

## Chapter III. State of Technology and Manufacturing in Appalachia

### 1. Wind

Today's wind turbines are much larger and more efficient than those of the 1980s. Modern turbines are as large as 5 MW each while in early 1980s, during that wave of wind power development, a typical turbine was 25 to 100 KW. Today's turbines produce much more power and also require a larger physical footprint. Costs have declined by about 90 percent over the last 20 years, mostly from capital cost decreases and efficiency improvements.<sup>13</sup>

As rotor diameters have gotten longer, increasing from about 10 meters in early 1980s to over 80 meters today, capacity and energy production actually increased as a faster rate. This recent development of larger turbines has made Appalachian wind more attractive to commercial developers due to the greater quantity of electricity that can now be generated per turbine as well as improved availability. Turbines up to two MW in size, such as those installed at the Bear Creek Wind Farm in Pennsylvania, or the 2.5 MW turbines proposed for Clipper project in Garrett County, MD, are among the largest on-shore turbines in the world. Due largely to the State of Pennsylvania's active policy toward wind development, wind-energy company **Gamesa Corp.** of Spain selected an industrial park in Ebensburg, PA as the site for its U.S. blade manufacturing facility. The increased size and height of turbines has spurred debate over the issue of "viewshed" impacts from wind installations. Larger turbines have hub heights over 300 feet and are thus visible from further distances compared to older, smaller turbines that may have been only 30 to 40 feet tall.

Wind energy efficiency improvements have included use of advanced electronics to develop variable speed turbines and longer lived turbines. Systems integration improvements have induced system operators to give wind capacity credit on the electricity grid, increasing the viability of wind projects. New R&D on low-speed land-based turbines can help take advantage of lower speed winds, which have applicability throughout the Appalachian region.

Other wind-related manufacturing activity in the ARC region includes **General Electric's** wind turbines R&D facility in Greenville, SC. That location does wind turbine fleet support engineering focused on the generator and other electrical components.

**Magna Machine** in Cincinnati, OH is a manufacturer of blade hubs. Its proximity on the border of the ARC region promises potential synergies with manufacturers in Appalachian.

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<sup>13</sup> American Wind Energy Association, 2005.

## 2. Solar

The primary barrier to widespread installation of solar energy conversion systems is price. Photovoltaic (PV) systems are still expensive, up to 32 cents per KWh. These systems are also still fairly inefficient: thin-film cells are less than 10 percent efficient and crystalline-silicon cells are 12 to 14 percent efficient. Further improvements in efficiency would allow the less intense sun areas of the Appalachian region to get more from a PV cell. Other issues that continue to stymie expansion include low component manufacturing rates; the industry has a goal of creating a 200 MW factory by 2020. Silicon production is also expensive and a larger supply chain is needed. In spite of these issues, PV production costs have fallen by 100 times since the mid-1970s.<sup>14</sup>

Breakthroughs in system integration have improved the ease of maintaining solar systems which promotes usability. In addition, marketing of solar systems in nationwide stores such as Home Depot has also made the technology more accessible.

Other means of capturing solar power, such as concentrating solar power, where thermal solar energy is collected as heat and directed toward a conventional power generating system, have also made progress but are less applicable to the Appalachian region. Since the 1980s DOE R&D support has allowed the costs of this type of system to decline considerably while also improving efficiency.

Solar manufacturing and solar R&D activity in the Appalachian region is concentrated in Pittsburgh area. **Plextronics Inc.** conducts research to manufacture polymer cells that are thinner, lighter and more flexible than current PV cells. Polymer cells are made from regioregular polythiophenes, self-assembling nanoscale conducting polymers. This type of PV cells has the potential to be more cheaply produced (printed) than other PV cells. **Plextronics** was founded in 2002 as a spin-off from Carnegie Mellon University's McCullough Lab.

A firm by the name of **Solar Power Industries, Inc.** in Belle Vernon, PA makes crystalline cells, primarily for the gardening products.

**AFG Industries'** Blue Ridge Plant in Kingsport, TN is a flat glass manufacturer that supplies BP Solar, Shell Solar and GE Solar with photovoltaic glass.

There are several other solar manufacturers that are in ARC states but not in the ARC region, that are worthy of mention. These include **Atlantis Energy Systems, Inc.** in Exmore, VA that makes building integrated PV products including PV roofing slates and PV glass laminates and **BP Solar** in Frederick, MD, which is one of the larger PV panel manufacturers in the country.

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<sup>14</sup> U.S. Department of Energy, Solar Energy Technologies Program.

### **3. Geothermal**

Most recent geothermal technology improvements have been related to system design. Some increased efficiency has also been seen but most improvements are due to the way air and water is delivered from the ground to the building. Staging and zoning of delivery have become more sophisticated, which has reduced the costs of supplying geothermal heating and air conditioning to multiple zone buildings.

There are two geothermal system design companies in the ARC region. Both of these are in Pennsylvania: **Sunteq/Enviroteq** in State College, and **Hydro Delta Corp.** in Monroeville. Both companies design, build and install custom geothermal systems designed for specific applications. Enviroteq manufactures compressor units, with up to three stages of heating and cooling that interface with conventional air handlers. Hydro Delta manufactures a broad range of heating, cooling and water heating systems, including on-demand water heating equipment, and was the industry's first manufacturer to custom-insulate tube-in-tube heat exchangers to prevent condensate from forming on the outer surfaces.

### **4. Small and Low Impact Hydro**

Modern hydroelectric technology has made progress in several areas. Overall, a major aspect of advancement has been in improved hydrologic assessment and project identification. Standardized design of turbines and generators also allows for greater ease of operation and maintenance.

Modern turbines also perform better regarding environmental impact. Newer turbines contribute less to fish mortality, with advanced turbine technology such as that supported by the DOE's Wind and Hydropower Technologies Program having the ability reduce fish mortality resulting from turbine passage to less than two percent, in comparison with turbine-passage mortalities of 5 to 10 percent for the best existing turbines and 30 percent or greater from other turbines. Newer turbines also have improved compliance with water quality standards in terms of maintaining required downstream dissolved oxygen levels.

The study team was not able to locate any regional firms that specialize in small-scale or low impact hydroelectric installations.

### **5. Biomass**

Biomass energy recovery systems utilize mature technology. The primary barriers to its further development are policy and knowledge based. Landfill gas systems, for example, are comprised of common commercial piping and compressions systems and generators. Eight of the 13 ARC states currently have landfill gas projects within the region's counties that are used both for generating electricity and for direct methane use.

The States of West Virginia, Ohio, Maryland, Virginia and Mississippi do not have landfill gas projects.<sup>15</sup>

## **6. Biofuels**

Cost is the primary barrier to widespread use of domestically produced biofuels. However, many states are providing financial incentives to overcome this barrier.

There are several biofuels production facilities in Appalachia and the development of biofuels is a large focus of many state energy plans in the region. Several states have operating biodiesel manufacturers. The manufacturers that were found for this report are summarized by state and should not be considered an exhaustive list of regional producers:

- The State of Kentucky is implementing a large-scale effort to power its school buses with biodiesel. Producers in the ARC region include:
  - **Green Earth Bio Fuels** is building a 3.2 million gallon biodiesel plant in Irvine, KY.
  - **Owensboro Grain** is building a 50 million gallon biodiesel plant in Owensburg, KY.
- The State of Georgia has at least two biofuels producers in the region. These are:
  - **U.S. Biofuels** uses chicken fat to produce three to five million gallons of biodiesel a year in Floyd County, GA.
  - **Peach State Labs** in Rome, GA produces soybean based biodiesel.
- The State of Alabama has at least one biodiesel producer in the region:
  - **Alabama Bio-Diesel** in Moundville, AL uses soybean oil to produce 24,000 gallons of biodiesel per year for the Birmingham Airport Authority, with plans to triple production.
- The State of Pennsylvania has at least one biodiesel producer in the region:
  - **Capital Technologies International** in Pittsburg, PA has a 10 million gallon capacity plant that can use a combination of soybean, corn, and canola oils, as well as used cooking oil and animal fats.
- The State of Ohio already has several ethanol plants, although only one closed facility may be in the region:
  - **South Point Ethanol** in South Point, OH is now a fairly antiquated facility that closed in 1995.

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<sup>15</sup> The Berkeley County Solid Waste Authority in West Virginia had a landfill gas to energy project from 1985 to 1996 that was a direct use line to a nearby Veterans' Administration hospital. The landfill was forced to close in 1992 following a lawsuit by a private landfill operator.