

Using Pumps as Turbines

The use of pumps as turbines has been fairly well documented, and if engineered correctly, can be very cost effective and efficient. The concept is to use a normal water pump, reverse engineer the pump curve for running the pump backwards efficiently, and run the penstock into the normal discharge outlet. In effect, the pump runs backwards, and acts as a turbine. Efficiencies as high as 85%-90% has been documented. In one case in British Columbia, Canada, an 8X10 pump was installed on a head of over 275 feet, producing up to 200 Kw. The cost of the turbine was less than \$25 Cdn per installed Kw. This is very inexpensive indeed.

The trick is being able to reverse engineer the pump curve. Not just any pump will work efficiently, and the pump curve of the existing pump does not apply in the reverse direction. [Thomson and Howe Energy Systems](#) has perfected the data and pump curve for reverse engineering the pump to work efficiently as a turbine. Morehead Valley Hydro Inc. has two pump units working (one 6x8 @ 12 Kw @ 3.3 cfs and one 8X10 @ 17 Kw @ 5.5 cfs). They are belt driven to an induction motor which is driven 50 RPM overspeed, turning it into an induction generator. See [Using Induction Motors as a Generators](#) for an analysis of this subject.

Besides the efficiency and cost effectiveness of using pumps as turbines, there are numerous other advantages as well. By installing multiple pumps, full efficiencies can be obtained from each on-line unit. Depending upon water flows, different pump units can be turned on or off to match inflows. In this way, there is no losses from inefficiencies in throttling the butterfly valve or wicket gates on a conventional turbine. In case of repairs to one of the units, the only downtime will be the actual unit that is being serviced, allowing the others to keep working. With one main large turbine, if it breaks down, there is 100% down time. In addition, if throttling one large unit, efficiencies really begin to fall off. Since each turbine/generator unit requires its own switch gear/protection panel, these are generally smaller and less expensive than one large switch gear panel for a large single turbine.

Pumps are most efficient between 40 feet (13 Meters) and 250 feet (75 Meters) of gross head. The higher the head, the less expensive the cost per Kw, as is the case in general with all turbines.