OVERVIEW
The basic requirements for community and commercial wind energy development are (1) availability of a good wind resource, (2) an appropriate topography, and (3) competitive cost of electricity. Any site that meets these requirements may be suitable for wind power.

There is a wide range of wind turbines available on the market today. There is no one turbine that fits perfectly with all projects. Determining which wind turbine is right for you depends on a number of factors including your wind resource, energy demand, and budget. Each project will require the selection of a particular turbine in order to ensure optimal cost-effectiveness.

PROJECT SCALES
Wind turbines come in a large variety of shapes and sizes, each specifically designed for a particular site or purpose.

- **Onsite**: These systems are small (typically ≤10 kW for residential and ≤500 kW for commercial), either stand-alone or net-metered, and would typically involve only 1 turbine. Net-metered systems allow owners to offset their electric bill by selling any surplus electricity back to the utility.
- **Community**: Community-scale projects are usually less than 10 MW in nameplate capacity, meaning it will produce 10 MW of power when operating at its rated output, and are typically owned by and provide power directly to the community. These projects could be connected to transmission lines, but are more commonly net metered or connected to the local distribution network. Most community projects involve less than 5 turbines.
- **Utility-scale**: These are industrial-scale wind power projects developed by a company that seeks to own or sell the project for the purpose of generating a return on their investment. An industrial-scale wind power project equal to or greater than 50 MW nameplate capacity is subject to the full approval process by the Commonwealth’s State Corporation Commission and less than 100 MW to the permit-by-rule process in Virginia.

The turbine size needed for an average household ranges from 2 kW to 10 kW depending on the home’s energy use and wind resource. For an average household, a single small-scale turbine such as the Skystream 3.7 (2.4 kW) is sufficient to curb the majority of the electricity costs, while a Vestas V27 (225 kW) would be more suitable for a community-scale project.

WIND CLASSES
In order to determine what kind of turbine is most suitable for your property, the wind speed at the potential wind turbine site needs to be known or at least estimated. Wind speeds are often characterized by wind classes where each class corresponds to a range of average annual wind speeds at a certain height. Most wind maps classify wind speeds at 50 or 80 meters. A table of wind classes, the corresponding wind speed range, and the potential for wind development is given below.

<table>
<thead>
<tr>
<th>Wind Class</th>
<th>Wind Speed at 50 m (m/s)</th>
<th>Potential for Wind Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 - 5.6</td>
<td>Marginal for onsite, but unsuitable for community-scale and utility scale</td>
</tr>
<tr>
<td>2</td>
<td>5.6 - 6.4</td>
<td>Marginal for onsite, but unsuitable for community-scale and utility scale</td>
</tr>
<tr>
<td>3</td>
<td>6.4 - 7.0</td>
<td>Appropriate for onsite, marginal for community-scale, but unsuitable for utility scale</td>
</tr>
<tr>
<td>4</td>
<td>7.0 - 7.5</td>
<td>Appropriate for onsite or community-scale, but marginal for utility-scale</td>
</tr>
<tr>
<td>5</td>
<td>7.5 - 8.0</td>
<td>Appropriate for all scales</td>
</tr>
<tr>
<td>6</td>
<td>8.0 - 8.8</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>8.8 - 11.9</td>
<td></td>
</tr>
</tbody>
</table>
HOW MUCH DOES A WIND TURBINE COST?
The total cost for installing a commercial-scale wind turbine varies depending on a number of factors including the cost of financing, when the turbine purchase agreement is executed, construction contracts, the type of turbine, and the location of the project. Cost components for wind projects include:

- wind resource assessment and site analysis expenses
- the price and freight of the turbine and tower
- construction expenses
- permitting and interconnection studies
- transformers
- protection and metering equipment
- insurance
- operations, warranty, maintenance and repair
- legal and consultation fees

Small farm or residential-scale turbines cost less, but are more expensive on a per kW capacity, because commercial wind projects benefit greatly from economies of scale. The cost of commercial wind turbines typically vary between $1,000 and $2,000 per kW, while small-scale turbine systems cost from $3,000 to $5,000 per kW of capacity.

HOW MUCH ELECTRICITY DOES A WIND TURBINE GENERATE?
The total electrical energy generated is measured in watts. For wind turbines the terms kilowatt (kW or 1,000 watts) and megawatt (MW or 1 million watts) are most commonly used to describe the generating capacity. Electricity production is commonly measured in kilowatt-hours (kWh) or megawatt-hours (MWh). A kilowatt-hour is one kilowatt of electricity produced steadily over one hour.

The output of a wind turbine depends on the size of the wind turbine and the wind speed at the rotor. Wind turbines being manufactured today have power ratings ranging from less than 1 kW to greater than 5 MW. The amount of electricity generated by a wind turbine across a range of wind speeds is best demonstrated by a chart called a power curve. The power curves for seven different wind turbines are shown in the next column.

The power curve comparison shows that different wind turbines have very different power curve characteristics. Different wind turbines are more or less efficient at different wind speeds. This is the reason why it is crucial to know the wind resource at your potential site, so that the best-matched wind turbine can be selected.

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