

Trends in blades and blade materials

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Asian Development Bank Conference
Manila, 5 June 2012

The importance of blades

- ▶ Blades represent about 18% of wind turbine ex works cost.
- ▶ Wind turbine generator represents about 55% of lifetime capital cost.
- ▶ Hence blades amount to about 10% of total lifetime cost.
- ▶ Thus **1% energy gain trades with 10% blade cost reduction.**

Blades need to be improved in both their capabilities and their cost

CAPABILITIES

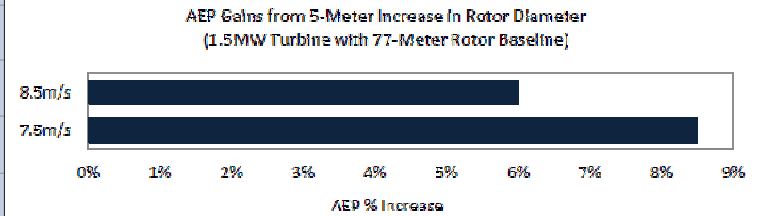
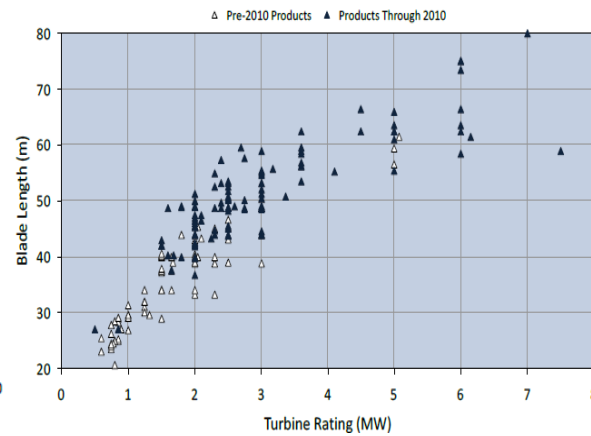
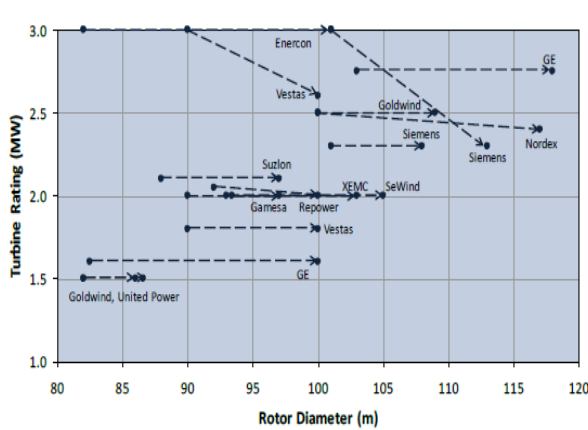
Blade length continues to grow to increase efficiency and annual energy production
Carbon fiber replaces glass fiber to reduce blades' weight and increase robustness
Aerodynamic technology (C_p/C_t coefficients) is being substantially improved

COST

Blades are being split in two parts to facilitate inland transport and reduce logistics costs
Manufacturing processes are being automated to reduce costs, minimize errors & variability

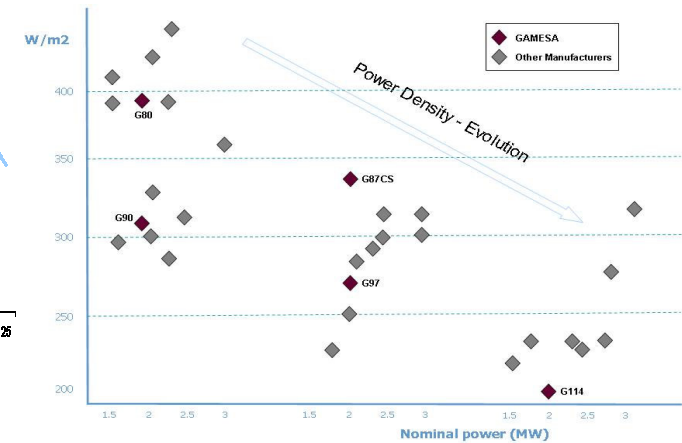
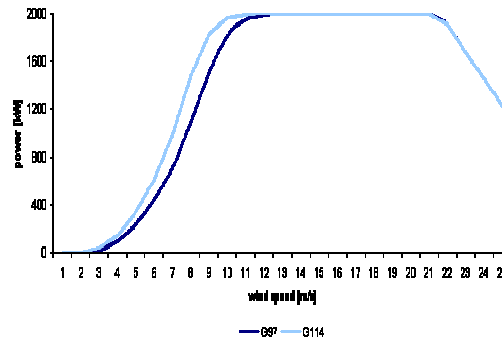
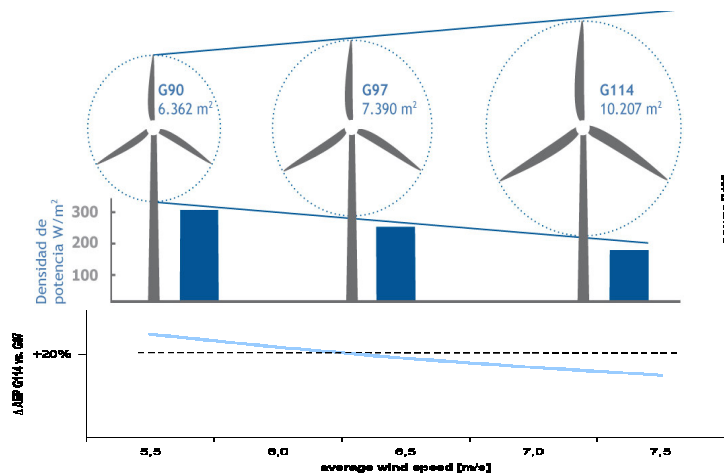
Main trends – blade length growth

Blade length continues to grow to increase efficiency in low wind turbines



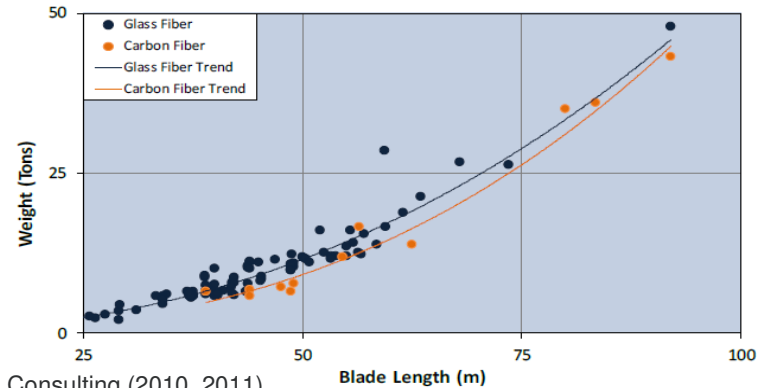
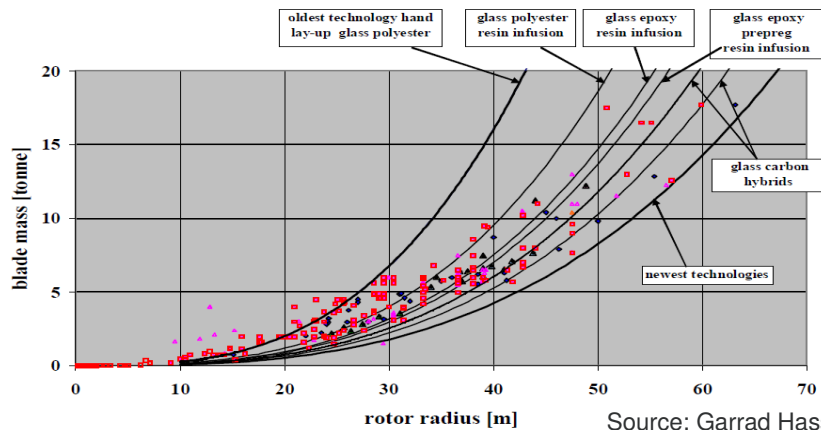
Source: MAKE Consulting "Wind Turbine Trends", December 2011

Example : Gamesa's G90, G97 and G114 substantially increase AEP with larger blades



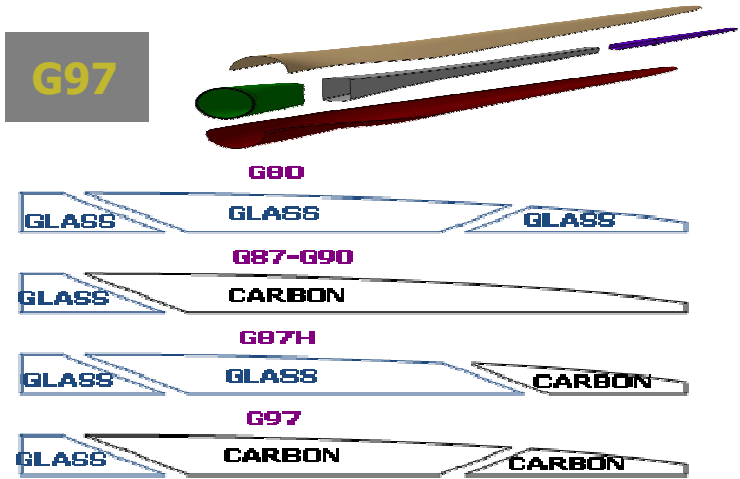
Main trends – carbon fiber introduction

Carbon fiber replaces glass fiber to reduce blades' weight and increase robustness



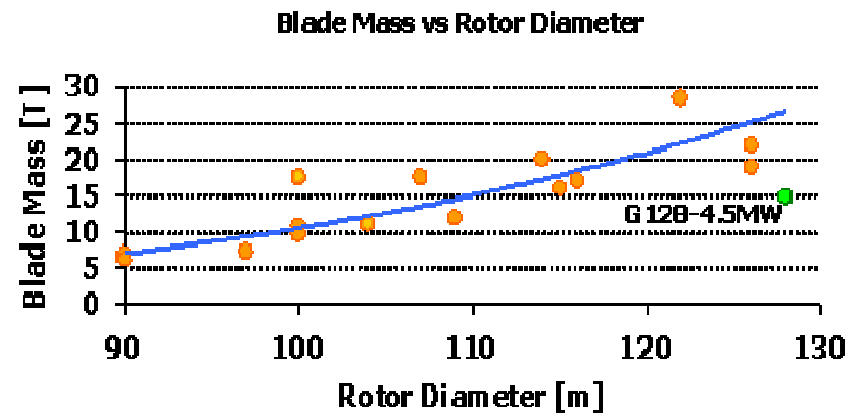
Source: Garrad Hassan, Make Consulting (2010, 2011)

Gamesa has introduced carbon fiber in its newer platforms G9X and G10X



G128

G128 blades are 40% lighter than market average



Main trends – aerodynamic technology

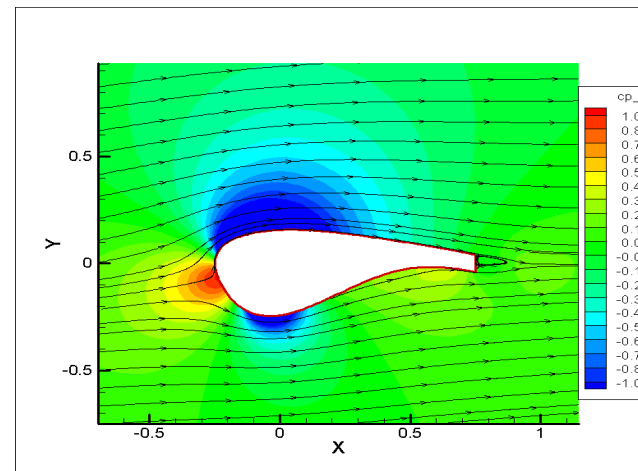
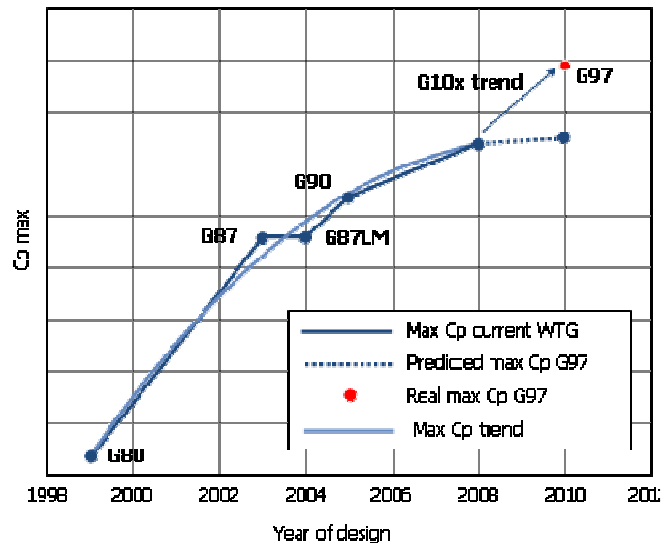
Significant improvements in recent years

C_t New optimized blade profile for the new Gamesa G97-2.0 MW:
 Optimized blade root with high thickness blade profiles.
 Lighter blades through the use of fiber glass, carbon fiber and preimpregnation methods.



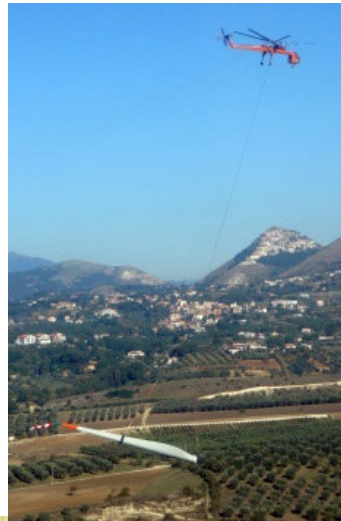
Maximum energy production and reduced noise emissions

Gamesa has been improving its C_t and C_p coefficients even more than predicted



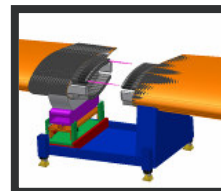
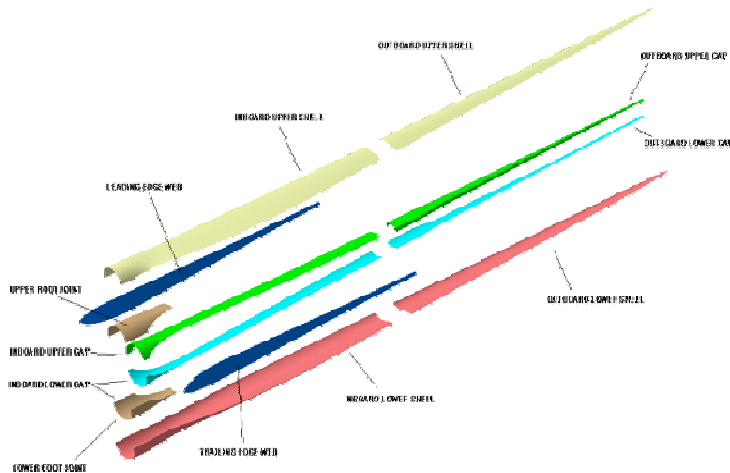
Main trends – longitudinal blade split

Longer blades are creating more difficulties in inland transport



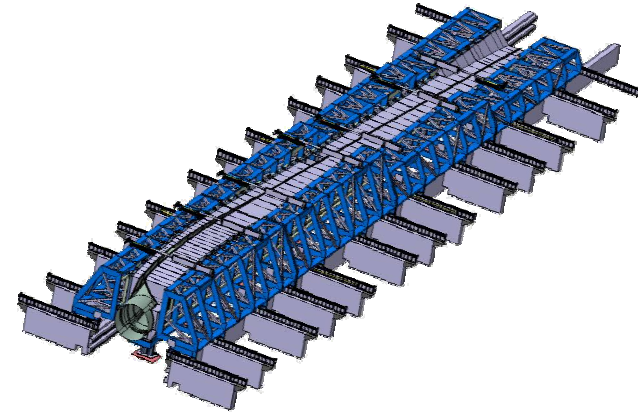
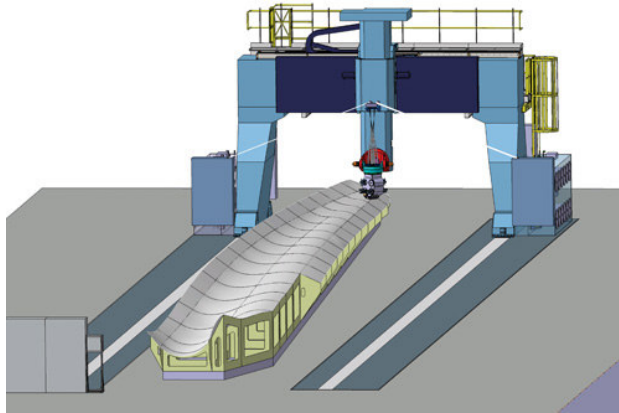
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Gamesa Innoblade®- G10X blades are split in two sections to be assembled on site



Main trends – manufacturing automation

Automated manufacturing processes reduce costs & variability



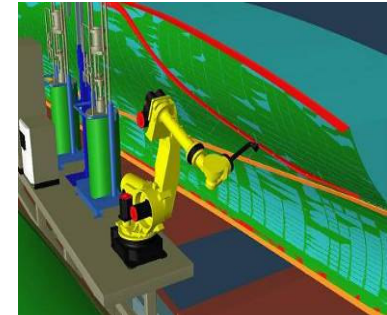
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Gamesa has introduced Fibramatic®, the new fully automated process for G9X blades

Lamination



Assembly line



Applicability to the Asian market

Trend	Applicability to the Asian Market	What can be done to accelerate wind development in Asia?
Blade length growth	Longer blades will help increase returns despite low FiT values, even in countries with low wind regimes - longer blades are fundamental	Promote the introduction of turbines with longer blades and best CoE/AEP ratios –
Introduction of carbon fiber	Several countries in Asia are introducing outdated turbine models which result in higher maintenance costs and lower energy production	Promote the introduction of wind turbines with the most advanced materials – an increase of profitability in the long run
Blade longitudinal split	Several countries in Asia have poor transportation networks -> split blades facilitate transport thus lowering costs	Improve the transportation networks, subsidize the construction of new roads for wind farms and develop policies to facilitate the introduction of split blades
Improvement of aerodynamic technology	Several countries in Asia are introducing outdated turbine models which result in higher costs, lower energy production and unnecessary higher noise levels	Promote the introduction of the most advanced wind turbines with the best aerodynamic technology – reducing noise pollution and increasing energy production.
Automation of manufacturing processes	Several countries in Asia host blade manufacturing plants highly based in low labour costs	Develop policies to promote the implementation of automated blade manufacturing plants

Conclusion

Promote the introduction of state-of-the-art advanced wind turbines



Thank you !

Any question ?

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