS Renewable Cost and Generation Projections

Study Understates Renewable Alternative Production Costs
The report's understates future solar and wind production costs. Given these assumed low costs, Black and Veatch projects that these technologies will be able to produce more electricity at lower cost than is likely possible given Pennsylvania's marginal wind and solar resources. The report paints solar as a developing technology with much upside, and projects that new solar installation costs will drop 5% annually until 2020. By this time, PV growth will be largely mature and prices will level off. The report projects a weighted average nominal cost of $2,856/Kw for solar PV. This dramatic drop from current costs leads the report to project that

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[3] B&V assumes that construction and operations works will cost $55,000/employee. EVA relies upon RS Means to estimate burden labor costs (wages plus benefits) at $90,000/year per construction worker and $102,000 per operation worker. Assuming lower employee costs enables B&V to support 38-46% more jobs per unit cost than current average wage costs.

[4] EVA estimate includes jobs associated only with new construction, engineering and manufacturing jobs. B&V analysis also includes employment created by their spending that will have a trickle down impact on the Pennsylvania economy, creating demand for additional goods and services, which would result in the creation of indirect jobs (schools, grocery stores, retail shops). While it is unclear exactly how many indirect jobs are created per generation type, the multiplier impact used to calculate these numbers dramatically overstates the indirect job creation impacts that are conceivable in established communities such as Pennsylvania.

solar PV will reach ~3,000 MW capacity by 2026. At the beginning of the period, B&V projects solar PV rooftop installations to cost $7200/Kw, with utility-scale solar PV installations to cost $5,800/Kw in urban areas and $4,000/Kw outside the city. EIA's Annual Energy Outlook 2009 projects solar PV prices at $6,171 in 2011, a much more expensive figure than B&V's projections.

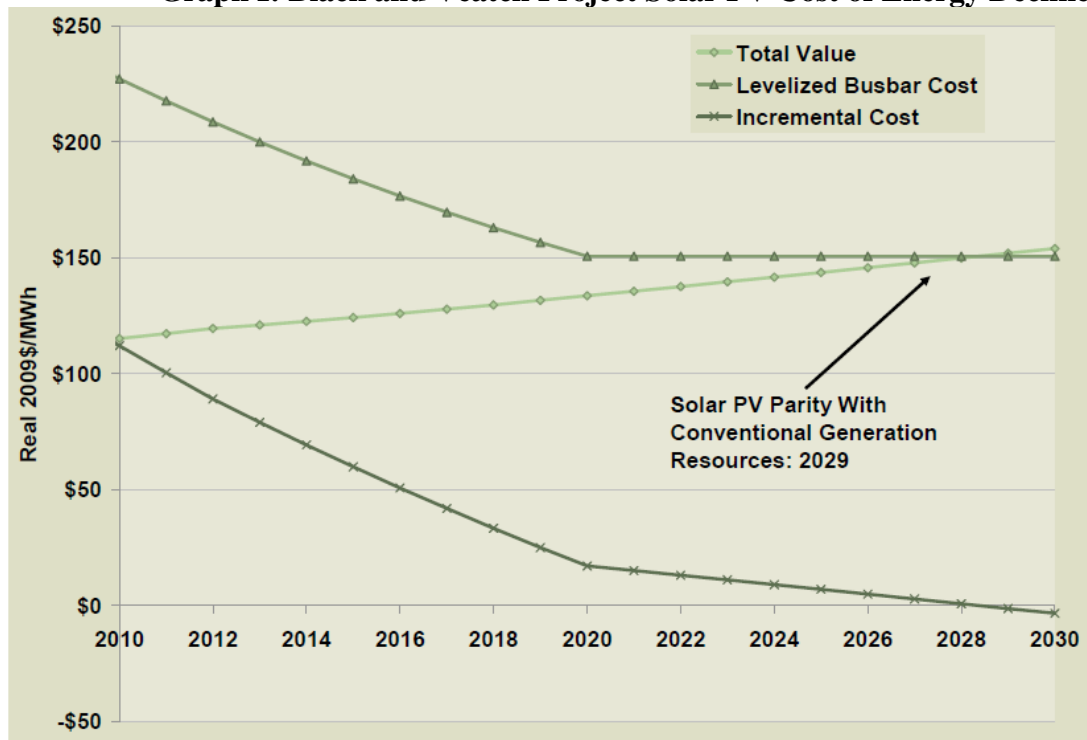**Graph I: Black and Veatch Project Solar PV Cost of Energy Declines**

Figure 6-3. Solar Photovoltaic Cost of Energy Decline, Real 2009$

While B&V overstates solar PV's ability to cut costs over the next decade, the report also misstates Pennsylvania's in-state wind resource potential. In doing so, they overstate wind's generation potential, which they project will comprise nearly one quarter of the total AEPS by 2020.

In 2007[5], Pennsylvania's 293 MW of wind capacity had an average capacity factor (CF) of 18.3%. This in-state capacity generated 470 GWh of electricity, or less than 10% of Pennsylvania's renewable energy generation[6]. However, one must account for the 164.5 MW of wind capacity that came online in 2006-7, which skews the data and provides lower capacity factors.

Pennsylvania had 748 MW of wind capacity by the end of 2009, installed largely to meet the existing Tier 1 AEPS, which reaches 8% by 2018. While wind is one of the lower cost renewable power sources, Pennsylvania possesses mostly marginal Class II-III on-shore wind resources, as

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[5] 2007 represents the last full year of state renewable energy data.
[6] Taken from EIA's State Renewable Energy Profiles:
http://www.eia.doe.gov/cneaf/solar.renewables/page/state_profiles/pennsylvania.html. 470 GWh represents 0.003% of Pennsylvania's total retail sales

well as some limited Class IV[7]. NREL projects Class II and III wind resources achieving average capacity factors between 25-28%, with Class IV sources at 31%.

However, B&V's long-term wind generation cost projections assume an average CF of ~ 34.7%. In 2026, B&V projects Pennsylvania will have 2,346 MW of installed in-state wind capacity, producing 7,012 GWh of generation. This figure is not only well-above Pennsylvania's average CF seen to this point[8], but is even higher than the CF's achieved in regions with rich wind resources like Iowa or North Dakota. Since wind production costs are dominated by fixed cost, the effect of assuming a above average power production performance likely understates the true wind production costs by 15-30 percent.

In their study, B&V identifies 106 potential in-state proxy sites for wind farms needed to meet an expanded AEPS, totaling 5,307 MW. Of these sites, the report projects 60 of the 106 will have capacity factors of 31% or more, with 24 having CF's of 35% or more, which would make them Class V. These projected capacity factors are markedly different from B&V's assertion that "there are areas in Pennsylvania of good to fair wind quality." Barring major technical advances, Pennsylvania, whose wind resources are average at best, will never be able to achieve B&V's projected wind generation total.

Study Adopts Large CO2 Penalty that Overstates Likely Conventional Costs
The report also assumes a carbon penalty for each ton of CO2 emitted. The report assumed the carbon penalty used in EIA's modeling of the Waxman-Markey bill, which starts at $18/ton CO2e in 2012 before eventually reaching $50/ton in 2026. This carbon penalty represents 34 percent of the total B&V fossil fuel generation production costs. By adding a carbon penalty to conventional generation, the study makes renewables more cost-competitive as a result. If Greenhouse Gas legislation does not pass or the penalties are less, renewable production cost premiums and SB 92's compliance costs would be much higher as well.

Understates Cost of SB 92
All these understated renewable cost projections lead B&V to determine that increasing the AEPS would increase cumulative present value costs by $1.6 billion from the assumed Fossil Fuel Only (FFO) prices over the course of the forecasting period (2010-2026) The AEPS case projects costs of $6.8 billion, a 31% increase from the $5.2 billion used in FFO. Over 16 years, this number projects to $100 million annually. Black and Veatch projects a 0.6 % increase over the average 2007 Pennsylvania retail electricity price of 9.08 cents/kWh, or that per household electricity costs would increase by about 50 cents per month versus the FFO scenario. The 31% price increase from the FFO scenario seems inconsistent with only a 0.6% increase in electric power rates.

The 0.6% premium was calculated by projecting the $1.6 billion over the projected aggregate generation requirements over a 16-year period. As utilities struggle to reach the growing solar and CCS requirements in 2022-2024, electricity costs will increase dramatically. The AEPS premium will be much higher in these years than B&V's stated 0.6% increase, while fairly low 2012-2016. The 0.6% is deceiving because it spreads the compliance cost over a 16-year period,

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[7] See page 5-36 of B&V report for a map of Pennsylvania's wind resources
[8] SNL's Power Plant Data for individual Pennsylvania wind farms provides a more complete picture of what constitutes a reasonable capacity factor. From 2004-2007, the 30-MW Meyersdale Plant averaged a 28.9% CF, while the 64.5 MW Waymart plant averaged 27.2% from 2004-2008.

making it appear much lower than its incremental cost as solar and coal CCS requirements ramp up.

The proper comparison is to examine the incremental cost difference between B&V's SB 92 projections and their Fossil Fuel Only case (Figure II) with and without carbon penalties. The B&V study adds a carbon penalty[9] to the conventional power costs. The carbon penalty helps offset a portion of the higher renewable power production costs. In this case, the higher cost for the expanded SB 92 renewable energy standard reaches $1.1 billion/year by 2025. However, if the carbon penalty is much less, or no Federal GHG legislation is passed, the difference between conventional and renewable production costs will be much higher. SB 92's compliance costs could reach $2.4 billion/year by 2025.

Graph II
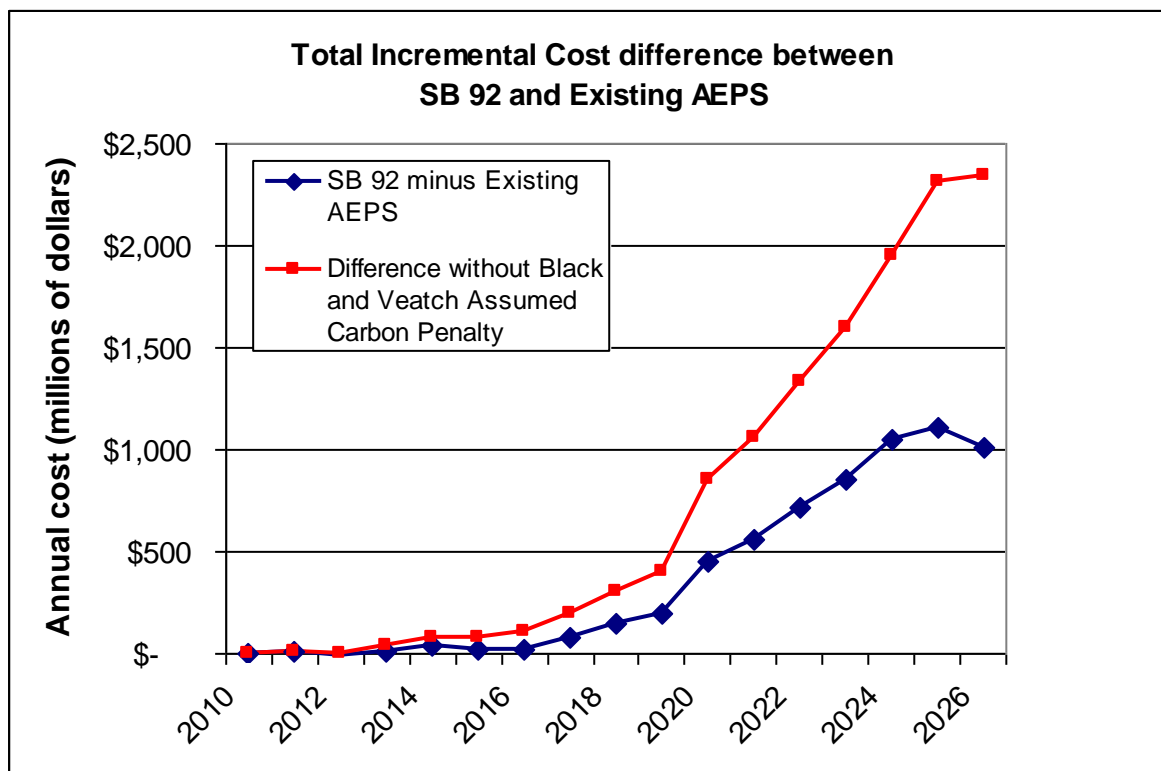
These increased costs for expanding SB 92's AEPS could also be translated into the increased cost per MWh. This is done by simply dividing the compliance cost by the incremental renewable energy. As is shown in Figure III, the additional costs for the renewable energy would cost Pennsylvania ratepayers more than $100/MWh after 2016 (see Graph III below). Given the aggressive input assumptions leading to the risk of understating the actual renewable power costs, Figure II and III could actually be *understating* the actual costs.

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[9] As previously stated, B&V used the projected carbon cost done in EIA's analysis of the Waxman-Markey bill, which started at $18/ton and increased to $50/ton in 2026.

Graph III

Incremental $/MWh costs to Expand RES between SB92 and existing AEPS

Legend: Difference between SB 92 and Existing AEPS

Y-axis: $/MWh — values: $-, $50, $100, $150, $200, $250

X-axis years: 2012, 2014, 2016, 2018, 2020, 2022, 2024
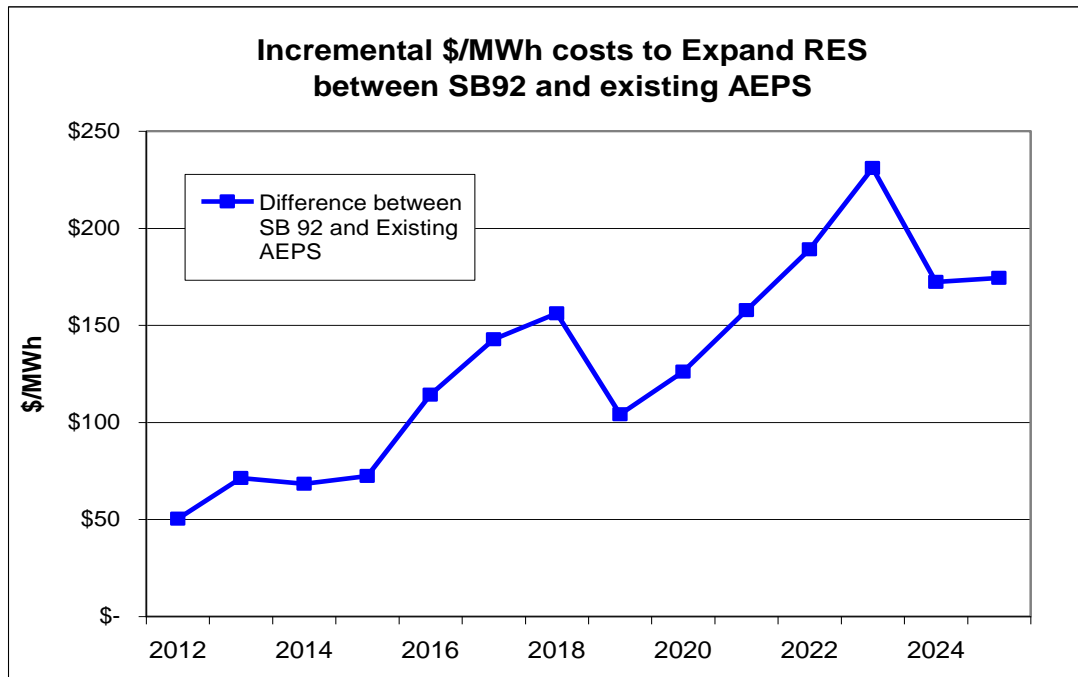
Comparison of Black and Veatch and EVA job calculations for 15% Tier 1 AEPS proposal

Black and Veatch's January 2010 *Assessment of a 15% Pennsylvania Alternative Energy Portfolio Standard* (AEPS) concludes that increasing Pennsylvania's Tier I renewable generation requirements would lead to a 129,000 more Pennsylvania construction and power plant operations jobs-years over the study period (2010-2026)). The study estimated the expanded AEPS would cost ratepayers $1.6 billion more in net present value.

EVA was asked to independently evaluate the Black and Veatch study's job creation methodology, assumptions and conclusions. While expanding renewable capacity to meet higher renewable portfolio demand would increase jobs, EVA analysis reveals that Black and Veatch has drastically overstated the amount of construction and operations jobs created.

A summary of the employment impacts is summarized in Table 1

Table 1
Comparison of B&V and EVA Construction and Power Plant Operations Jobs

Construction Jobs	Black and Veatch	EVA
Cumulative AEPS job-years	138,236	17,357
Cumulative FFO job-years	54,004	4,378
Annual Avg. AEPS jobs	8,131	1,021
Annual Avg. FFO jobs	3,177	258
Annual Net Difference (AEPS-FFO)	**4,954**	**763**
Power Plant Operations Jobs		
Cumulative AEPS job-years	72,342	29,170
Cumulative FFO job-years	27,849	6,709
Annual Avg. AEPS jobs	4,255	1,716
Annual Avg. FFO jobs	1,638	395
Annual Net Difference (AEPS-FFO)	**2,617**	**1,321**

A detailed discussion of these findings is provided below.

Construction Jobs
B&V dramatically overstates the temporary construction jobs created for different generation sources, as compared to EVA estimates.
- Wind temporary construction jobs are _27_ times EVA's estimate
- Solar construction jobs are _5_ times EVA's estimate
- Retrofitting carbon capture and sequestration (CCS) on existing coal plants is 4 times EVA's estimate

B&V artificially assumes low labor costs, which unrealistically increases individual job creation estimates.

- B&V uses $55,000/year as labor cost; EVA uses $90,000/year at $68,000 salary[10]. This discrepancy inflates B&V's job creation estimate by 164%.

Graph 4

Comparison of Black and Veatch and EVA Projected Pennsylvania Construction job creation given 15% Tier 1 AEPS
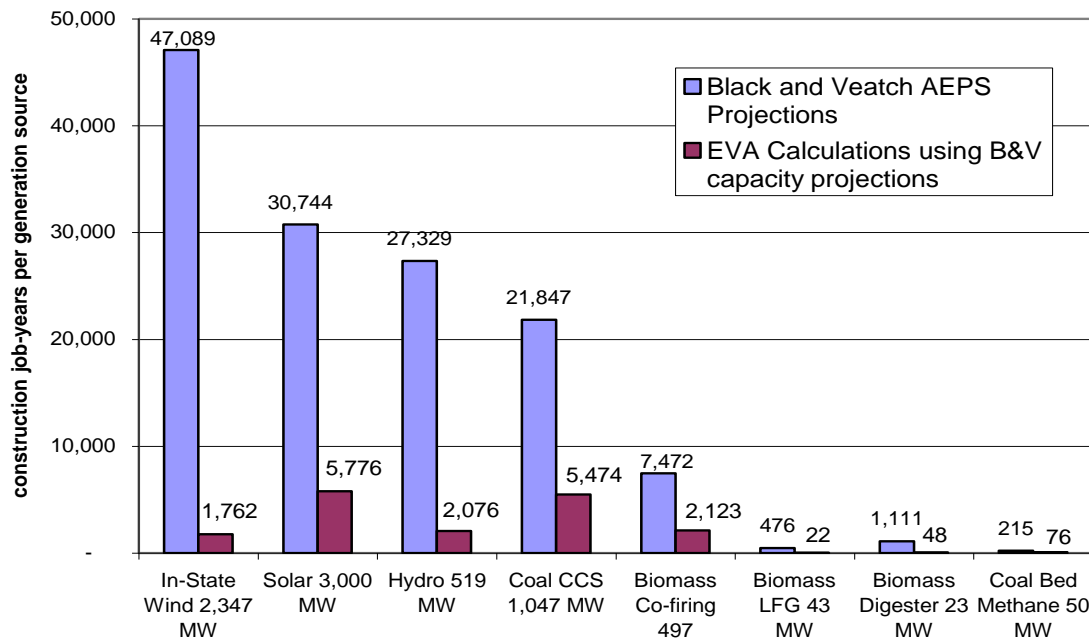
The Black and Veatch study projects that 8,345 MW of renewable capacity will be constructed by 2026. B&V then used a multiplier impact taken from the regional RIMS II input-output model to project the cumulative indirect job creation impacts of increasing Pennsylvania's Tier 1 AEPS from eight to 15% by 2022. Essentially, by creating construction and power plant operation jobs through the AEPS, B&V projects that the increased spending power of these new jobs will have an indirect, trickle down impact on the Pennsylvania economy.

For wind plant construction, B&V projected that every MW of wind capacity construction would create 7.8 direct jobs (construction, engineering and turbine manufacturing) and 12.8 indirect jobs (schools, retail, grocery stores, etc). Usage of the multiplier impact led B&V to calculate that a cumulative 138,326 job-years would be created over the course of the study period (2010-2026), an average of 8,131 construction jobs/year[11]. While constructing wind turbines could provide an indirect job boon to areas that are lightly populated (i.e. North Dakota), Pennsylvania is a relatively dense, established state with existing infrastructure to handle large renewable capacity increases. EVA suspects that new jobs would not be created in Pennsylvania as much as existing jobs would be better utilized.

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[10] Construction jobs assume NREL *Cost and Performance Baseline for Fossil-Energy Plants* (May 2007) labor cost and salaries at $66,000/yr salary ($90,000 with benefits).

[11] Given the different capacity factors of renewables vs. conventional options, B&V projects that 2,951 MW in the Fossil Fuel Only (FFO) case would need to be constructed to generate an equivalent amount of power as the AEPS case. The FFO case would create a cumulative total of 54,004 job-years, or a study average of 3,177.

Using B&V's capacity projections for the AEPS case, EVA projects that 17,357 job-years will created over the cumulative construction period (2010-2026), or annual average of 1,021 jobs[12]. While B&V projects that wind plant construction would create 7.2 job-years/MW installed, EVA calculations project it to be 0.75 job-years/MW installed. EVA job calculations include on-site construction, engineering and materials manufacturing, while B&V numbers include these as well as the indirect job impacts (new schools created, new grocery and retail stores opened). These numbers are difficult to accurately project.
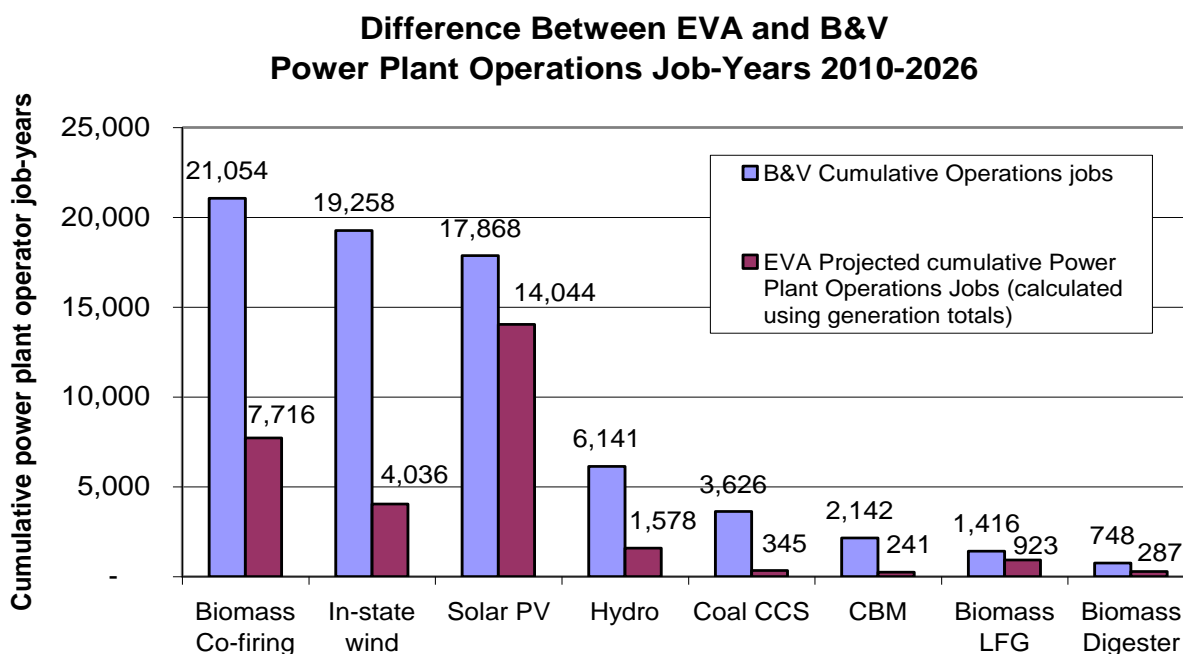
Operations jobs
B&V also dramatically overstates the permanent power plant operation jobs created by the AEPS, as compared to EVA estimates
- Wind jobs are 4.8 times EVA estimates
- Solar jobs are 1.3 times EVA estimates for this evolving, still developmental technology
- CCS jobs are **_10.5_** times EVA estimates

As with construction jobs, B&V understates labor costs, enabling them to overestimate labor employment numbers
- B&V uses $55,000/year as labor cost; EVA uses $68,000 salary ($102,000 with benefits)[13].

Difference Between EVA and B&V
Power Plant Operations Job-Years 2010-2026

B&V projects that the operation of the new renewable capacity would also prove to be a huge job creation tool. They project the AEPS scenario would create 72,342 job-years over the cumulative course of the study (2010-2026), or 4,255 jobs annually. Over 80% of the operations jobs come from the operation of wind, solar, and biomass co-firing installations. While solar and

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[12] EVA used B&V's projected cumulative AEPS capacity totals per generation source to calculate construction jobs. EVA then calculated total construction job-years using factors calculated in previous EVA job studies(see Appendix). Like B&V, EVA used a job-year factor for each MW capacity installed.

[13] Based on NREL's May 2007 Cost and Performance Baseline for Fossil-Energy Plants which reported estimated maintenance cost beyond operating cost and operating jobs, EVA estimated that at annual salaries of $66,000, or $102,300/year with benefits, that 25% additional blue-collar jobs are created by contractors or outside professionals. Again, white collar support for these blue-collar workers was estimated at 35%

wind tend to be labor-intensive in their manufacturing phase, operating them requires relatively little manpower compared to gas, coal and other conventional options. B&V's FFO case projects operating coal and gas plants would employ 1,638 jobs annually from 2010-2026.

For power plant operations, B&V assumed that one MW of a coal capacity would employ fewer employees (0.4 man-years) vs. wind capacity (0.5 man-years). EVA analysis of wind plant and coal plant construction reveals that operating coal plants is substantially more labor intensive than operating wind plants.

EVA used B&V's annual generation projections in their calculation of operating jobs[14].

Power Plant Operations Jobs

Cumulative AEPS job-years	72,342	29,170
Cumulative FFO job-years	27,849	6,709
Annual Avg. AEPS jobs	4,255	1,716
Annual Avg. FFO jobs	1,638	395
Annual Net Difference (AEPS-FFO)	**2,617**	**1,321**

Conclusions

Forcing utilities to build renewable capacity in areas with marginal resources will inevitably increase electricity costs to consumers. By understating the upfront capital cost of solar, wind and coal CCS technologies and assuming a rate of technology improvement that may not be realistic, Black and Veatch overstates how much these electricity these generation types can produce.

As the expanded AEPS forces more solar and coal CCS projects to come online after 2022, annual renewable compliance costs will increase substantially compared to the Fossil Fuel Only (FFO) case. To get around this, B&V uses the cumulative present value calculation, which averages the compliance cost over the study's 16-year period. Doing so distorts the high costs of solar and coal CCS projects (which will come online after 2020), and suggests that the compliance costs will be minimal to Pennsylvania ratepayers (a 0.6% premium over the existing price). Graphs II and III provide a more complete picture of how expanding the existing AEPS will increase electricity costs in the years to come.

On the job creation side, B&V assumes that expanding the Tier 1 AEPS will be enough to bring the green economy to Pennsylvania. After passing the AEPS in 2004, Pennsylvania has issued tax abatements to attract wind manufacturers and solar developers to the state, as shown in Chapter 3-3 of the Black and Veatch report. Spanish wind manufacturer Gamesa has its U.S. headquarters in Philadelphia, and has two manufacturing plants in state- a nacelle-producing plant in Fairless Hills and a blade plant in Edensburg[15]. Both plants employ a total of approximately 800 workers. However, Gamesa's wind blade manufacturing plant is relatively low-wage ($12.34-$18.39/hour). EVA suspects the relatively limited spending power of these manufacturing jobs will not have the indirect wealth creation impacts as assumed in the B&V

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[14] Also taken from *NREL Cost and Performance Baseline for Fossil-Energy Plants* (May 2007)
[15] Source: http://www.pittsburghlive.com/x/pittsburghtrib/business/s_628426.html

study. While some higher paying solar R&D jobs have been created[16][17], the economic recession of 2008-9 forced Gamesa to cut 180 manufacturing jobs in the last year.

While Gamesa and other renewable manufacturers do provide Pennsylvania with an in-state manufacturing base, it is easy to overstate the impact this in-state presence has on job creation. While the Gamesa plants produce nacelles and blades, these are but two components of overall wind turbine design. The remaining components would likely to be imported from out-of-state or more likely, overseas, to complete turbine construction. On the other hand, Pennsylvania has proven, well-paying coal mining, natural gas extraction, fossil fuel engineering, construction and operation jobs. EVA suspects B&V has understated this number in the Fossil Fuel Only case. Doing so creates a larger apparent difference between AEPS and FFO job creation, and overstates the net job creation potential of the AEPS case compared to FFO.

In any case, in-depth review of the B&V study calls into question the accuracy of B&V's report and its unrealistic renewable production cost, generation and job creation projections. While constructing new renewable capacity will create jobs, B&V understates the cost renewable development will have on electricity prices compared to the FFO case. On the other hand, the Black and Veatch report overstates the actual job creation total by underestimating labor costs and by assuming an indirect, trickle down impact on the state's economy that may not be realistic.

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[16] http://www.plextronics.com/aboutus.aspx
[17] http://www.phillyburbs.com/news/news_details/article/175/2009/june/25/ae-polysilicon-has-high-hopes-1.html

Appendix

Taken from B&V report page 6-22

Table 6-6. Cumulative Construction Multiplier Impacts, AEPS Technologies.

Technology	Total MW	Output Impact ($ million)	Earnings Impact ($ million)	Employment Impact
In-State Wind	2,346	10,719	2,227	47,089
Biomass Landfill Gas	43	84	23	476
Biomass Digester	23	179	53	1,111
Biomass Cofiring	497	1,140	359	7,472
Hydro	519	3,701	1,252	27,329
Solar PV	3,000	8,408	1,544	30,744
CCS	1,047	4,081	1,089	21,847
CMM	50	38	10	215
Biomass Direct	0	0	0	0
Out of State Wind	819	2,304	90	1,954
Total	8,345	30,657	6,648	138,236

Table 6-7. Cumulative Operation Multiplier Impacts, AEPS Technologies.

Technology	Total MW-Years	Output Impact ($ million)	Earnings Impact ($ million)	Employment Impact
In-State Wind	13,066	2,205	686	19,258
Biomass Landfill Gas	651	154	50	1,416
Biomass Digester	238	81	26	748
Biomass Cofiring	4,948	971	735	21,054
Hydro	6,028	375	220	6,141
Solar PV	18,430	1,697	631	17,868
CCS	4,712	518	136	3,626
CMM	763	216	77	2,142
Biomass Direct	0	0	0	0
Out of State Wind	4,677	380	3	88
Total	53,533	6,798	2,563	72,342

Table 6-8. Cumulative Construction Multiplier Impacts, FFO Technologies.

Technology	Total MW	Output Impact ($ million)	Earnings Impact ($ million)	Employment Impact
Pulverized Coal	295	1,987	947	19,787
Combined Cycle Gas	1,623	4,074	1,154	25,254
Simple Cycle Gas	1,033	1,644	364	8,963
Total	2,951	7,705	2,464	54,004

Table 6-9. Cumulative Operation Multiplier Impacts, FFO Technologies.

Technology	Total MW-Years	Output Impact ($ million)	Earnings Impact ($ million)	Employment Impact
Pulverized Coal	2,204	657	185	4,229
Combined Cycle Gas	12,124	2,268	792	16,902
Simple Cycle Gas	7,715	668	320	6,718
Total	22,043	3,593	1,297	27,849

On-Site Construction, Engineering and Manufacturing Related Employment

Employment Man-years/Billion Capital $ Invested

Technology Type		A Onsite Construction	B Engineerin	C Direct Ons Subtotal	D Material Mfg Jobs	E Conventior Equip	F Turbine/Bo CCS Mfg Jobs	G direct+ indirect Subtotal	H Labor Cost %Total	I Induced Jo	J Total Employme Impact	Capital Cost $/MW installed	Capacity Installed for $1billion	Direct+ Indirect jobs /MW capacity
Coal	Subcritical-no CCS	3,167	543	3,710	114	814	943	5,581	50%	2,791	8,372	$ 1,550,000	645	8.7
	Est. PA Jobs	1,584	543	2,127	114	814	314	3,369					645	5.2
	Subcritical-CCS	2,755	515	3,270	80	626	1,227	5,203	42%	2,602	7,805	$ 2,893,000	346	15.1
	Est. PA Jobs	1,492	515	2,007	80	626	409	3,122					346	9.0
	Supercritical-no CCS	3,100	547	3,647	110	789	1,027	5,573	50%	2,787	8,360	$ 1,575,000	635	8.8
	Est. PA Jobs	1,556	516	1,872	110	789	342	3,113					635	4.9
	Supercritical-CCS	2,711	516	3,227	78	565	1,273	5,143	46%	2,572	7,715	$ 2,870,000	348	14.8
	Est. PA Jobs	1,356	516	1,872	78	565	424	2,939					348	8.4
IGCC	no CCS	2,303	513	2,816	137	546	1,609	5,108	46%	2,554	7,662	$ 1,759,000	569	9.0
	Est. PA Jobs	1,152	513	1,665	137	546	531	2,879					569	5.1
	w/CCS	2,340	509	2,849	123	493	1,419	4,884	44%	2,442	7,326	$ 2,388,000	419	11.7
	Est. PA Jobs	1152	509	1661	123	493	468	2,745					419	6.6
NGCC	no CCS	1,816	490	2,306	143	634	1,752	4,835	44%	2,418	7,253	$ 555,000	1,802	2.7
	Est. PA Jobs	908	490	1,398	143	634	578	2,753					1,802	1.5
	w/CCS	1,813	498	2,311	95	722	1,779	4,907	44%	2,454	7,361	$ 1,171,000	854	5.7
	Est. PA Jobs	907	498	1,405	95	722	578	2,800					854	3.3
Coal Control Retrofit	CCS Retrofit	2,164	554	2,718	3	60	1,961	4,742	47%	2,371	7,113			
	PA CCS Retrofit	1,082	554	1,636	3	60	-	1,699						
Wind	JEDI 3	294	34	328	306	included	included	634	6%	317	951	$ 2,643,000	378	1.7
	Est. PA Jobs	147	34	181	103			284					378	0.8
Solar	JEDI 3	1,316		1,316 included	included	477	455	2,248	20%	1,124	3,372	$ 4,862,000	206	10.9
	Est. PA Jobs	197		197		47	152	396					206	1.9
Biomass Subcritical w/o CCS		3,167	543	3,710	114	814	943	5,581	50%	2,791	8,372	$ 2,000,000	500	11.2
	Est. PA Jobs	1,584	543	2,127	114	814	-						500	-
BIGCC w/o CCS		2,303	513	2,816	137	546	1,609	5,108	46%	2,554	7,662	$ 2,285,000	438	11.7
	Est. PA Jobs	760	513	1,273	137	814	1,609	2,224					438	5.1

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EVA Construction

Direct/Indirect on-site Jobs

Jobs years/MW capacity	0.75	1.93	4	5.22	4.25	0.5	2	1.53	Total
	In-State Wind	Solar	Hydro	Coal CCS	Biomass Co-firing	Biomass LFG	Biomass Digester	Coal Bed Methane	
Total Installed Capacity	**2,347**	**3,000**	**519**	**1,047**	**497**	**43**	**23**	**50**	**7,526**
minus out-of-state wind									
Black and Veatch AEPS Projection:	**47,089**	**30,744**	**27,329**	**21,847**	**7,472**	**476**	**1,111**	**215**	**136,283**
EVA Calculations	**1,762**	**5,776**	**2,076**	**5,474**	**2,123**	**22**	**48**	**76**	**17,357**
using B&V capacity projections									

	Capacity	Direct-Indirect Jobs
PC	**295**	1,541.00
NGCC	**1623**	1,259.27
GT	**1033**	1,578.34
		4,378.60