Material use in Vestas turbines

By knowing how Vestas' products and materials contribute to the environmental performance of the wind plant, it is possible to make fact-based and informed decisions that will minimise overall environmental impacts. Life Cycle Assessments are used to provide detailed knowledge regarding the material composition of the wind plant.

The figures on the following pages show the typical material breakdown of Vestas' turbines.

For example, a V162-6.2 MW™ turbine is composed of around 88% metals (e.g. steel, iron, copper and aluminium), 10% polymers and composite materials, and the remainder a mixture of electronics/electrical items, lubricants and fluids, etc.

Main materials used

- Steel and iron materials
- Aluminium and alloys
- Copper and alloys
- Polymer materials
- Glass / carbon composites
- Electronics / electrics
- Lubricants and fluids

Wind. It means the world to us.™
EnVentus™ Platform
Turbines

V172-7.2 MW™
166m hub height and wind class IECS. Total mass: 928 tonnes *

Steel and iron materials: 87.6%
Aluminium and alloys: 1.1%
Copper and alloys: 0.6%
Polymer materials: 4.2%
Glass / carbon composites: 5.7%
Electronics / electrics: 0.5%
Lubricants and fluids: 0.3%
Not specified: 0.1%

V162-7.2 MW™
166m hub height and wind class IECS. Total mass: 894 tonnes *

Steel and iron materials: 87.9%
Aluminium and alloys: 1.1%
Copper and alloys: 0.6%
Polymer materials: 3.9%
Glass / carbon composites: 5.7%
Electronics / electrics: 0.5%
Lubricants and fluids: 0.3%
Not specified: 0.1%

* Values are based on an internal streamlined Life Cycle Assessment
V162-6.2 MW™

149m hub height and wind class IECS. **Total mass: 801 tonnes** *

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel and iron materials</td>
<td>85.9%</td>
</tr>
<tr>
<td>Aluminium and alloys</td>
<td>1.1%</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>0.6%</td>
</tr>
<tr>
<td>Polymer materials</td>
<td>4.7%</td>
</tr>
<tr>
<td>Glass / carbon composites</td>
<td>5.6%</td>
</tr>
<tr>
<td>Electronics / electrics</td>
<td>0.8%</td>
</tr>
<tr>
<td>Lubricants and fluids</td>
<td>0.1%</td>
</tr>
<tr>
<td>Not specified</td>
<td>1.2%</td>
</tr>
</tbody>
</table>

V150-6.0 MW™

155m hub height and wind class IECS. **Total mass: 773 tonnes** *

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel and iron materials</td>
<td>86.4%</td>
</tr>
<tr>
<td>Aluminium and alloys</td>
<td>1.5%</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>0.6%</td>
</tr>
<tr>
<td>Polymer materials</td>
<td>4.4%</td>
</tr>
<tr>
<td>Glass / carbon composites</td>
<td>5.2%</td>
</tr>
<tr>
<td>Electronics / electrics</td>
<td>0.9%</td>
</tr>
<tr>
<td>Lubricants and fluids</td>
<td>0.4%</td>
</tr>
<tr>
<td>Not specified</td>
<td>0.6%</td>
</tr>
</tbody>
</table>

* Values are based on an externally reviewed Life Cycle Assessment available on vestas.com
4 MW Platform

Turbines

V163-4.5 MW™
98m hub height and wind class IECS. Total mass: 501 tonnes *

Steel and iron materials: 81.7%
Aluminium and alloys: 1.0%
Copper and alloys: 0.6%
Polymer materials: 6.6%
Glass / carbon composites: 9.1%
Electronics / electrics: 0.6%
Lubricants and fluids: 0.3%
Not specified: 0.1%

V155-3.6 MW™
105m hub height and wind class IECS. Total mass: 441 tonnes *

Steel and iron materials: 84.0%
Aluminium and alloys: 1.1%
Copper and alloys: 0.7%
Polymer materials: 4.2%
Glass / carbon composites: 8.2%
Electronics / electrics: 0.7%
Lubricants and fluids: 0.3%
Not specified: 0.0%

* Values are based on an internal streamlined Life Cycle Assessment
V150-4.5 MW™
105m hub height and wind class IEC3B. Total mass: 446 tonnes *

83.5% Steel and iron materials
11% Aluminium and alloys
0.7% Copper and alloys
3.6% Polymer materials
10.0% Glass / carbon composites
0.8% Electronics / electrics
0.3% Lubricants and fluids
0.1% Not specified

V150-4.2 MW™
155m hub height and wind class IEC3B. Total mass: 682 tonnes *

89.0% Steel and iron materials
11% Aluminium and alloys
0.5% Copper and alloys
2.7% Polymer materials
5.7% Glass / carbon composites
0.6% Electronics / electrics
0.2% Lubricants and fluids
0.0% Not specified

V136-4.5 MW™
112m hub height and wind class IEC2B. Total mass: 466 tonnes *

85.8% Steel and iron materials
1.3% Aluminium and alloys
0.7% Copper and alloys
3.1% Polymer materials
7.9% Glass / carbon composites
0.8% Electronics / electrics
0.3% Lubricants and fluids
0.1% Not specified

V136-4.2 MW™
112m hub height and wind class IEC2B. Total mass: 544 tonnes *

88.5% Steel and iron materials
1.3% Aluminium and alloys
0.6% Copper and alloys
2.8% Polymer materials
5.8% Glass / carbon composites
0.7% Electronics / electrics
0.3% Lubricants and fluids
0.0% Not specified

V136-3.45 MW®
132m hub height and wind class IEC3A. Total mass: 601 tonnes *

89.4% Steel and iron materials
1.3% Aluminium and alloys
0.5% Copper and alloys
2.7% Polymer materials
5.1% Glass / carbon composites
0.6% Electronics / electrics
0.3% Lubricants and fluids
0.0% Not specified

* Values are based on an externally reviewed Life Cycle Assessment available on vestas.com
V126-3.45 MW®
117m hub height and wind class IEC2A. Total mass: 530 tonnes *

- Steel and iron materials: 88.6%
- Aluminium and alloys: 1.3%
- Copper and alloys: 0.6%
- Polymer materials: 2.7%
- Glass / carbon composites: 5.7%
- Electronics / electrics: 0.7%
- Lubricants and fluids: 0.4%
- Not specified: 0.0%

V117-4.2 MW™
91.5m hub height and wind class IEC1B. Total mass: 445 tonnes *

- Steel and iron materials: 86.2%
- Aluminium and alloys: 1.3%
- Copper and alloys: 0.8%
- Polymer materials: 4.1%
- Glass / carbon composites: 6.4%
- Electronics / electrics: 0.8%
- Lubricants and fluids: 0.4%
- Not specified: 0.0%

V117-3.45 MW®
91.5m hub height and wind class IEC1B. Total mass: 436 tonnes *

- Steel and iron materials: 96.1%
- Aluminium and alloys: 1.3%
- Copper and alloys: 0.7%
- Polymer materials: 3.5%
- Glass / carbon composites: 7.3%
- Electronics / electrics: 0.8%
- Lubricants and fluids: 0.4%
- Not specified: 0.0%

V112-3.45 MW®
94m hub height and wind class IEC1A. Total mass: 438 tonnes *

- Steel and iron materials: 87.1%
- Aluminium and alloys: 1.0%
- Copper and alloys: 0.7%
- Polymer materials: 2.8%
- Glass / carbon composites: 7.1%
- Electronics / electrics: 0.8%
- Lubricants and fluids: 0.4%
- Not specified: 0.0%

V105-3.45 MW™
72.5m hub height and wind class IEC1A. Total mass: 357 tonnes *

- Steel and iron materials: 84.5%
- Aluminium and alloys: 1.3%
- Copper and alloys: 0.9%
- Polymer materials: 3.3%
- Glass / carbon composites: 8.6%
- Electronics / electrics: 0.9%
- Lubricants and fluids: 0.5%
- Not specified: 0.0%

* Values are based on an externally reviewed Life Cycle Assessment available on vestas.com
2 MW Platform Turbines

V120-2.2 MW™
110m hub height and wind class IEC5. Total mass: 303 tonnes *

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel and iron materials</td>
<td>87.0%</td>
</tr>
<tr>
<td>Aluminium and alloys</td>
<td>1.5%</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>0.4%</td>
</tr>
<tr>
<td>Polymer materials</td>
<td>4.5%</td>
</tr>
<tr>
<td>Glass / carbon composites</td>
<td>5.5%</td>
</tr>
<tr>
<td>Electronics / electrics</td>
<td>0.6%</td>
</tr>
<tr>
<td>Lubricants and fluids</td>
<td>0.2%</td>
</tr>
<tr>
<td>Not specified</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

V110-2.0 MW™
80m hub height and wind class IEC3A. Total mass: 248 tonnes **

<table>
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<tr>
<th>Material</th>
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</thead>
<tbody>
<tr>
<td>Steel and iron materials</td>
<td>85.0%</td>
</tr>
<tr>
<td>Aluminium and alloys</td>
<td>1.5%</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>0.5%</td>
</tr>
<tr>
<td>Polymer materials</td>
<td>5.2%</td>
</tr>
<tr>
<td>Glass / carbon composites</td>
<td>6.1%</td>
</tr>
<tr>
<td>Electronics / electrics</td>
<td>0.9%</td>
</tr>
<tr>
<td>Lubricants and fluids</td>
<td>0.3%</td>
</tr>
<tr>
<td>Not specified</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

* Values are based on an internal streamlined Life Cycle Assessment
** Values are based on an externally reviewed Life Cycle Assessment available on vestas.com
### V100-2.0 MW®

80m hub height and wind class IEC2B. Total mass: **230 tonnes**

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel and iron materials</td>
<td>84.3%</td>
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<tr>
<td>Aluminium and alloys</td>
<td>1.5%</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>0.5%</td>
</tr>
<tr>
<td>Polymer materials</td>
<td>3.4%</td>
</tr>
<tr>
<td>Glass / carbon composites</td>
<td>8.7%</td>
</tr>
<tr>
<td>Electronics / electrics</td>
<td>0.9%</td>
</tr>
<tr>
<td>Lubricants and fluids</td>
<td>0.3%</td>
</tr>
<tr>
<td>Not specified</td>
<td>0.2%</td>
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</tbody>
</table>

### V90-2.0 MW™

80m hub height and wind class IEC3A. Total mass: **240 tonnes**

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Steel and iron materials</td>
<td>85.7%</td>
</tr>
<tr>
<td>Aluminium and alloys</td>
<td>1.7%</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>0.7%</td>
</tr>
<tr>
<td>Polymer materials</td>
<td>3.4%</td>
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<tr>
<td>Glass / carbon composites</td>
<td>6.6%</td>
</tr>
<tr>
<td>Electronics / electrics</td>
<td>1.0%</td>
</tr>
<tr>
<td>Lubricants and fluids</td>
<td>0.4%</td>
</tr>
<tr>
<td>Not specified</td>
<td>0.5%</td>
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</table>

*Values are based on an externally reviewed Life Cycle Assessment available on [vestas.com](http://vestas.com)
Offshore Platform Turbines

V236-15 MW™
143m hub height and wind class IEC6. Total mass: 1530 tonnes *

<table>
<thead>
<tr>
<th>Material Group</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Steel and iron materials</td>
<td>82.4%</td>
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<tr>
<td>Aluminium and alloys</td>
<td>1.3%</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>0.9%</td>
</tr>
<tr>
<td>Polymer materials</td>
<td>0.5%</td>
</tr>
<tr>
<td>Glass / carbon composites</td>
<td>9.5%</td>
</tr>
<tr>
<td>Electronics / electrics</td>
<td>0.9%</td>
</tr>
<tr>
<td>Lubricants and fluids</td>
<td>0.4%</td>
</tr>
<tr>
<td>Not specified</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

V174-9.5 MW™
119m hub height and wind class IEC1B. Total mass: 893 tonnes *

<table>
<thead>
<tr>
<th>Material Group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel and iron materials</td>
<td>81.3%</td>
</tr>
<tr>
<td>Aluminium and alloys</td>
<td>1.5%</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>1.5%</td>
</tr>
<tr>
<td>Polymer materials</td>
<td>7.2%</td>
</tr>
<tr>
<td>Glass / carbon composites</td>
<td>6.5%</td>
</tr>
<tr>
<td>Electronics / electrics</td>
<td>1.4%</td>
</tr>
<tr>
<td>Lubricants and fluids</td>
<td>0.5%</td>
</tr>
<tr>
<td>Not specified</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

* Values are based on an internal streamlined Life Cycle Assessment
V164-9.5 MW™

87m hub height and wind class IECS. Total mass: 909 tonnes *

Steel and iron materials: 82.2%
Aluminium and alloys: 1.5%
Copper and alloys: 1.4%
Polymer materials: 4.9%
Glass / carbon composites: 8.0%
Electronics / electrics: 1.4%
Lubricants and fluids: 0.5%
Not specified: 0.1%

* Values are based on an internal streamlined Life Cycle Assessment