Activity Six: Wind Turbine Economics

Grade Level
7-12

Objectives
- Determine the cost of installing wind turbine at your school
- Use math to determine what the savings a school wind turbine provides to a school

Overview
Youth will use a worksheet to determine what the actual and projected costs that would in incurred for the installation of a wind turbine at a school. A possible extension is to look a wind farms in Colorado and determine the economic costs of building and maintaining a wind farm.

Materials (per group)
- Worksheet (see attached)
- Skystream technical specifications worksheet (http://www.skystreamenergy.com/products/skystream/skystream-3.7) or Specifications worksheet for another wind turbine
- Access to DSIRE Website for federal, state and local rebate information (www.dsireusa.org)

Estimated Cost of Materials
$0

Computer Required?
Yes

Duration
35-50 minutes

Primer References
- Wind Power in Colorado
- Colorado Wind Farms
- Economic Impacts of Wind Power Development in Colorado

Engagement
This activity is ideally conducted after "What Speed Do We Need" since in that lesson students should have learned that the school wind turbine is insufficient to provide the school's electricity needs and won't generate any electricity at all if the wind doesn't blow.

1. What sort of savings is the school seeing from having the wind turbine?
2. How long does it take to pay off a wind turbine?
3. What does this look like on the scale of an entire wind farm?

Investigation
Let's determine the economic benefit of the school turbine.

Wind for Schools Turbine Worksheet

1. In order to calculate the total annual potential energy, we need to know the capacity of the turbine and the total hours in a year. To determine the capacity of the turbine, use this link or print the handout at this link: http://www.skystreamenergy.com/products/skystream/skystream-3.7.

2. Determine the annual average predicted energy by multiplying the turbine's capacity factor for your location by the total annual potential energy.
    a. The capacity factor can be determined by looking up the nearest site from CSU's Anemometer Loan Program at: http://www.engr.colostate.edu/ALP/
    b. Alternatively, and to keep students from accidentally finding the predicted kWh when looking up the capacity factor, use a default of 30% noting that this will vary based on your location's wind regime.
3. The total cost to the school can be estimated using an approximate total cost of the turbine plus cost of installation and total local fees minus the incentive available. In order to determine the available incentives, go to www.dsireusa.org and check with your local utility.
4. To determine the annual avoided costs, multiply the annual average predicted energy by the cost of electricity (dollars/kWh).
5. The avoided costs for twenty years can be calculated by multiplying the annual avoided costs times 20.
6. Assuming that the cost of electricity and wind speeds are constants, students will finally calculate the total number of years to recover costs by dividing the total costs to the school after incentives by the annual avoided costs.

Class Review

Now that we have a better idea about the economics of the wind turbine at our, answer the following questions:

Wind for School Turbine Questions

Obviously, cost of electricity and wind speeds are not constants.

1. What if the cost of electricity has a flat increase of 4% indefinitely?
2. What about maintenance costs?
3. What if the cost of electricity goes up slower or faster than 4%?

References/For More Information

- Wind Energy in Colorado: A Practical Guide for Farmers and Ranchers About Producing Energy from Wind
- http://www.landsward.nau.edu/windforschools.html
- http://www.agmrc.org/media/cms/WIND_REPORT_Final_A97037D9FC0B8.pdf

Wind Turbine Economics	
Skystream 3.7 Turbine on 33 Foot Tower	
Capacity of Turbine (kW): (*Hint* Nominal Power)	
Hours in a Year:	8,760
Total Annual Potential Energy (kWH):	
Capacity Factor (% of time generating):	30.0%
Annual Average Predicted Energy (kWH):	
Cost of Turbine Installed:	$25,000
Incentives Available	
Federal:	$ 7,500
State:	
Local:	
Total Cost to the School after Incentives:	
Cost of Electricity (cents/kWH):	$ 0.11
Annual Avoided Costs:	
Avoided Cost Over 20 Years:	
Total Cost to the School after Incentives:	
Annual Avoided Costs:	
** Assumption that the cost of electricity and wind speed **NEVER CHANGES**	
Total Number of Years to Recover Costs:	
Questions:	
Obviously, cost of electricity and wind speeds are not constants.	
What if the cost of electricity has a flat increase of 4% indefinitely?	
What about maintenance costs?	
What if the cost of electricity goes up slower or faster than 4%?	