



## **American Landmarks** IN RENEWABLE ENERGY

Americans made important contributions to the origins of renewable energy. Hydroelectric power goes back to Edison's electric plants. Wind power achieved grid interconnection prior to WWII. The silicon solar cell followed in the wake of the transistor.

## Hydroelectric Power Lights Up

The Vulcan Street plant on the Fox River in Appleton, Wisconsin, was the first hydroelectric central station to provide electric light to private and commercial customers in North America. These included paper mills, a blast furnace, and a hotel. It began operating in November 1882, very soon after Thomas Edison's first steam plant on Pearl Street in New York. Previously, the Edison system of producing light from water-powered generators had only been demonstrated in exhibitions. Driven by a water wheel operating under a 10ft fall of water, the Vulcan Street plant's 110 Volt DC generator was capable of lighting 250 50W lamps.



Diagram showing the scale of the Vulcan St. hydroelectric plant equipment, which was destroyed by fire in 1891. *Lawrence University Archives* 



## Wind Power Scales Up

Danish engineers in the late 1910s had successfully integrated a wind turbine into a central grid via an induction generator. The giant 110-foot high, 1MW wind turbine built during 1939–41 by the American engineer Palmer Putnam and his university and private industry partners took this achievement to a new level. It sat atop Grandpa's Knob, an "advantageously exposed" forested summit in the Green mountains of Vermont. Fifteen times more powerful than its predecessors, Putnam's daring design employed adjustable rotor blades that kept the generator in sync with the line as the wind speed varied. Although the turbine operated for only 16 months during WWII, Putnam's technical solutions were revived when wind power became commercially viable in the 1970s and 1980s.

(Left) Putnam's majestic turbine was not surpassed in size until 1978. On the right is the erection crane. *From the collection of Carl Wilcox* 

## **Solar Power Becomes Efficient**

In the early 1950s Bell Labs scientists Gerald Pearson, Daryl Chapin, and Calvin Fuller were investigating how to power telephone systems in tropical climates. Humidity degraded dry cell batteries, so they turned to solar. Earlier selenium-based solar cells, however, were too inefficient. After several trials, the trio created a solar cell out of long, thin silicon strips that achieved their target efficiency of 6%. By doping with arsenic and boron, they were able to maintain the photosensitive p-n junction close to the surface and establish good electrical contact with the silicon. During the space race, the new solar cells rapidly became the go-to power source for orbiting satellites.

![](_page_0_Picture_14.jpeg)

(Below) Pair of prototype Bell Labs silicon solar cells, each capable of developing a third of a Volt on open circuit in full sunlight. *Solarmuseum.org* 

(Above) Bell Labs chemist Calvin Fuller holds a quartz tube containing silicon laced with arsenic, prior to heating in the presence of boron. *AT&T Archive* 

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