

## Carleton College Wind Turbines

### Project Fact Sheet (Fall 2012)

#### TURBINE #1: THE FIRST COMMERCIAL-SIZED COLLEGE WIND TURBINE

- **Model:** Vestas V82, 1.65 Megawatt nameplate capacity
- **Installation Date:** September 2004
- **Interconnection:** Since Carleton's electrical grid was not yet upgraded to 13.8 KV at the time turbine #1 was installed, it was connected to the public electricity grid along Wall Street Road.
- **Construction Cost:** \$1,865,000 (includes turbine + installation, foundation, access road, electrical/phone requirements, permits/fees). Design fees not included.
- **Income:** Carleton sells the electricity to Xcel Energy at a wholesale rate of \$0.03 per kilowatt-hour (kWh) or \$33 per megawatt-hour (MWh). Xcel Energy keeps all renewable energy credits (RECs) associated with the power production. For the first ten years, Carleton also earns a state incentive of 1.5 cents per kWh or \$15 per MWh.
- **Energy Output:** Annual output since 2004 varied between 3,700 – 4,900 Megawatt-hours per year.
- **Tower/Blades:** The turbine tower is 70 meters tall and has 82.5 meter diameter blades. The turbine starts spinning at a windspeed of 3.5 m/s (the "cut-in speed") and will ramp up to a steady rotation of 14.4 rpm (the blade pitch and position adjust to maintain constant speed). The turbine will stop spinning if windspeed exceeds 20 m/s (the "cut-out speed") to avoid excessive mechanical stress.
- **Foundation:** The turbine #1 foundation is in the shape of a vertical column, much like a caisson used for multi-story building foundations.
- **2011-2012 Production Statistics:** the Vestas turbine is connected to the public grid. From January – December 2012 it produced 4,217 MWh of electricity, generating ~\$139,000 in sales to Xcel.



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#### TURBINE #2: KRACUM WIND TURBINE

- **Model:** General Electric (GE) XLE turbine, 1.68 Megawatt nameplate capacity
- **Installation Date:** Turbine #2 was dedicated on October 21, 2011.
- **Interconnection:** Turbine #2 connects directly to the campus electrical grid at the Carleton diesel back-up generators located near the water tower. Carleton has an interconnection agreement with Xcel energy which allows any excess electricity to be delivered to the public grid.
- **Construction Cost:** \$2,645,000 (includes turbine + installation, foundation, access road, electrical/fiber requirements, permits/fees). Design fees not included.
- **Income:** Carleton offsets its market rate for electricity which averaged \$0.07 in 2011-2012. Because Carleton uses the power directly, there are no available renewable energy credits (RECs). Annual operating expenses include approximately \$35,000 for the lease, service agreement, and insurance plus a \$60,000 allocated annual to a wind turbine maintenance reserve.
- **Energy Output:** Annual output is expected to be 4,300 – 4,900 Megawatt-hours per year, serving 25-30% of Carleton's annual electricity demand with wind energy.
- **Tower/Blades:** The turbine tower is 80 meters tall and has 82.5 meter diameter blades. It starts spinning at a windspeed of 3.5 m/s (the “cut-in speed”) and will ramp up to a steady rotation of 14 rpm (the pitch and direction of blades adjust to maintain constant speed). The turbine will stop spinning if windspeed exceeds 25 m/s (the “cut-out speed”) to avoid excessive mechanical stress.
- **Installation:** The wind turbine tower was installed in three stacking sections. After the nacelle was placed on the top, the contractor hoisted the blade assembly. A nearly 1,000,000 lb crane with an approx 350 ft tower was used to hoist the turbine components into place.
- **Foundation:** Because soil borings revealed sandstone 8-10 ft below the surface, turbine #2 could be built on a mat slab foundation. Contractors excavated a 51' x 51' x 10' square and poured a concrete slurry mat. They then built a rebar cage and filled it with over 600 tons of concrete.
- **2011-2012 Production Statistics:** From January 2012 – December 2012, the Kracum turbine produced 4,262 MWh of electricity, serving 27% of Carleton’s total electric consumption and saving approximately \$298,000 (gross) in avoided electricity purchases. Most of this electricity was used directly by the Carleton campus grid, but a small amount of excess (<3% of total) was delivered to the Xcel public grid. During fiscal year 2012 (July 2011 – June 2012), Carleton cumulatively spent approximately 257 hours (11 days) running on 100% wind power.

