

DIVERSIFYING ENERGY IN WEST VIRGINIA: A GLIMPSE INTO SOLAR ENERGY AND ENERGY EFFICIENCY IN THE MOUNTAIN STATE



appalachian
transition
fellowship



 **EEWV**
ENERGY EFFICIENT WEST VIRGINIA

ACKNOWLEDGEMENTS

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ENERGY EFFICIENCY

In a time of high energy demand, energy efficiency is a least cost resource to ensure security of the electrical grid for residents, schools, businesses, industry, and government facilities. Energy efficiency, simply put, is providing the same service using less energy. This is a brief survey of energy efficiency in the state of West Virginia, intended to provide insight to the strengths and weaknesses of our state's energy efficiency policies. Energy efficiency serves as an underutilized opportunity for accessible job creation and security for the people of West Virginia.

IN HOMES

The most direct, impactful energy efficiency development is seen in people's homes, particularly in low-income households. Low-income efficiency achieves cost-savings for the utility by reducing bad debt, arrearages, and the administrative costs of collection and service termination. The efficiency and demand savings delivered by low-income programs reduce strain on the grid, which is particularly valuable during summer and winter peaks. Lastly, since low-income rate subsidies are generally funded via tariff riders, high-performing efficiency programs reduce costs for all ratepayers (American Council for an Energy-Efficient Economy, "Myths of Low-Income Energy Efficiency: Implications to Outreach").

Non-energy benefits can accrue to different stakeholders or to society as a whole. Examples include higher property values, improved appearance of the community, local job creation, local spending, improved human health, and potentially lowering costs of government and utility subsidies (International Energy Agency, "Evaluating the Co-Benefits of Low-Income Energy Efficiency Programs").

E4: ENERGY EFFICIENCY IN THE EAST END

PROJECT SUMMARY

e4 is a competition that pits East End blocks against one another to compete for the largest reduction in energy consumed (as a block) through Appalachian Power's HomeSMART assessments and energy efficiency retrofits. The goal of e4 is to create momentum and education around being a smart energy consumer, thereby creating "a culture of energy conservation."

In total, there were 385 participants. Of that number, 254 requested ApCo Home Energy Assessments, 79 requested weatherization assistance, 34 requested a more comprehensive audit, 39 requested HVAC assistance, 42 were interested in solar electricity, 26 were interested in solar hot water systems, and 19 requested plumbing assistance.

In 2013, more than 8,000 kw/h were saved, equivalent to \$720. Over 40 ApCo Home Energy Assessments were completed. This included only the first 75 participants. Between 2013 and 2014 e4 saw a growth of 500% in total participants, and a growth of 600% in total

requested energy audits.

The introduction of a canvass team proved to be particularly successful in building participation. Expanding the canvas to ensure on-going contact with the residents throughout the competition and to traverse more territory is critical to the success of the competition, but more importantly to the broader goals of energy conservation and monetary savings. Expansion of the canvas will require more funding. Additionally, the hire of a full time project manager for e4 will leverage better results for residents, the competition, and savings. Direct attention on a regular basis is needed to fully capitalize on the competition.

This project is a good competition-based model of energy efficiency promotion, though there are limiting factors that can be observed in the data, as well as in comparisons to similar projects.

ReEnergize Pittsburgh, of Pittsburgh, Pennsylvania, is another coalition that organizes an active energy efficiency competition. It operates in 14 com-

munities across Pittsburgh, organizing alongside "community ambassadors." It has a broader cross-sector partnership than e4, as well as more investment.

LOCATION:

East End Neighborhood,
Charleston, WV

AUDITOR USED:

Good Cents

CONTRACTOR USED:

EJ Thompson & Sons

PROJECT COSTS:

2013: \$10,000 from the WV
Division of Energy
2014: \$25,000 from the WV
Division of Energy

This is assured through Pennsylvania state law which states that utilities are required to spend 0.2% gross revenues on low-income weatherization programs. Adopting this policy in West Virginia would allow programs that hold significance in the lives of many, such as e4 and PRIDE Community Services' Weatherization Program, to continue operating at fuller capacity.

PRIDE WEATHERIZATION PROGRAM

PROJECT SUMMARY

The Low-Income Weatherization at PRIDE Community Services was the recipient of the money given to Logan County through the American



LOCATION:

Logan, West Virginia

JULY 2011-2012 JOBS COMPLETED:

72 total homes

JULY 2013-2014 JOBS COMPLETED:

30 total homes

AVERAGE YEARLY SAVINGS:

\$1560

AVERAGE JOB COSTS:

\$2303

Recovery and Reinvestment Act (ARRA) in 2009.

In one of its best funded and most successful years, 2011-2012, PRIDE's construction team provided weatherization services to 72 households. This means a total of \$112,320 had been saved as a result of this year's services alone, largely in the homes of low-income families.

The most common services provided are insulation of roof, walls, and floor; heating system safety and efficiency

inspections; and heating system upgrades.

During the 2013-2014 season, with less than half the funding that was available in 2011-2012, a total of 30 homes received weatherization services from PRIDE.

Not only does this program strengthen the housing infrastructure of Logan County, it provides accessible employment to many Logan County residents with on-the-job training from PRIDE and the Office of Economic Opportunity.

IN SCHOOLS

Across the country, schools are faced with tighter and tighter budgets. In the 2014 fiscal year, 34 states provided less per-student funding for K-12 education than in fiscal year 2008, the height of the country's recession (Center on Budget and Policy Priorities, "Most States Funding Schools Less Than Before The Recession").

West Virginia schools, as well as many schools across the country, are also facing severe teacher shortages. As of 2013, local school districts across the US had cut a total of 324,000 jobs since 2008 (Center for Budget and Policy Priorities). In 2013, in Kanawha County—West Virginia's largest school district—216 teachers quit their jobs. About 75% of those were retirees (Charleston Gazette, "As school starts, more teachers needed to fill holes"). These startling figures are not only a reflection of a mass exodus of baby boomers into retirement, but of the compensation we provide teachers. West Virginia ranks 48th in teachers' compensation (West Virginia Education Association, "WV Unions: Raise Teacher Pay").

The Least Controversial, most effective and realistic answer to addressing budget shortages in schools in West Virginia is energy efficiency. One successful example of energy efficiency in schools is the Wyoming County School System in southern West Virginia, which has realized significant reductions in operating costs through energy efficiency. In 2003, the school system created a formal energy plan where they prioritized new projects based on the cost per square foot to operate. Since January 2004, the school system has saved more than \$1,690,450 in energy costs through investments in energy management systems, motion sensors, upgraded heating equipment, more efficient lighting and other efficiency measures (West Virginia Department of Commerce, "Wyoming County Schools earn ENERGY STAR accolades").

The average cost to operate the schools in this county is \$0.94/sq. ft., which is much lower than the national average of \$2/sq. ft. (West Virginia Department of Commerce). This means that, in theory, more money will be available for higher wages for teachers and for furthering general education reform to more adequately equip youth with the tools they need to be engaged and well-informed members of society.

Not only can schools see major savings through energy efficiency, but they also have the potential to be innovators in the sector. One featured school, Webster County High School, has installed a fully automated, 500 ton geothermal heat pump loop consisting of 240 wells; it is 307 feet deep, with over 28 miles of underground piping spread in an adjacent practice football field. They are one of the largest, most energy intensive institutions in the state to utilize the untapped geothermal potential of the state. Through this and other measures, Webster County High School has seen a greater than 50% reduction in heating, ventilating, air conditioning, and lighting costs.

Energy efficiency improvements also offer an opportunity to bring up-to-date the state's aging infrastructure. Many schools in the state still operate with coal-fired boilers and have inadequate ventilation, as many of the buildings were opened in the mid-1900s.

GLADE ELEMENTARY + MIDDLE SCHOOL



ABOUT THE PROJECT

Glade Elementary + Middle School, originally built in 1974, had additions in 1976, 1984, and 1994 with an extensive energy efficiency renovation in 2010. The project included upgrading the all-electric HVAC system in the building and electric service capacity. The project was also scheduled in phases by Webster County Schools, and accordingly no school days were missed throughout construction.

Portions of this school were not previously air conditioned, which was addressed as part of

the HVAC upgrades. The HVAC system was through packaged roof mounted air handling units. ZDS designed comprehensive DDC controls with remote monitoring, humidity and CO2 controls including DDC centralized monitoring, which allows Webster County Schools to optimize energy and assist in remote troubleshooting and maintenance.

To resolve poor lighting conditions, ZDS incorporated energy-efficient lighting technology with lamps and fixtures that require less ener-

LOCATION:

Cowen, WV

TOTAL PROJECT COST:

\$3,588,000

SBA FUNDS UTILIZED:

\$3,558,160

ENERGY SAVINGS:

>30% reduction HVAC and operating costs

ENERGY AUDITOR & ENGINEER:

ZDS Design/Consulting Services
281 Smiley Drive
St. Albans, WV 25177

gy and produce less heat while meeting industry requirements. The project also addressed emergency lighting to meet the State Fire Marshal's requirements which the school had been cited to address.

WEBSTER SPRINGS ELEMENTARY SCHOOL

PROJECT SUMMARY

ZDS implemented many technologies in the process of improving the indoor air quality (IAQ) and Heating, Ventilation, and Cooling (HVAC) systems of Webster Springs Elementary. Where Webster Springs Elementary once had outdated, coal-fired boilers and venti-



heating and cooling system, energy efficient lighting, multi-speed fans that self regulate speed to maintain climate conditions, increased ventilation, improved filtration, and ultraviolet lights that reduce the risk of mold growth and other airborne germs. To minimize operating costs for the increased ventilation required to meet IAQ standards, ZDS incorporated carbon dioxide outdoor ventilation air control.

In addition to upgrading the HVAC sys-

tem and IAQ at Webster Springs Elementary, ZDS also helped Webster County Schools obtain funding for the project from the state's School Building Authority (SBA).

LOCATION:

Webster Springs, WV

TOTAL PROJECT COST:

\$1,430,000

SBA FUNDS UTILIZED:

\$1,300,000

PROJECTED ENERGY SAVINGS:

40% reduction in HVAC electricity use

ENERGY AUDITOR & ENGINEER:

ZDS Design/Consulting Services
281 Smiley Drive
St. Albans, WV 25177

“The indoor air quality is likely the best of any school in the state and the energy usage is less than half what it used to be!”

Harry Given, former administrator of Facilities and Support Services, Webster County Schools

lation systems that were harmful to health, they now have a geothermal

ELKINS MIDDLE SCHOOL

ABOUT THE PROJECT

As with other energy efficiency projects in public schools highlighted in this collection, there was extensive use of SBA funds as a basis for this project. Elkins Middle School was experiencing growing energy and interior environmental issues arising from the outdated mechanical, lighting, electrical and safety systems, all of which were addressed through services provided by ZDS Design & Consulting Services. Through careful planning with school administration and ZDS, these services were provided with minimal loss of

productive school days.

ZDS designed air handling systems to address health, safety, and indoor air quality issues by increasing outdoor ventilation air rates, increasing filtration, creating strict humidity control, and providing other air quality relat-



ed services. Other mechanical challenges revolved around lighting and a malfunctioning, aging plumbing system. The plumbing was modernized and energy efficient lighting technology, such as new bulbs, lamps, and fixtures, was installed. Also addressed was the sprinkler system that previously had not been up to state building code. Each of these upgrades improved the conditions within the facility, allowing the students, teachers and staff to focus on the top priority - education.

LOCATION:

Elkins, WV

TOTAL PROJECT COST:

\$8,686,000

SBA FUNDS UTILIZED:

\$7,300,890

ENERGY AUDITOR & ENGINEER:

ZDS Design/Consulting
Services
281 Smiley Drive
St. Albans, WV 25177

WEBSTER COUNTY HIGH SCHOOL

ABOUT THE PROJECT

In order to cope with high energy costs, Webster County High School used a fully automated, 500 ton geothermal heat pump loop consisting of 240 wells, 307 feet deep, with over 28 miles of underground piping

spread in an adjacent practice football field. Indoor air quality issues are addressed in the new design through increased ventilation, improved filtration, customizing the design of the air heating units, and cleaning/coating existing ductwork. Operating costs for the in-

“We had a totally electric school with a bill of about \$120k a year. With the new HVAC system, we’ve reduced our electricity bill about \$60k. And this high school has the best air quality of any school in the state. It’s been a win-win situation for us.”

Harry Given, former administrator of Facilities and Support Services, Webster County Schools

LOCATION:

Upperglade, WV

TOTAL PROJECT COST:

\$5,083,000

SBA FUNDS UTILIZED:

\$5,083,000

PROJECTED ENERGY SAVINGS:

>50% reduction HVAC and lighting operating costs

ENERGY AUDITOR & ENGINEER:

ZDS Design/Consulting Services
281 Smiley Drive
St. Albans, WV 25177



creased ventilation were minimized through incorporating air-to-air energy recovery systems into the new rooftop air handling equipment. The combining of the air-to-air heat recovery together with the primary air handling equipment is receiving national attention and may be the first of its

kind for geothermal applications. The interior lighting, ceilings, and bricking of the exterior are part of the overall upgrades to Webster County High. The energy efficiency project of Webster County High School was successful enough that Webster County Schools expanded their energy efficiency programs.

IN COMMERCE AND PRODUCTION

Industries are, by far, the largest energy consumers tied to the grid, and scaled-up infrastructure means scaled-up savings. Although it takes time, even the simplest measures can result in significant savings on energy costs, and allow other operations to run more smoothly. In order to convey the true scale of the savings potential in industrial energy efficiency, I will refer to the findings of this Lawrence Berkley National Lab study.

Table 3. Summary of ancillary benefits from 81 U.S. industrial energy improvement projects

Metric	Value
Total project costs	\$68,219,115
Total annual energy savings	\$47,662,220
Total annual ancillary value	\$21,080,449
Total annual combined (energy + ancillary) benefit value	\$68,742,669
Simple payback based on energy savings alone	1.43 years
Simple payback based on combined benefit value	0.99 year
Number of the 81 projects that demonstrate ancillary benefits	54 (67%)
Number of the 54 projects with ancillary benefits providing a negative CCE	31 (57%)

Source: Lung et al. 2005

CENTER HARDWARE

PROJECT SUMMARY

Center Hardware is a St. Albans based, family owned and operated hardware store with a long legacy of energy efficiency improvements. From structural improvements to efficient lighting, nearly forty years of alterations have made this business operate more cost-effectively.

In the 1970s, the business contacted their power provider to find information on what energy efficiency measures would provide the most balanced payback and savings. After this consultation, the owners then installed 6" of insulation on the ceiling.

Prior to 1980, the

store was heated with forced air gas heaters. From 1980 to 1995, the building was heated with



wood, and in 1995 Center Hardware finally transitioned to burning wood pellets. These measures cut heating costs approximately 80% from natural gas. Also installed in the 1980s were vestibules on the store entrance, further expanding on the build-

ing's atmosphere control capabilities.

In 2011, Center Hardware made its latest investment in energy efficiency by replacing 84

96" incandescent bulbs with 96" compact fluorescent bulbs. This increased lighting by about 50%, making products easier to view, as well as reducing lighting costs. The total investment was \$4,000-\$5,000, offset by a \$2,000 rebate from AEP.

TOYOTA MOTOR MANUFACTURING

LIGHTING

- Toyota Motor Manufacturing West Virginia (TMMWV), of Buffalo, WV, was operating with inefficient lighting in the plant's high bay for some time.
- Metal halide lights used >400W per light
- The lights take over 10 minutes to warm up, so they were left on 24/7

STRATEGY

- Replace current metal halide lights with fluorescent lights.
- Use motion sensors on light to ensure lights go out when no one is in the plant (weekends and between shifts).

RESULTS

- installed ~2,000 lights
- each light saves 220W or 158 kWh per month
- average WV home uses 1116 kWh per month
- 2,000 lights changed is equivalent to taking 280 houses off the electric grid



AUTOMATED MOTOR CONTROL (VFD)

What is a VFD?

Variable Frequency Drive

How are VFD used?

To control the speed of an AC Motor

How does the VFD work?

The VFD is able to control the AC motor speed by controlling the frequency of the electrical power supplied to the motor.

Example:

VFD set at 60 Hz, AC motor speed is at 100%

VFD set at 30 Hz, AC motor speed is at 50%

PHASE 1: TMMWV ENGINE PLANT

Installed VFDs on 34 HVAC units

PHASE 2: TMMWV A/T PLANT

22 units being installed

CURRENT MONTHLY ENERGY SAVINGS:

750 kW or \$20,000

RETURN ON INVESTMENT:

1 year

CURRENT PROJECTS:

modifying HVAC programming to optimize VFD energy savings

IN GOVERNMENT

City and country governments, as well as the state of West Virginia itself, have shown that investment in energy efficiency in the public sector—be it street lamps, building renovations, or alternative energy sources—can save the public’s tax dollars. Within the state’s aging infrastructure there is great potential for public sector job creation in HVAC and construction. Several states have embraced public sector energy efficiency and seen tremendous economic benefit. With an already semi-skilled workforce developed within our state, public sector energy efficiency is a necessary step in providing jobs and keeping people in West Virginia.

WEST VIRGINIA CULTURE CENTER

PROJECT SUMMARY

Until 2001, the West Virginia Museum of Culture and History building had longstanding HVAC

The mechanical and electrical renovations for the State of West Virginia Library Com-

missions project for the Division of Culture and History. The retrofits saved energy and improved indoor air quality and comfort within the building. The culture Center renovations are estimated to save nearly \$153,000 annually over the costs of operating the old system.

The fire alarm and fire protection renovations were completed well under budget and the building remained occupied while work was being done.



and Indoor Air Quality issues, placing many priceless artifacts and pieces of history at risk of being damaged. It was then that ZDS Design and Consulting Services began to address these issues for the WV Division of Culture and History. They returned in 2008 to provide fire alarm and fire protection upgrades which were completed in 2010.

mission stacks and office spaces were also part of the \$4.5 million HVAC and Electrical Renova-

LOCATION:

Charleston, WV

PROJECT COSTS:

\$6,000,000

ANNUAL SAVINGS:

\$153,000

ENERGY AUDITOR & ENGINEER:

ZDS Design & Consulting
Services

SOLAR POWER

Presently development opportunities in the solar industry are growing. Compared to other states, West Virginia has many legislative and economic limitations regarding the development of solar energy production on all scales, but we have some laws that allow homeowners to make investments in solar and significantly cut their utility costs. There are steps that must be taken to use the opportunity the solar industry presents while it is still available. States across the country have embraced the solar market and seen tremendous gain as a result. This is a collection of examples from around the state that show the savings we have gained and are hoping to gain with solar development in commercial, residential, and government settings.

HURRICANE WATER + WASTEWATER DIVISION

PROJECT SUMMARY

The City of Hurricane was the recipient of a grant from the US Department of Energy worth \$180,000. The grant was used to incorporate solar energy into several parts of the city's municipal water infrastructure. The largest installation is an array of 82 panels, 20kW each at

ness of the solar potential we hold in this region.

The grant also allowed for the purchase of three battery back up lift stations for sewer access, and two battery back up telemetry stations, to be used to get automated readings of tank levels in case of power outage. All



the wastewater treatment facility. The array was intentionally placed beside the westbound lanes on Interstate 64 to raise aware-

ness of these measures increase the security of the areas surrounding this plant and sewer system in case of emergency.

LOCATION:

Hurricane, WV

PROJECT COST:

\$150,000

MONTHLY SAVINGS:

\$400-\$500

AUDITOR, CONTRACTOR, & DESIGNER:

Mountain View Solar

The solar systems were installed, also, for the purpose of decreasing consumer's rates. Unfortunately, the price of Solar Renewable Energy Certificate's sold to other states are not valuable enough to make a significant impact on consumer rates. This can be changed through the creation of an instate Solar Renewable Energy Certificate market.

AMERICAN PUBLIC UNIVERSITY SYSTEM

ABOUT THE PROJECT

American Public University System's facilities at Ranson are home to the state's largest solar array. The array, built above the facilities parking lot in 2012, utilizes 1,660 240W solar panels to potentially generate approximately 50 percent of the center's energy requirements—enough electricity to supply 30 homes with electricity for a full



LOCATION:
Ranson, WV

ANNUAL OUTPUT:
2,000,000 kWh

**AUDITOR, CONTRACTOR,
& DESIGNER:**
Mountain View Solar

No financial data available at this time

year. In just the fourth quarter of 2012, it produced 515,000 kWh of energy, and features 15 electric car charging stations for use by employees, visitors and local residents with electric or hybrid vehicles. The array is also constructed on top of a former brownfield.

MALCOLM FARMS

LOCATION:

Moorefield, WV

TOTAL PROJECT COST:

\$120,000

FUNDING SOURCES:

USDA REAP Grant: \$30,000

Natural Capital Investment Fund Loan: \$90,000

SAVINGS:

Produces 80% of electricity used

PAYBACK PERIOD:

15 years

AUDITOR, CONTRACTOR, & DESIGNER:

Mountain View Solar

In January 2014, Malcolm Farms took a step to reducing costs of operating their poultry houses by installing a 35kW solar array. In its first year, this system produced about

ABOUT THE PROJECT



37,000 kWh of electricity. Through federal tax incentives and the funding from the REAP grant and the NCIF loan, it is estimated farm owner Ward Malcolm's investment will pay itself off in 15 years.

“Without the REAP grant and the federal tax credit available, we would not have been able to do this. If the folks at Natural Capital Investment Fund hadn't done the paperwork for the REAP grant, this project wouldn't have happened.”

Ward Malcolm, Farm Owner, Malcolm Farms

MORGAN COUNTY COURTHOUSE

ABOUT THE PROJECT



The array at the Morgan County Courthouse is of considerable size. It is composed of 108 SolarWorld 235W poly-crystalline modules, for a total peak-rated power output of 25.38kW, accompanied by three inverters. The project cost was \$196,000. It saves about \$2,763 per year with an estimated 71 year return on investment. The courthouse saves about

3.5% of energy consumed monthly. Since 2011 the courthouse has generated \$1,333 in the sale of Solar Renewable Energy Credits (SRECs) to other states. The length of return on investment would sharply decline if West Virginia created an in-state SREC market, as out-of-state SRECs are generally lessened in value to incentivize solar development in a given

state. The entire system was paid for through the Energy Efficiency Conservation Block Grant Program.

LOCATION:

77 Fairfax Street, Berkeley Springs, WV 25411

SOLAR INSTALLER:

Mountain View Solar

TOTAL COST:

\$196,000

