**Cost Efficiency of Hydropower vs. Wind Power**
**in the Context of the Fate of the Boardman River Dams**

## Introduction

One argument made in favor of keeping the Boardman River Dams has been the value of hydropower as a renewable energy resource. The goal of this paper is to explore this argument based on the cost of hydropower as compared to the cost of wind power.

Conservation groups have detailed the ecological, economic and social reasons for dam removal and those comments will not be duplicated here. Examples of those comments can be seen in letters to the Boardman River Dams Committee dated December 10, 2008 from the Watershed Center; December 11, 2008 from Conservation Resource Alliance; December 11, 2008 from Trout Unlimited; and other letters available on the BRDC website at: http://theboardman.org/events/details/boardman_river_dams_committee_meeting14/

## Cost of Hydropower

The Engineering and Feasibility Study conducted by the Boardman River Dams Committee estimates the cost of re-powering the upper three dams – Sabin, Boardman and Brown Bridge – at $16,768,000 or approximately $17 million. A key reason that re-powering the dams would be this expensive is because a new generating license would be required from the Federal Energy Regulatory Commission. Likely outcomes of this re-licensing would be requirements to add fish ladders to allow for safe fish passage, and cold water bottom-draw to minimize warming of habitat downstream of the dams.

## Generation Capacity of Hydropower

Information provided by Traverse City Light and Power shows that over a nine-year period, between 1996 and 2004, the average annual generation output from the three upper dams was 10,934,102 KiloWatt Hours (KWH) or 10.9 MegaWatt Hours (MWH).

The total nameplate generation capacity (the capacity as stated by the manufacturer of the generator) on the upper three dams is 2,225 KiloWatts (KW) or 2.225 MegaWatts (MW). This means that at any given point, the maximum generating capacity of the three upper dams is 2,225 KW or 2.225 MW. In order to determine the annual maximum capacity, we multiply this number by the number of hours in a year – 8,760 – and we get 19,491,000 KWH or roughly 19.5 MWH.

Therefore, the maximum potential annual output of the upper three dams is 19.5 MWH while the historical average annual output was 10.9 MWH. This means that, dividing the average annual output into the maximum potential annual output, we arrive at a capacity factor of 0.558 or roughly 56%. The term "capacity factor" is used in the generation industry to describe either the historical or predicted generation output of any given generating source.

Capacity factors are important because no electrical generating system operates at 100% capacity. All power plants require maintenance activities that result in less than 100% performance. Some power plants operate on a demand basis and reduce generation when demand is lower. Coal-fired power plants, for example, typically operate at around a 60% capacity factor. Renewable energy sources, such as hydropower, wind and solar, operate at less than a 100% capacity factor due to variations in rainfall, wind velocity and sunlight.

**Cost of Wind Power**

The average size of a wind turbine being installed in the U.S. today is 2,000 KW or 2 MW at a cost of $3.5 million per turbine (Windustry website: http://www.windustry.org/how-much-do-wind-turbines-cost)

If we assume that the Grand Traverse region has $17 million available for re-powering the upper three dams, and we spend that $17 million on wind turbines instead, we could install roughly five 2 MW turbines for a total nameplate generating capacity of 10,000 KW or 10 MW.

**Generation Capacity of Wind Power**

In order to determine the annual maximum capacity of a wind power option, we again multiply the maximum generating capacity (10,000 KW or 10 MW) by the number of hours in a year – 8,760 – and arrive at 87,600,000 KWH or 87.6 MWH.

Again, no generating system operates 100% of the time. In the case of wind power, wind velocity is not always high enough to generate electricity. So a capacity factor must be applied. High quality wind sites generate at between 30% to 40% capacity. We will use a conservative 25% capacity factor in this example.

Applying a 25% capacity factor to the maximum annual generating capacity of 87.6 MWH arrives at 21.9 MWH.

## Conclusion

This exercise demonstrates that an investment of $17 million in wind power would result in annual generation of 21.9 MWH, while that same investment in re-powering the upper three dams on the Boardman River would result in annual generation of 10.9 MWH. In other words, an investment in wind power produces twice the amount of electricity as the same investment in hydropower on the upper three dams of the Boardman River.

The Grand Traverse Region should invest in renewable energy sources for a variety of very important environmental, economic and social reasons. However, as mentioned above, there are very important ecological, economic and social reasons for dam removal. And, as this issue paper demonstrates, wind power would be a much more efficient investment than hydropower.

The importance of ensuring that renewable energy investments are as efficient as possible is not just economic. A common example of why our society should invest in renewable energy is the impact of coal-fired power plants on health and the environment. Investments in renewable energy displace the demand for coal-fired power, thus reducing four major pollutants of concern: carbon dioxide, nitrogen oxide, sulfur dioxide and mercury. These reductions in emissions lead to reduced impacts on climate change, ozone and fine particle pollution which causes asthma and other public health problems, acid rain, and fish consumption advisories due to mercury deposition. Reducing demand for coal-fired power also reduces impacts from mining, such as mountain-top removal, acid mine drainage and other associated environmental problems. Reducing coal-fired power also reduces the generation of coal-combustion waste, which contains heavy metals and is currently poorly regulated. Coal combustion waste has been shown to contaminate ground and surface waters.

If an investment in wind power produces twice the electrical output as a similar investment in hydropower, as this paper demonstrates, then wind power would displace twice the demand for coal-fired power, thus reducing these critical environmental and public health impacts by twice the amount over hydropower. From an economic, environmental and social standpoint, wind is clearly a better investment than hydropower.

About the author:
Andy Knott is executive director of The Watershed Center Grand Traverse Bay. Prior to working with the Watershed Center, Knott served as the environmental director for the Grand Traverse Band of Ottawa and Chippewa Indians for two years. In that capacity he managed the initial phases of a renewable energy study for the Tribe, funded by a grant from the US Department of Energy. Prior to working with the Grand Traverse Band, he served as air and energy policy director for the Hoosier Environmental Council for twelve years. In that capacity he managed renewable energy advocacy campaigns for the Council.