



# Integration to Wind Energy Business

Global Outlook to Turkish Supply Chain



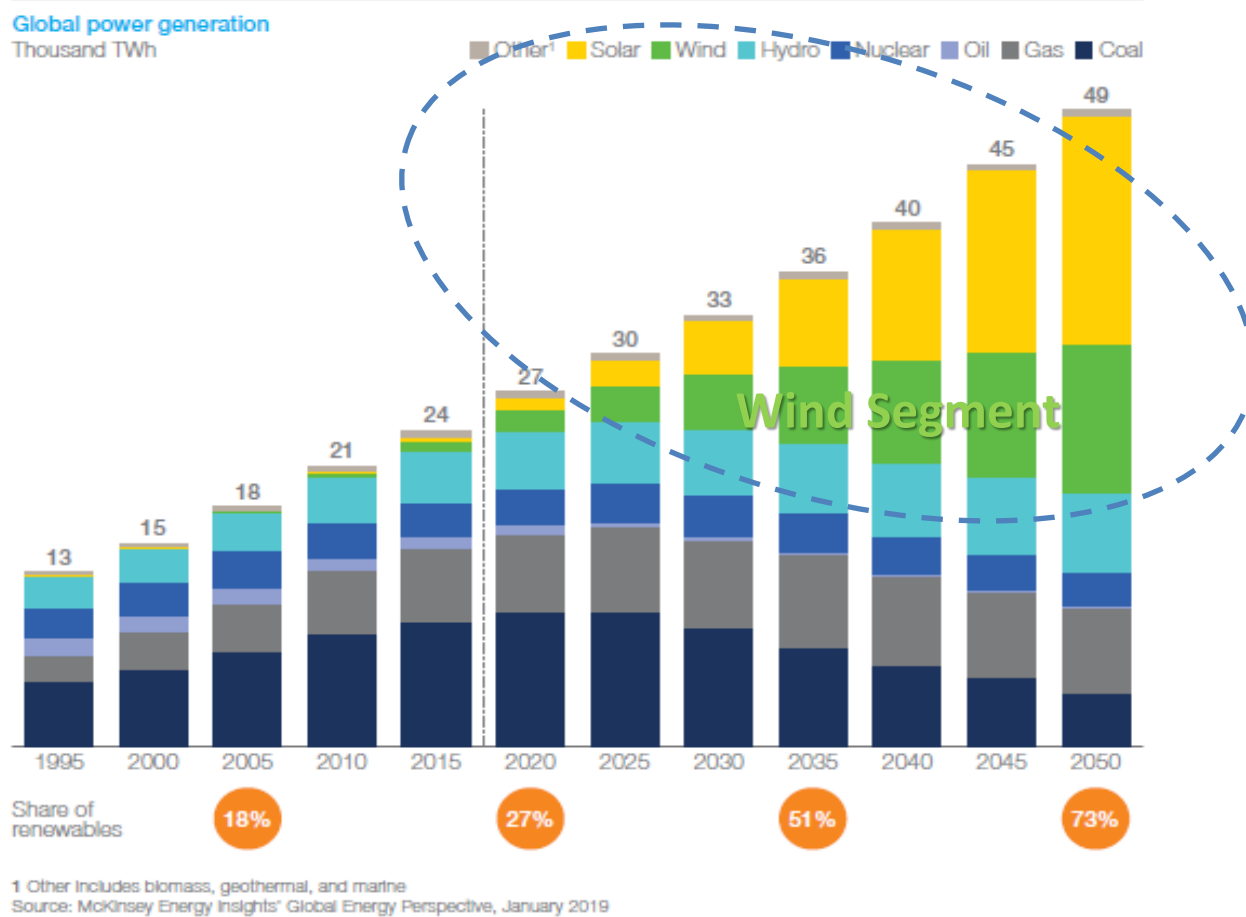
28.07.2021

# Global Trends in Power Generation

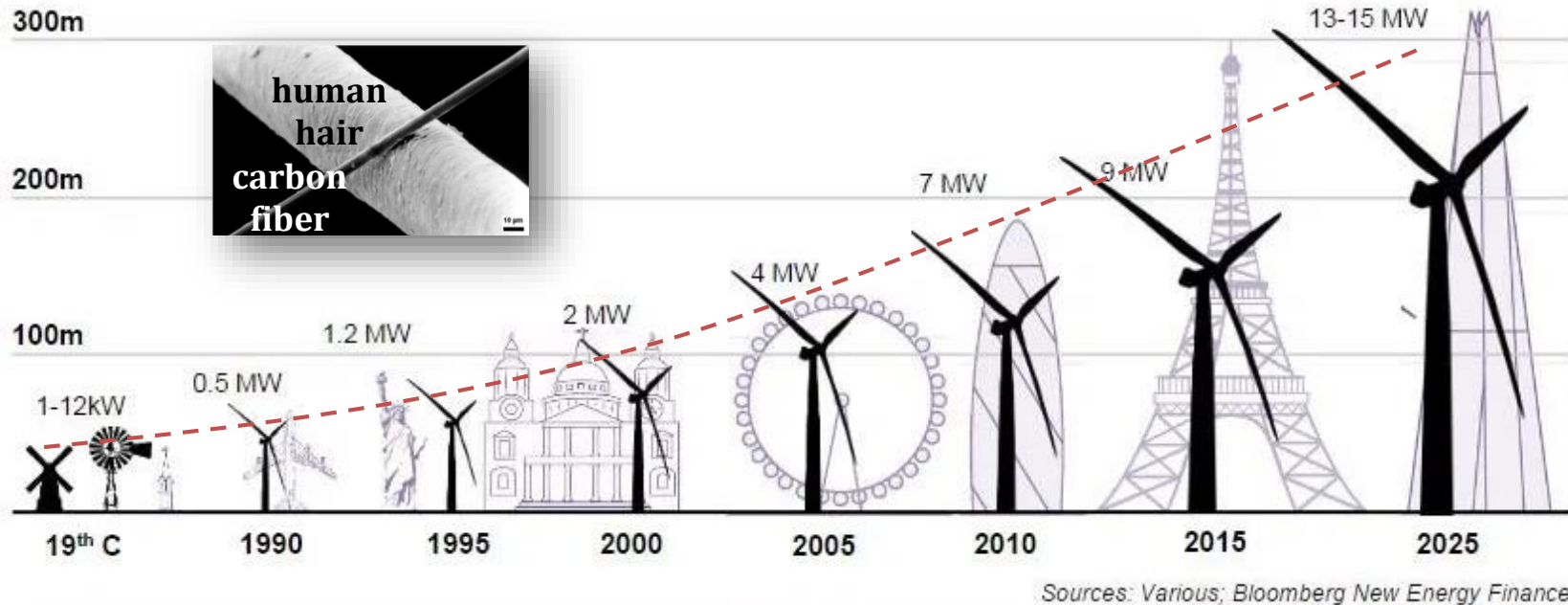


Renewable generation accounts for more than 50% of power supply post-2035, a clear trend break from historical fossil fuel-based generation

- Wind and Solar are in global growth trend. From around 30% today to around 50% by 2035 and close to 75% by mid-century.
- Growth driven by competitive LCOE and Low Opex.
- Market has been resilient to Covid-19. And, expected to stay stable.



# Trend towards to bigger size turbines...



➔ For **Better Economics** of Wind Power Systems; **Carbon Fiber** is **enabler** to support **Evolution of Wind Turbines with Longer Blades by Superior Mechanical Properties** like;

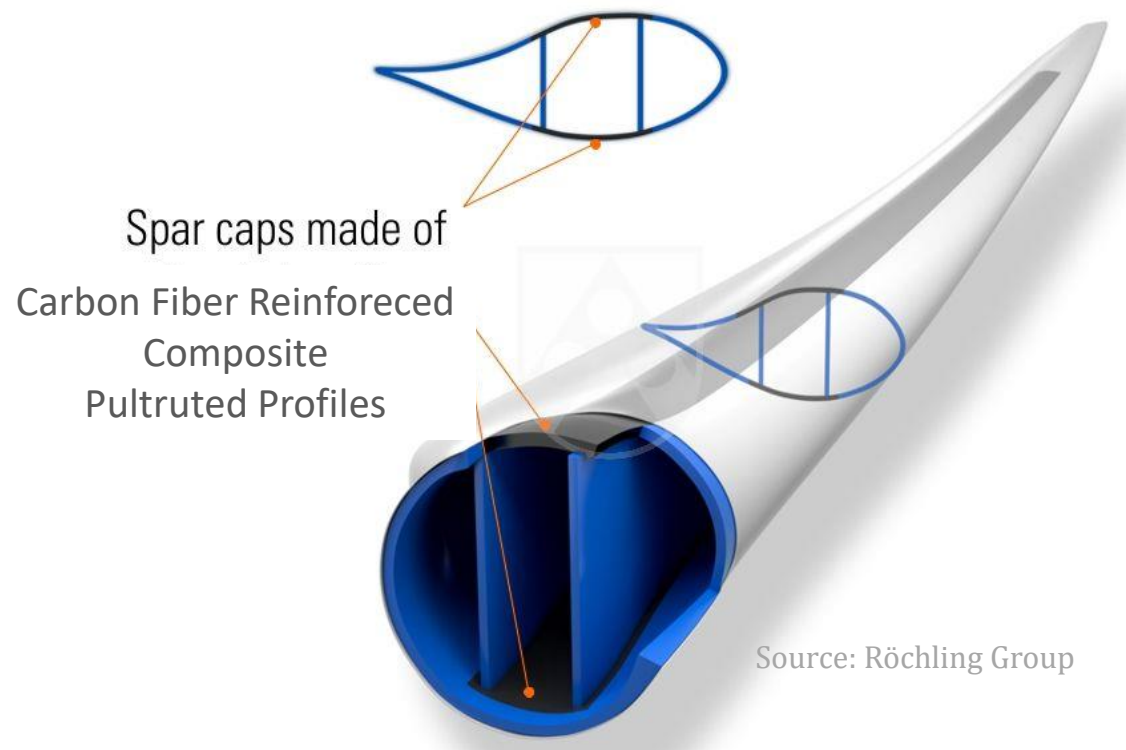
- Having **stiffness, deflection** and **weight advantages**
- Excellent performance under **tension loads** and negligible **fatigue strength** losses
- Having **high load carrying capacity** and **fatigue resistance**.
- Enabling the use of less material resulting in **thinner laminates**

➔ **Wind Business Segment** is the «Star» and «Largest Consumer» in **Carbon Fiber World** with strong growth rate of 20% (based on 2019).

# Where is Carbon Fiber Reinforced Structure in Blade?



- ➔ **Pultruded Laminates** are Game Changer in comparison other reinforcement technologies/forms of materials.



- ➔ Rotor Blades are **second biggest cost component** (22 %) for Wind Power Systems. And, **Pultruded Laminates** cost is around 20-25% of Rotor Blades total cost.

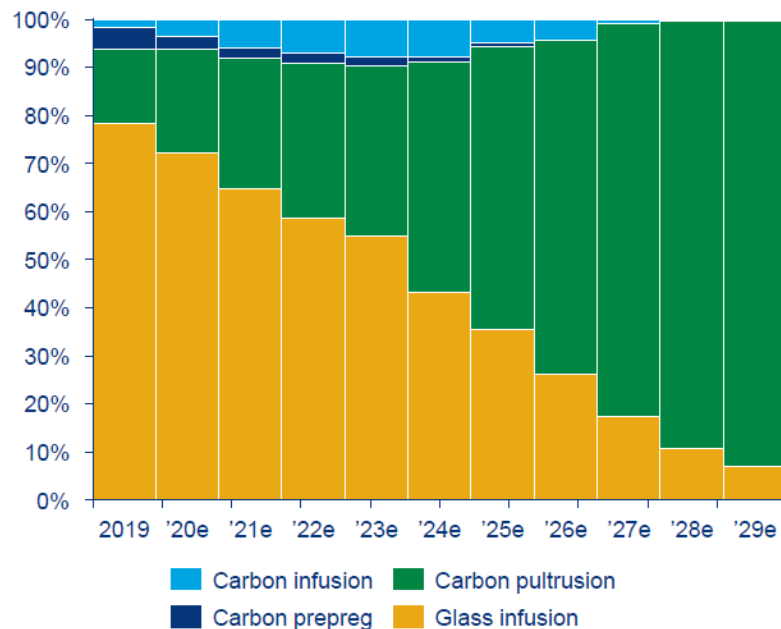
# ONSHORE Wind Turbines Spar Tech Trend



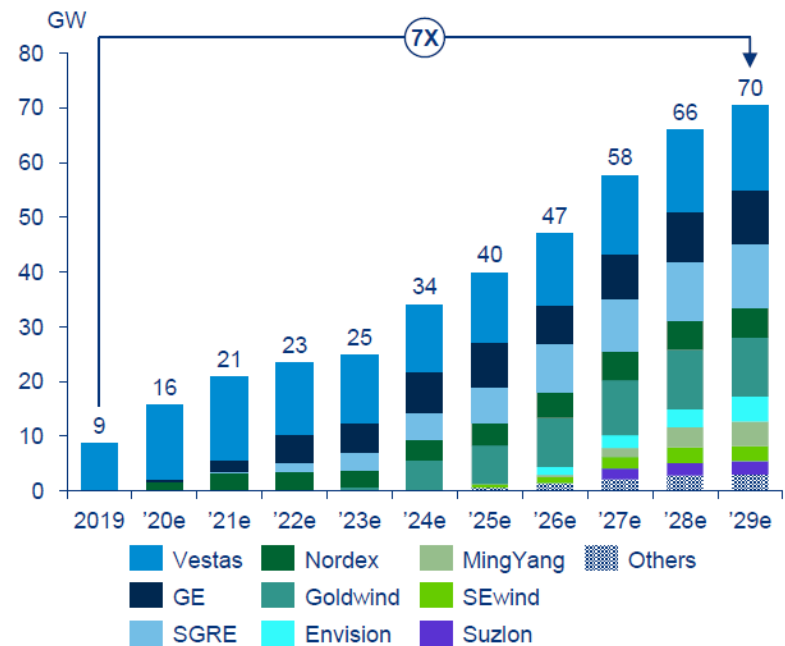
## ONSHORE: Pultrusion adoption rises, leaving behind prepreg and glass infusion

Pultruded composites in wind blades are expected to outpace the wind installs volume growth

ONSHORE: Global blade sparcap material, 2019-2029e



ONSHORE: OEM carbon pultrusion trends, 2019-2029e



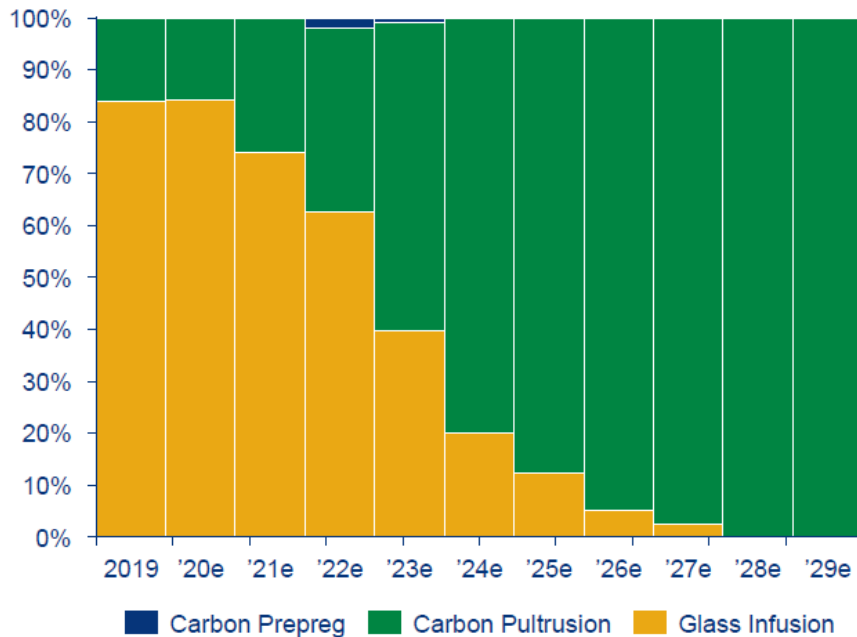
Source: Wood Mackenzie

# OFFSHORE Wind Turbines Spar Tech Trend

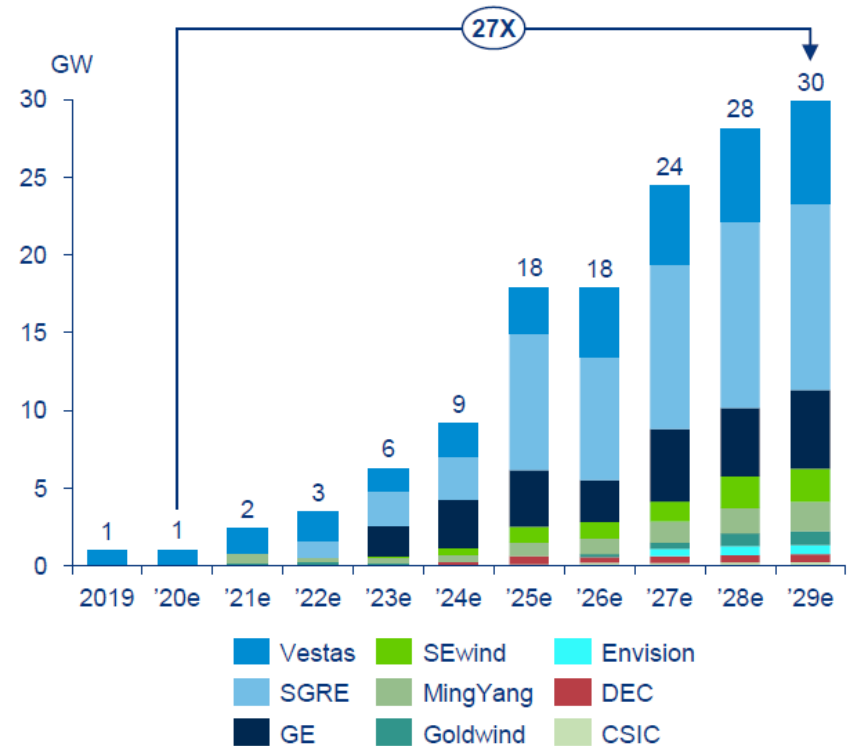


**OFFSHORE: Carbon pultrusions move from niche to mainstream technology in the next five years; driving supply ramp up to meet growing demand**

OFFSHORE: Global blade sparcap materials, 2019-2029e



OFFSHORE: OEM carbon pultrusion trends, 2019-2029e





# DowAkse

*The product, engineering,  
technology and knowledge  
to support your carbon fiber and  
composite needs*



# Decisively Built for Market Opportunity



*Starting from 2012;*

*DowAkSa combines the strengths of two world class companies:*

**Dow** has the formulation expertise, proven composite technologies, global reach and materials science.



**AkSa** is the world's largest producer of acrylic fibers.



Yalova, Turkey

- A **Fully Integrated Carbon Fiber and Pultruded Laminates manufacturer** in Turkey with strategic proximity to Europe and Asia.
- **Capacity to expand** supply of **high-quality, reliable and competitively-priced** carbon fiber and composites solutions.



# Full Downstream Integration Model in Turkey

Crude Oil/Propylene



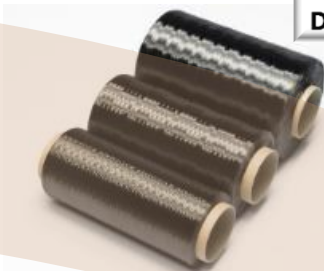
Acrylonitrile



Special Polymer & Acrylic Fiber-Precursor



Carbon Fiber



Wind Energy Turbines

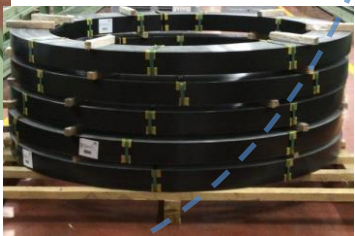


Wind Blades with Carbon Fiber Laminate Spar



PU Impregnated Carbon Fiber Laminates

Polyurethane Resin



# Key for success...Collaboration!

## Right synergies & Know-How Development



### Carbon Fiber and Laminate



- High Quality & Low Cost Carbon Fiber
- Fully Integrated Production
- Capability to built needed volume acc. to OEM' s expansion plans
- Local content provider (Turkey)
- Carbon Fiber Science and Technology
- Polyurethane Injection & Carbon Fiber Pultrusion Know How
- Take on and drive the unique opportunity – from Pilot scale to Commercialization in 1 YEAR
- Composite manufacturing and testing capability
- Network with best composite testing centers (IMA, CTE)
- Become preferred supplier in the NEW/NEW

### PU System



- Polyurethane Chemistry
- Differentiated PU resin system
- R&D roadmap to support DowAksa w. NextGen resin systems
- Fluid Mechanics & Kinetics
- Process Modelling
- Analytical Sciences

### Pultrusion Expertise



- 35+ Experience in Pultrusion Technology
- European Leader in mold (die) manufacture and pultrusion line design
- Strong internal capabilities and external network for fast support to project needs
- Full engagement and Innovative approach
- Tool manufacturing expertise
- Agreement to design and supply the pultrusion lines

# DowAksa Integrated Pultrusion Capability



DowAksa has started up the state-of-the-art pultrusion facility in July 2017;

The Wind Blade  
Plants that DowAksa  
has been serving...

6 Sites  
Globally

Delivered meter of  
laminates for Spars  
from start...

11 Mio  
meter  
(~ 4.000 blades)

DowAksa Global  
Market Share

12%  
forecasted  
in 2021

As next step; DowAksa is **growing** substantially to Support Wind Business globally.

And, DowAksa is enjoying **Project Based Incentive Program.**

## Enablers in General for -Full Downstream Integration Model- to have «Better Economy» and «Advanced Technology»

- **Local Content Provisions** together with **Export** opportunities; Smart **Incentives**
- **R&D and/or Technology Transfer** support; **Training, Testing** and **Tech. Application Centers**
- Supply Chain **Coordination** and **Clustering**



# Thank you!

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