

# Wind powered water pumps

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Windpumps were used to pump water since at least the 9th century in what is now Afghanistan, Iran and Pakistan.<sup>1</sup> The use of wind pumps became widespread across the Muslim world and later spread to China and India.<sup>2</sup> Windmills were later used extensively in Europe, particularly in the Netherlands and the East Anglia area of Great Britain, from the late Middle Ages onwards, to drain land for agricultural or building purposes.

Simon Stevin's work in the waterstact involved improvements to the sluices and spillways to control flooding. Windmills were already in use to pump the water out, but in Van de Molens (On mills), he suggested improvements, including the idea that the wheels should move slowly, and a better system for meshing of the gear teeth. These improvements increased the efficiency of the windmills used to pump water out of the polders by three times. He received a patent on his innovation in 1586.<sup>3</sup>

Eight- to ten-bladed windmills were used in the Region of Murcia, Spain, to raise water for irrigation purposes.<sup>4</sup> The drive from the windmill's rotor was led down through the tower and back out through the wall to turn a large wheel known as a noria. The noria supported a bucket chain which dangled down into the well. The buckets were traditionally made of wood or clay. These windmills remained in use until the 1950s, and many of the towers are still standing.

The Netherlands is well known for its windmills. Most of these iconic structures situated along the edge of polders are actually windpumps, designed to drain the land. These are particularly important as much of the country lies below sea level.

In the UK, the term windpump is rarely used, and they are better known as drainage windmills. Many of these were built in The Broads and The Fens of East Anglia for the draining of land, but most of them have since been replaced by diesel or electric powered pumps.<sup>9</sup> Many of the original windmills still stand in a derelict state although some have been restored.<sup>;</sup><sup>;</sup>

Windpumps are used extensively in Southern Africa, Australia, and on farms and ranches in the central plains and Southwest of the United States. In South Africa and Namibia thousands of windpumps are still operating. These are mostly used to provide water for human use as well as drinking water for large sheep stocks.

Kenya has also benefited from the African development of windpump technologies. At the end of the 1970s, the UK NGO Intermediate Technology Development Group provided engineering support to the Kenyan company Bobs Harries Engineering Ltd for the development of the Kijito windpumps. Bobs Harries Engineering Ltd is still manufacturing the Kijito windpumps, and more than 300 of them are operating in the whole of East Africa.<sup>;</sup><sup>;</sup>

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In many parts of the world, a rope pump is being used in conjunction with wind turbines. This easy-to-construct pump works by pulling a knotted rope through a pipe (usually a simple PVC pipe) causing the water to be pulled up into the pipe. This type of pump has become common in Nicaragua and other places. #91; citation needed #93;

A multi-bladed windmill is a mechanical device with a piston pump. Because a piston pump has a fixed stroke, the energy demand of this type of pump is proportional to pump speed only. On the other hand, the energy supply of a wind rotor is proportional to the cube of wind speed. Because of that, a wind rotor runs at over speed (more speed than needed), yielding a loss of aerodynamic efficiency.

A variable stroke would match the rotor speed according to wind speed, functioning like a "variable-speed generator". The flow rate of variable stroke windpump can be increased two times, compared to fixed stroke windpumps at the same wind speed. #91; 18 #93;

A piston pump has a very light suction phase, but the upstroke is heavy and puts a big backtorque on a starting rotor when the crank is horizontal and ascending. A counterweight on the crank up in the tower and yawing with the wind direction can at least spread the torque to the crank descent. #91; citation needed #93;

Although multi-bladed windpumps are based on proven technology and are widely used, they have the fundamental problems mentioned above and need a practical variable stroke mechanism. #91; citation needed #93;

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