Comparative Air Emissions Of Wind and Other Fuels

Wind energy's most important environmental benefit is its lack of emissions of both air pollutants and greenhouse gases when compared with alternative methods of generating electricity.

The American Wind Energy Association (AWEA) has developed a set of statistics to quantify the comparative emissions of wind and other fuels, based on data gathered by the U.S. Department of Energy's Energy Information Administration (EIA)[1], which collects information on the U.S. utility industry.

This, and similar fact sheets, can be found online at http://www.awea.org/pubs/factsheets.html.

For carbon dioxide (CO\(_2\)), the leading greenhouse gas associated with global warming, comparative emissions during electricity generation are as follows:

<table>
<thead>
<tr>
<th>Fuel</th>
<th>CO(_2) Emitted Per KWh Generated (in pounds)</th>
<th>KWh Generated, 1997 (billions)</th>
<th>CO(_2) Emitted, Total Generation (billion pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>2.13</td>
<td>1,788</td>
<td>3,807</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1.03</td>
<td>283.6</td>
<td>291</td>
</tr>
<tr>
<td>Oil</td>
<td>1.56</td>
<td>77.8</td>
<td>122</td>
</tr>
<tr>
<td>U.S. Average</td>
<td>1.52</td>
<td>3,494</td>
<td>5,313</td>
</tr>
<tr>
<td>Fuel Mix [2]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>--0--</td>
<td>3.4</td>
<td>--0--</td>
</tr>
</tbody>
</table>

For sulfur dioxide (SO\(_2\)), the leading precursor of acid rain:

<table>
<thead>
<tr>
<th>Fuel</th>
<th>SO(_2) Emitted Per KWh Generated (in pounds)</th>
<th>KWh Generated, 1997 (billions)</th>
<th>SO(_2) Emitted, Total Generation (million pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>0.0134</td>
<td>1,788</td>
<td>24,028</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>0.000007</td>
<td>283.6</td>
<td>2</td>
</tr>
<tr>
<td>Oil</td>
<td>0.0112</td>
<td>77.8</td>
<td>870</td>
</tr>
<tr>
<td>U.S. Average</td>
<td>0.0080</td>
<td>3,494</td>
<td>27,914</td>
</tr>
<tr>
<td>Fuel Mix [2]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>--0--</td>
<td>3.4</td>
<td>--0--</td>
</tr>
</tbody>
</table>
For nitrogen oxides (NOx), another acid rain precursor and the leading component of smog:

<table>
<thead>
<tr>
<th>Fuel</th>
<th>NOx Emitted Per Kilowatt-hour (kWh) Generated (in pounds)</th>
<th>KWh Generated, 1997 (billions)</th>
<th>NOx Emitted, Total Generation (million pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>0.0076</td>
<td>1,788</td>
<td>13,668</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>0.0018</td>
<td>283.6</td>
<td>504</td>
</tr>
<tr>
<td>Oil</td>
<td>0.0021</td>
<td>77.8</td>
<td>162</td>
</tr>
<tr>
<td>U.S. Average</td>
<td>0.0049</td>
<td>3,494</td>
<td>17,112</td>
</tr>
<tr>
<td>Fuel Mix [2]</td>
<td>--0--</td>
<td>3.4</td>
<td>--0--</td>
</tr>
<tr>
<td>Wind</td>
<td>--0--</td>
<td>--0--</td>
<td>--0--</td>
</tr>
</tbody>
</table>

A single 750-kilowatt wind turbine, operated for one year at a site with Class 4 wind speeds (winds averaging 12.5-13.4 mph at 10 meters height), can be expected to displace a total of 2,697,175 pounds of carbon dioxide, 14,172 pounds of sulfur dioxide, and 8,688 pounds of nitrogen oxides, based on the U.S. average utility generation fuel mix.[3]

AWEA has prepared a spreadsheet which permits calculations based on these and other air emissions statistics and which can be e-mailed to researchers on request.

NOTE


2. The numbers for kilowatt-hours generated and emissions for "Coal," "Natural Gas," and "Oil" are based on U.S. electric utility generation. The numbers for kilowatt-hours generated and emissions for "US Average Fuel Mix" and "Wind" are the totals for all U.S. generation, including nonutility plants."


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