

# Triblade – Next Generation Rotor Blades



22m Triblade rotor on a wind turbine.

## 1 Summary

Winfoor has developed a new type of rotor blades for large scale wind turbines. The unique technology, called Triblade, is a 3-in-1 blade that lowers the costs for rotor blades dramatically. It makes shipping easy and efficient. Blades become lighter, they can be made in modules and the production process can be automated to a level that is not possible to reach with conventional blades. Looking ahead, Triblade can also spearhead the development of next generation larger and more powerful wind turbines, by allowing for longer blades than today.



Triblade is co-funded by the European Commission program SME Instrument.

To take Triblade to the market, Winfoor has teamed up with Marstrom Composite, who is a leading composite manufacturer from Sweden. The project is co-funded by the European Commission program SME Instrument (project ID number 778553). In the project the Triblade technology has advanced further and a 22m diameter Triblade rotor has been built. The rotor was installed on a wind turbine, where it has been evaluated extensively and under real conditions. The test results are good and demonstrates the validity of the technology working under real conditions and for a longer period of time.

The top priority for the wind power industry is to reduce total Cost of Energy (CoE). One of the components that influence CoE the most are the wind turbine rotor blades. They use a lot of expensive material, they are mainly produced by hand, they are made in one piece, and they are often very long. Both production and shipping are challenging and come at high cost. Triblade is a game changing technology that can

- lower the total Levelized Cost Of wind Energy (LCOE) and thereby making it more attractive as an energy source
- accelerate the transition to greater use of wind power worldwide, and
- give Winfoor a unique opportunity on a global rotor blade market that is projected to reach \$33 billion by 2025.

## 2 Triblade at a glance

Triblade is a 3-in-1 blade. Three slender blades are linked together by supporting structure (bracing) to form a truss (framework). It makes it very stiff and lightweight.



Installing a Triblade rotor.



The three slender blades are the ones that drive the rotor. They are approximately parallel to each other. Each one has one third of the chord length (width) of a standard blade, so combined they have the same chord length as a standard blade.

The supporting structure is called bracing and it runs between the blades on the diagonal and perpendicular to the blades. The blades and the bracing form triangles that together make up a truss structure. Trusses is a very well-known and common building technique that can be found in numerous applications such as bridges, cranes, roof beams etc. It makes lightweight and stiff structures. Trusses have an optimal mechanical action since its members are mainly subjected to pure tension or compression, which results in structures having high stiffness and strength.

The three slender blades of Triblade are connected to the bracings at certain positions. The connections are called joints. Each blade can furthermore be divided along its length into separate blade segments that are connected to each other at these joints. The result is that Triblade can be assembled from smaller parts that are connected at the joints. This makes Triblade perfect for being made in modules. In fact, both production and shipping can be done in modules, dramatically lowering the cost of both. Assembling is done at or near the site of installation. Alternatively, Winfoor can ship Triblade in modules to the turbine maker for later assembly at their facilities. By keeping module sizes below 12m x 2m x 1m Triblade can be shipped in ordinary containers on standard trains, trucks and ships. This is in stark contrast to standard blade transport that requires special vehicles together with complex and expensive logistical solutions, such as roadworks, shutting down traffic, and taking long detours to avoid bottlenecks in the road network.



Left: Triblade seen from side. Right: Installation of Triblade rotor.

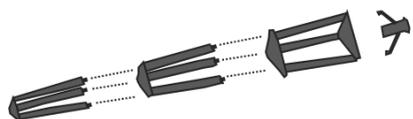


A complete 22m Triblade rotor installed on a wind turbine at test center in Denmark.

The technology has been demonstrated under real conditions through a 22m diameter Triblade rotor mounted on a wind turbine. The test results are good and demonstrate the validity of the Triblade technology under real conditions and during a longer period of time.



### 3 Triblade benefits



- Triblade will lower the costs for rotor blades dramatically and, in the end, the total cost of wind energy.
- Both production and shipping can be done in modules.
- The material cost is much lower
- Blades can be made longer than today.
- **For manufacturing**, smaller and more flexible production facilities can be used. The production can be highly automated.
- **For transportation**, standard trucks and containers can be used to ship Triblade in modules. Assembling is done at or near the site of installation.

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It has the potential to significantly alter the economics and scale of wind power, playing an important role in increasing installed base worldwide, driving the next generation of larger and more powerful wind turbines. The new technology is expected to facilitate 20MW wind turbines. By using a single large turbine instead of several smaller ones, OPEX will also be reduced. The introduction of a modular design will allow easier shipping and installation and give access to sites that were previously inaccessible. It reduces shipping costs dramatically and allows for standardized shipping in containers and on ordinary trucks and ships.



Winfoor

## 4 Partners



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