대형 풍력터빈용 블레이드 개발 현황 및 전망

2019년 6월

(주)휴먼컴퍼지트 양 승 운

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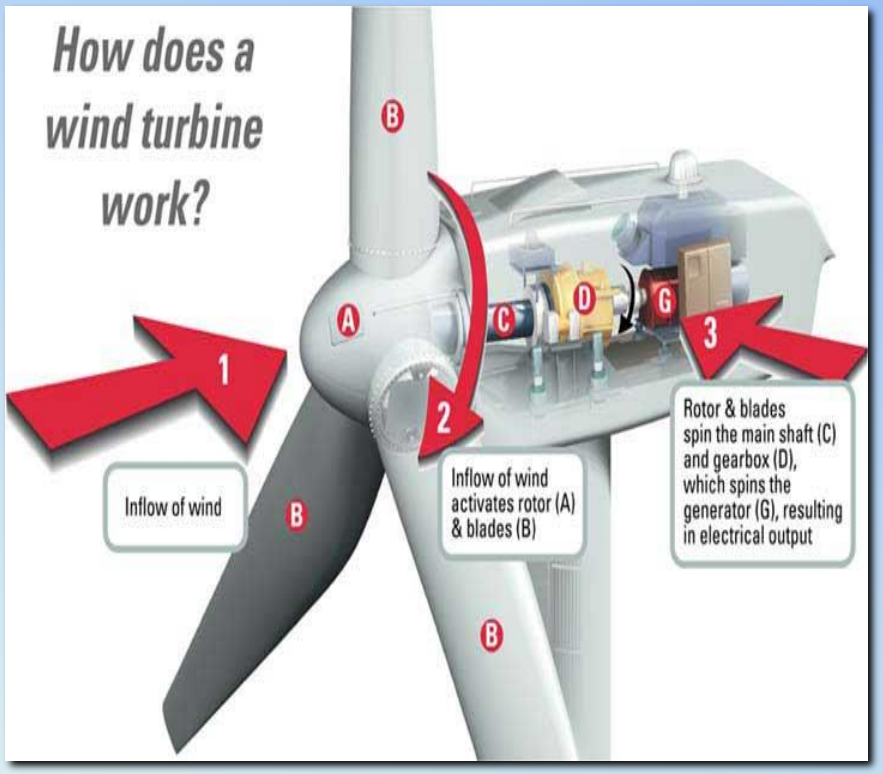
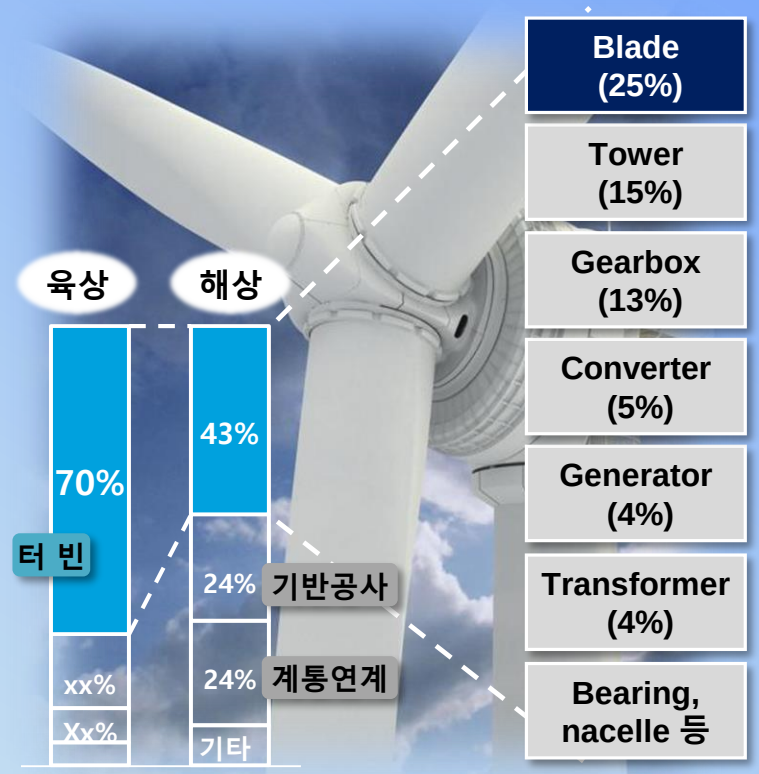
블레이드 개요

블레이드는 출력 & 하중/소음 발생원



풍력발전기 가격 비중

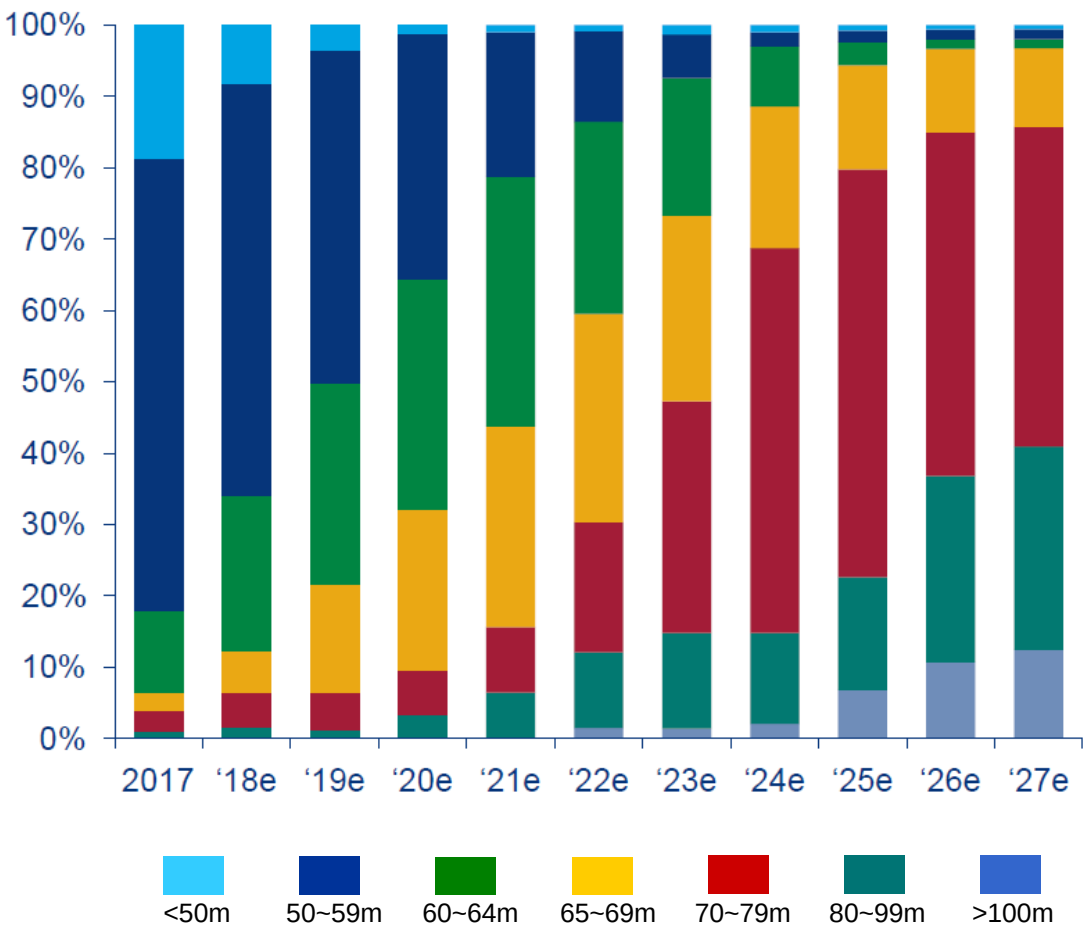


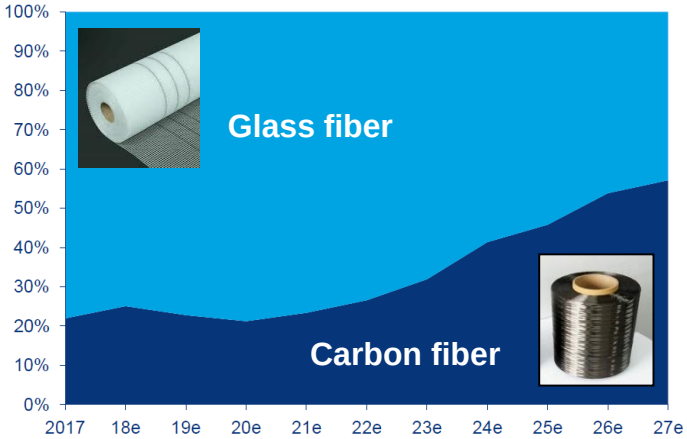
블레이드 해외 현황

Major Trends

- Frequent new product introduction
- Longer blades dictate material shift
- Western OEMs seek independent suppliers
- Offshore growth brings a massive opportunity

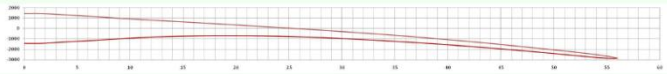
Large Blade & Carbon Fiber



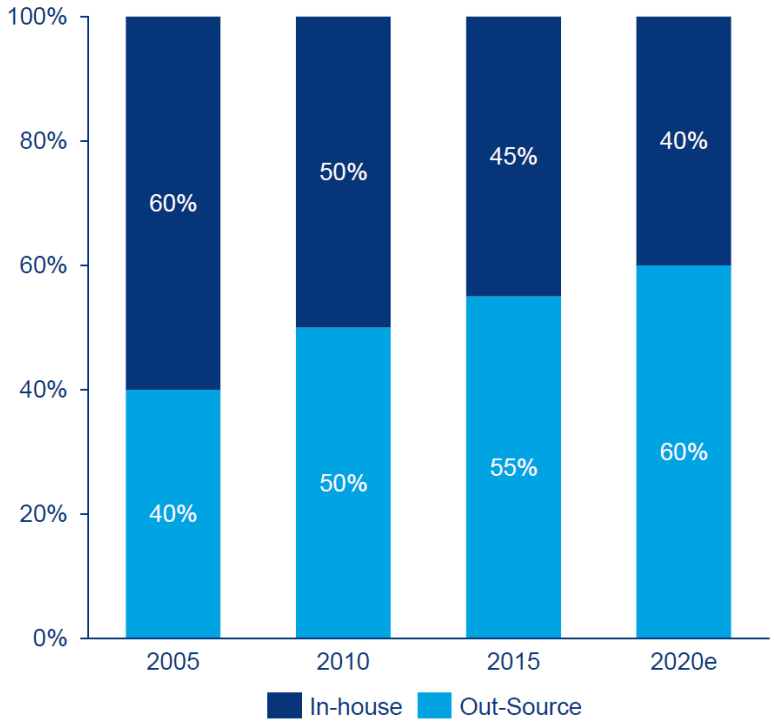


Carbon Blade

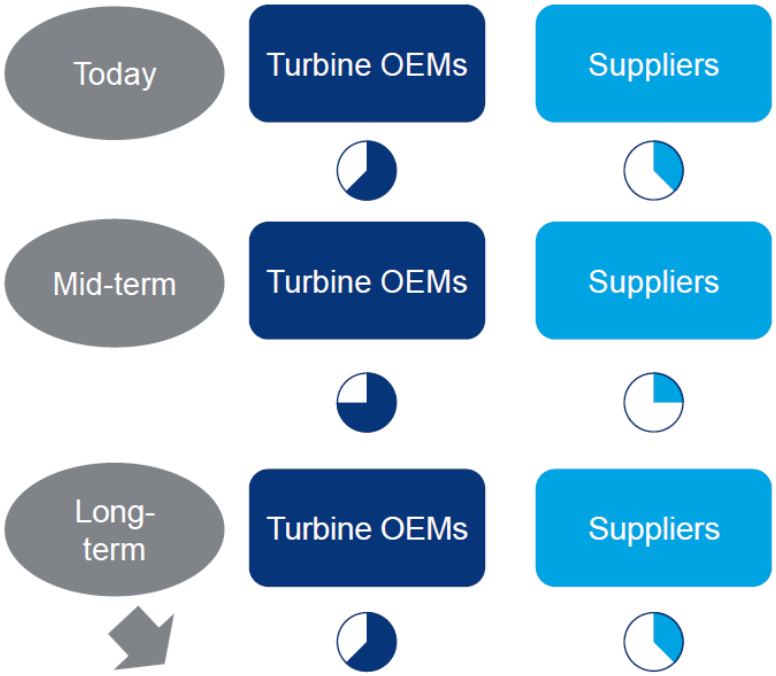
- *Longer span with smaller deflection*
- *Higher Cp with thinner airfoil section*
- *Lighter weight and low loads*
- *Fewer dynamic issues*
- *Higher reliability & manufacturing*



Outsourcing (유럽 vs 중국)

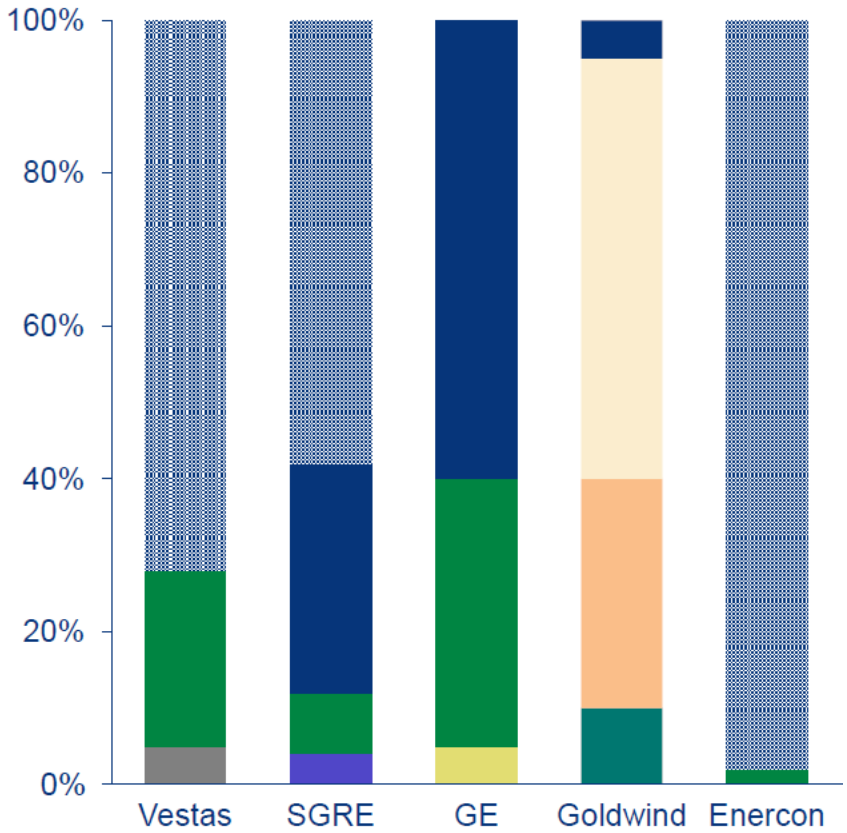


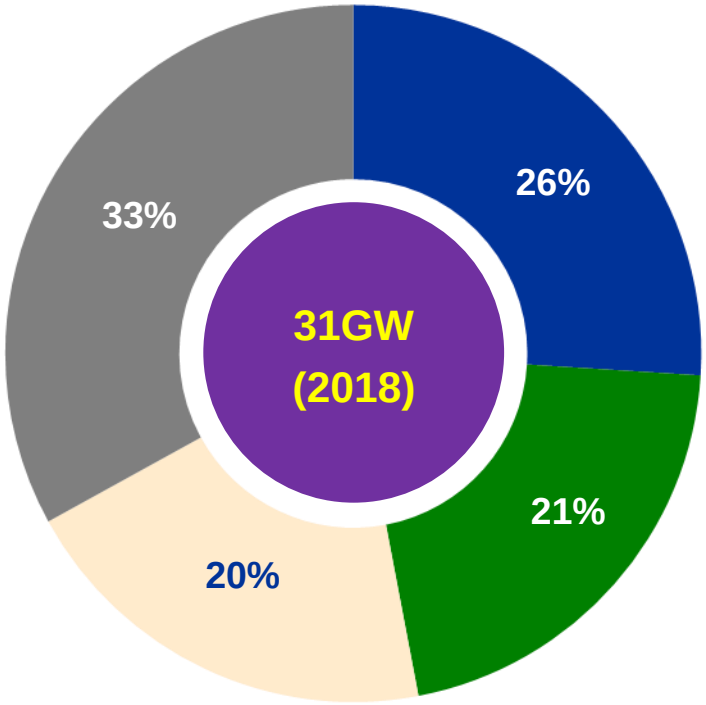
Blade Manufacturing



Blade Design

Supply Chain

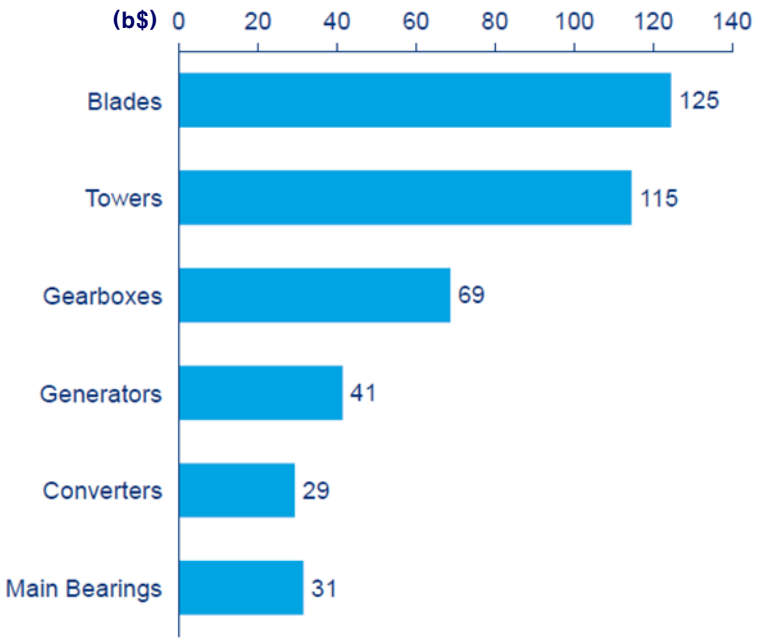




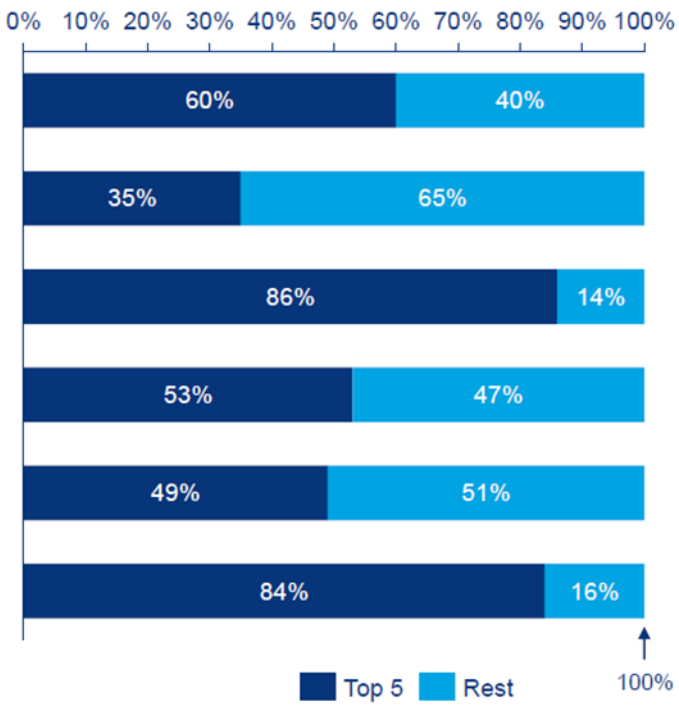
In-house | LM | TPI | Sinoma & LZ | Others

Market Share

Market Potential (2019~2027)



Market Share (2018)



Future Share Concentration

Local Content Policy (LCP)

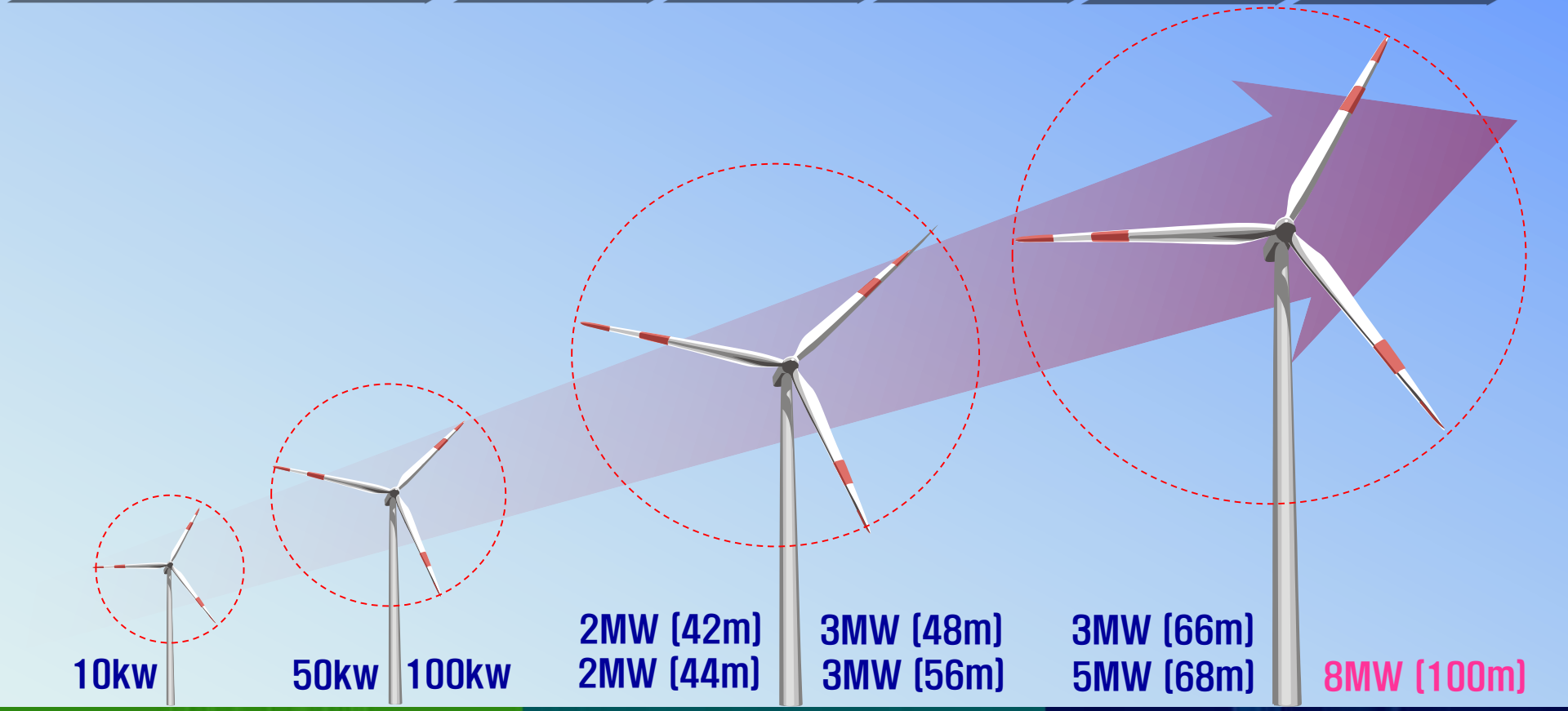
Country	LCP trend	Nacelles / Hub assembly	Blades	Gearboxes	Generators	Converters	Towers	Main bearings
Brazil	=	Expansion of existing facilities	Expansion of existing facilities	No new investment	No new investment	No new investment	Expansion of existing facilities	No new investment
Turkey	↗	New investments	Expansion of existing facilities	No new investment	New investments	No new investment	Expansion of existing facilities	No new investment
Taiwan	=	No new investment	New investments	No new investment	New investments	No new investment	New investments	No new investment
South Africa	↗	No new investment	No new investment	No new investment	No new investment	No new investment	Expansion of existing facilities	No new investment
Australia	=	New investments	No new investment	No new investment	New investments	No new investment	No new investment	No new investment
Egypt	=	New investments	New investments	No new investment	No new investment	No new investment	New investments	No new investment
France	=	New investments	New investments	No new investment	New investments	No new investment	New investments	No new investment
Saudi Arabia	↗	New investments	No new investment	No new investment	New investments	No new investment	No new investment	No new investment
Argentina	=	New investments	No new investment	No new investment	No new investment	No new investment	New investments	No new investment
Russia	↗	New investments	New investments	No new investment	No new investment	No new investment	New investments	No new investment
Morocco	=	No new investment	New investments	No new investment	No new investment	No new investment	No new investment	No new investment
Ukraine	=	No new investment	No new investment	No new investment	No new investment	No new investment	No new investment	No new investment
Indonesia	=	No new investment	No new investment	No new investment	No new investment	No new investment	No new investment	No new investment

New investments | Expansion of existing facilities | No new investment

블레이드 국내 현황

블레이드 사업 이력

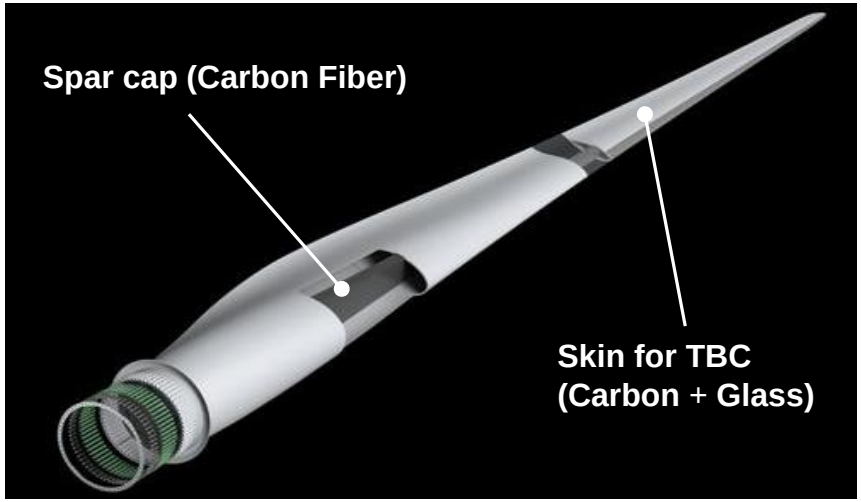
2007 ~ 2013 | 2014 | 2015 | 2016 | 2017 | 2018

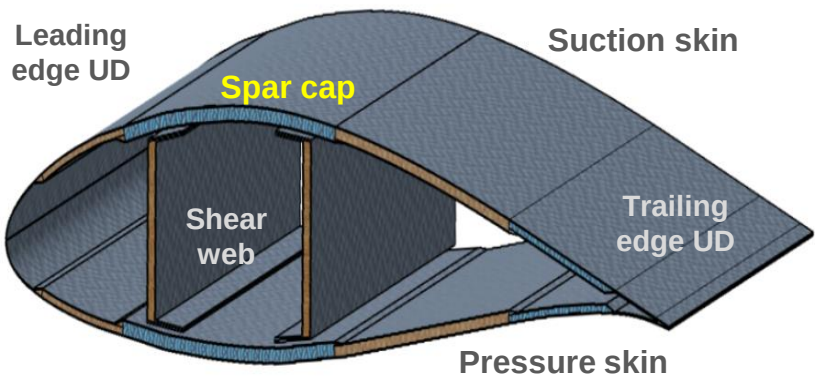


소형풍력 블레이드	육상풍력 블레이드	해상풍력 블레이드

서남해 해상풍력(60MW) – 카본 블레이드

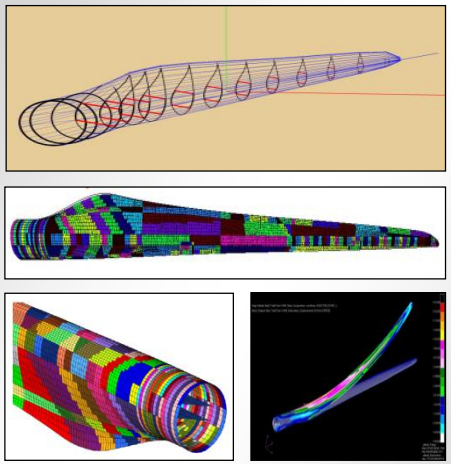
Product	Carbon Blade
Rated Power	3MW, Class 3S
Chord & Span	4.0m x 65.5m
Weight	14,000 kg
Material	Glass & Carbon Fiber Core (Balsa/PVC foam)
Process	Resin Infusion Molding





서남해 해상풍력(60MW) – 카본 블레이드

Design

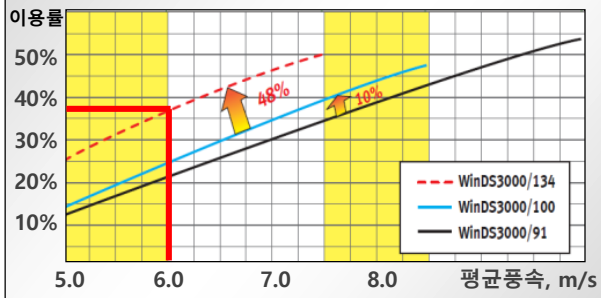


- 형상설계, $Area_{swept}$ 14,100m^2
- 구조설계, Carbon 경량화 설계
- 구조해석, 파손/좌굴/진동

Material & Process

- 소재, 탄소 PP/레진 국산화
- 금형, RIM 금형 국산화
- 공법, 탄소 PP 중온 경화

Test & Evaluation



- 하중시험-피로시험(20년)-하중시험
- S-Class, 정하중$_{C2}$ + 피로$_{C3}$
- 국제 인증, DEWI-OCC 인증 획득

한국형 저풍속-고효율 블레이드

실증시험 측정 결과 : 이용률 37% at 6.0m/s

☞ 기존제품 대비 이용률 48% 향상 (해외 수준의 경제성 확보)

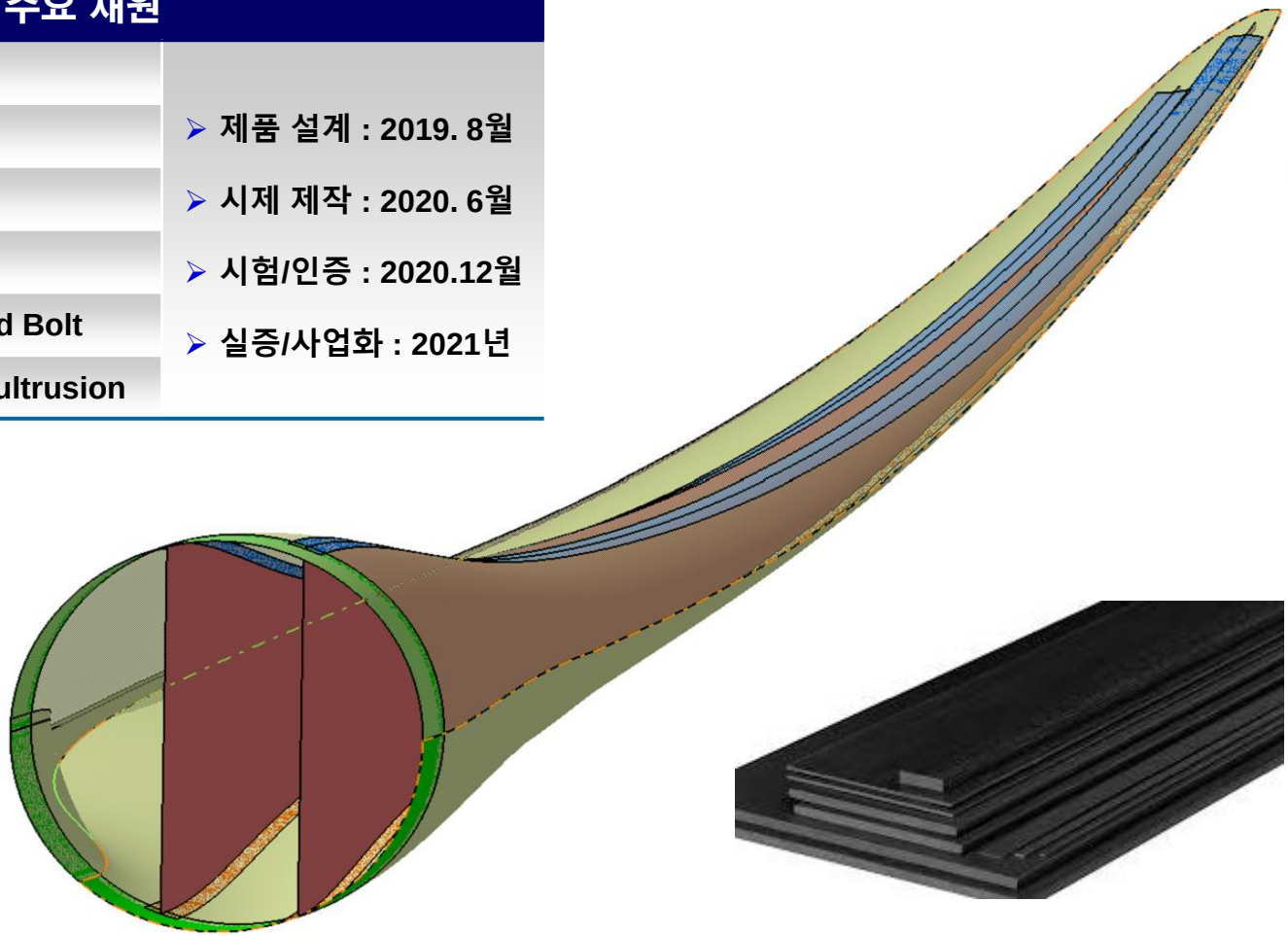
Supply Chain – 카본 블레이드

블레이드 Supply Chain			
원소재	유리섬유	삼우, 동일산자	➢ 소재-금형-제품 Supply Chain 구축 ➢ 설계-개발-인증 기술 자립화
	탄소 PP	한국카본, SK 케미칼	
	에폭시	국도화학, 금호피앤비	
금형		정인테크	
블레이드		휴먼컴퍼지트	
인증시험		재료연구소(KIMS)	

차세대 블레이드 (8MW 급)

주요 재원	
Length	90m+α
Max. Chord	6.3m
Weight	43 ton
Root Dia.	4.72m
Root Type	Embedded Bolt
Spar Cap	Carbon Pultrusion

- 제품 설계 : 2019. 8월
- 시제 제작 : 2020. 6월
- 시험/인증 : 2020.12월
- 실증/사업화 : 2021년



블레이드 R&D

극한 환경용 아이스포빅 코팅 기술

블레이드 초음파 NDT 기술

저가형 피치계 탄소섬유 생산 기술

Future R&D

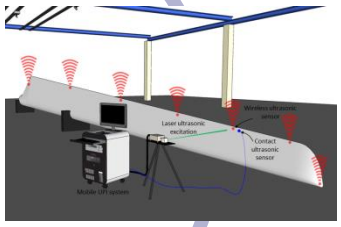
Two-piece Blade

Stealth Blade

Real-time Monitoring (O&M)

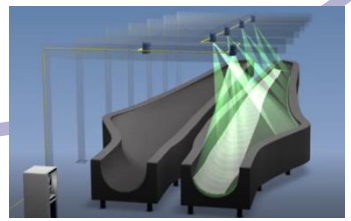
Carbon Pultrusion

Ultra-heavy Carbon Prepreg



블레이드 P-Laser NDT 기술

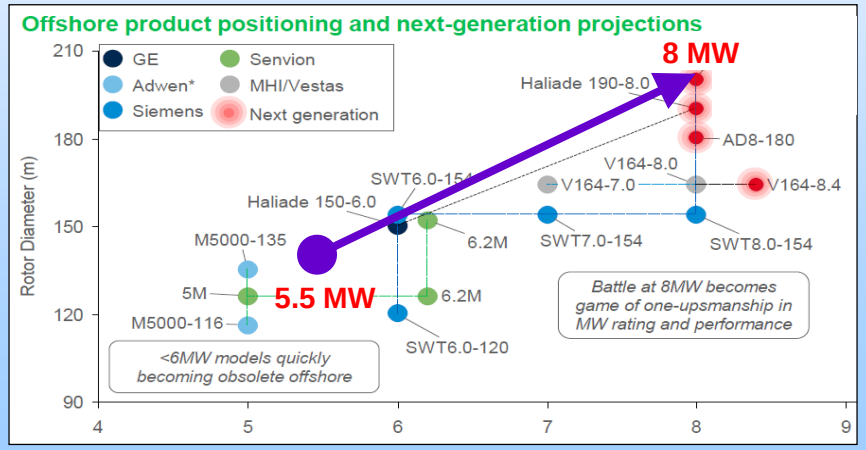
탄소복합재 리사이클링 기술



블레이드 제조공정 자동화 기술

블레이드 사업화 · 정책

제 품	2016	2017	2018	2019	2020	비고
3.0 MW (Class 3S)	개발/인증		사업화			➢ 서남해 해상풍력
5.5 MW (Class 1A)		개발/인증		사업화		➢ 제주도 해상풍력
8.0 MW (Class 2S)			개발/인증			➢ 대규모 해상단지



재생에너지 산업경쟁력 강화 방안

(산업부, 2019. 4)

- *4대 핵심부품 국산화 육성*
- *기술고도화 - 가격·기술 격차 조기 극복*
- *지역기반 혁신 생태계 조성*
- *내수시장 확대 및 REC 제도 개편*

감사합니다 !!!