AKSA
Akrilik Kimya Sanayii A.Ş.

Next Step is COMPOSITES

Fulya Aktas
Carbon Fiber Sales&Marketing
After Sales Service Engineer

18 March 2010

AKSACA

AKKÖK

www.aksa.com

Content

- Aksa:
  - What we do?
  - How we do it?
  - Who we are affiliated with?
- Aksa's CF business
  - Our CF products
- From CF to Composites
- Potential Applications for TURKEY
  - Pressure vessels
  - Wind blades
  - Infrastructure
  - Marine applications
- Conclusion

AKSA
Akrilik Kimya Sanayii A.Ş.

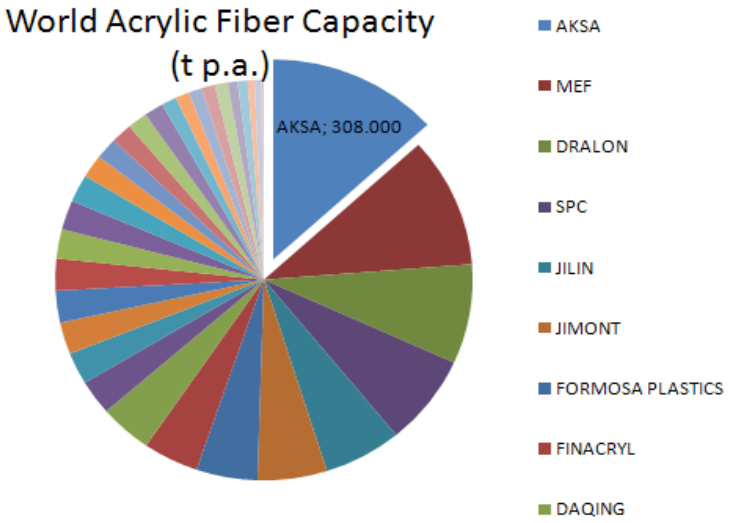
AKSACA

AKKÖK

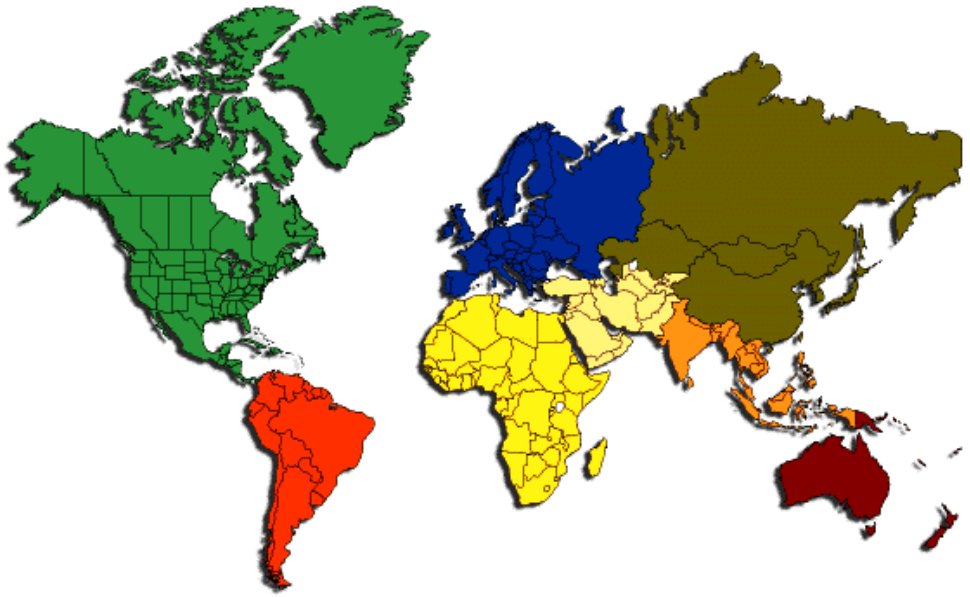
www.aksa.com

AKSA

- AKSA is the world leader in acrylic fiber.
  - Founded in 1968
  - #1 in capacity
  - 12% market share
  - Standard acrylic fibers
  - Specialty acrylic fibers
  - Broadest and best product offering
  - More than 10,000 products
  - Wide range of applications and broad customer base



What AKSA does?



- We supply the world from Turkey
  - Expanding into international markets from 1977

  -Global Distribution to more than 50 countries

  -More than 300 active customers.

- Vision:
  - -Create New Profitable Areas and End Uses
  - -Maximize Value Added
  - -Invest in Technology
  - -Benefit the Company and Customer

How AKSA does it?

- More than 600 employees
  - Dedicated in-house R&D center with staff of more than 70

  - Annual spending on R&D between 5-10 Mio $.
  -AKSA ranks among the top 17 in Turkey in R&D spending.

  -Six-Sigma (6σ) experience since 2004.
  -9 Black Belts; 63 Green Belts.

  -Systems:
    - 1993: ISO 9001
    - 1993: Responsible Care
    - 1997: ISO 14001
    - 2007: ISO 18001

Awards / Recognitions

1995: Turkish Chemical Manufacturers Association (TCMA) Responsible Care
1996: ISO Environmental Award
1997: ISO Jury's Special Environmental Award
2000: TCMA R&D Award
2000: Ministry of Energy, Energy Saving Projects Award
2001: TCMA Responsible Care Award TCMA "Project Award"
2004: Turkish Standard Institute 50th Year Successful Company Award
2005: ISO Sector Environment Award
2007: Accountability Rating Award
2008: National Quality Award

Who is AKSA with?

- Akkok Group of companies:

  -Currently includes 20 industrial and commercial companies
  -Operate out of 15 production sites

CHEMICALS
AKSA, AKSA EGYPT, AK-KİM, AKMELTEM

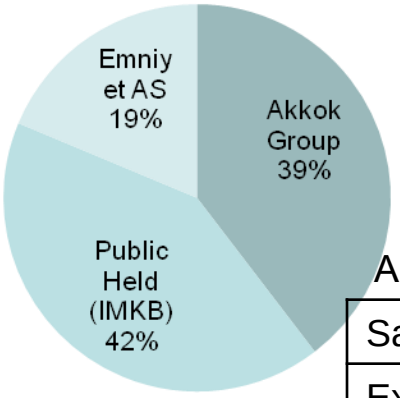
ENERGY
AKENERJİ

TEXTILES
•**AK-AL, AK-TOPS, AKSU** (AKSU was the first company, founded in 1952 to produce fabrics)

REAL ESTATE DEVELOPMENT
AKMERKEZ, AK TURİZM, AKİŞ

OTHER SERVICES
AK-PA, DİNKAL, AKPORT, AKTEK, AKMERKEZ LOKANTACILIK

Share Ownership



AKKÖK	2006	2007	2008
Sales	1.314	1.337	1.514
Exports	342	346	326

(in million US dollars)

AKKÖK

www.aksa.com

AKSA's CF Business

- Our capabilities
  - -34 mt Pilot Line established in 2008
  - -1.500 mt Production Line established in 2009
  - -Dedicated Precursor Lines
  - -Dedicated Polymerization & Dope Preparation

- Aksa's CF was developed during 2006-2009 by our own in house R&D team.
- AKSA's Carbon Fiber Research and Development Project has been supported by "TÜBİTAK-TEYDEB" (The Scientific and Technological Research Council of Turkey).

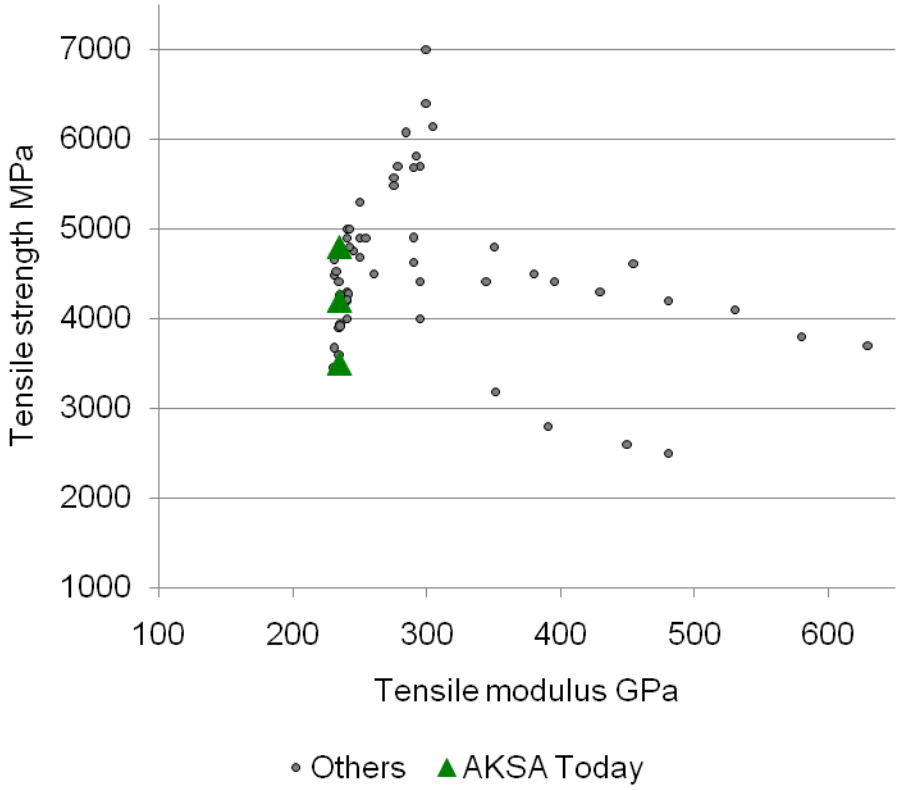
AKSA
Akrilik Kimya Sanayii A.Ş.

AKSACA

AKKÖK

www.aksa.com

Properties of AKSACA Carbon Fiber



Initial Products

(2009)

- 3k to 24k Format
- Standard Modulus (235-240 GPa)
- Tensile Strengths up to 4.800 MPa

Properties of CF

- High tensile strength and stiffness,
- Low weight,
- High thermal conductivity,
- Excellent creep resistance,
- Good chemical resistance
- Low thermal expansion

From CF to Composites

AKSA
Akrilik Kimya Sanayii A.Ş.

Carbon Fiber

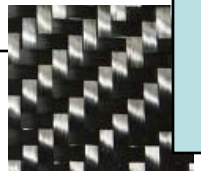
Filament Winding

Pressurised Vessels

Multiaxial Fabric

Wind Blades

Marine

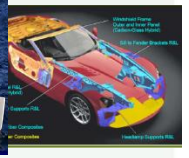


Fabric

Prepreg

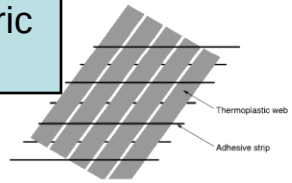
Automotive

Marine

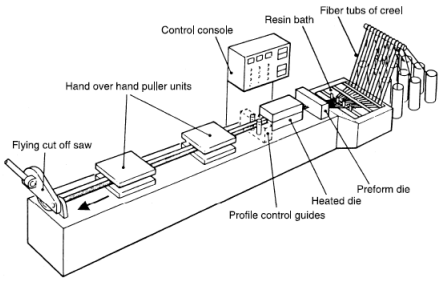


Pultruded Part

UD Fabric



Infrastructure



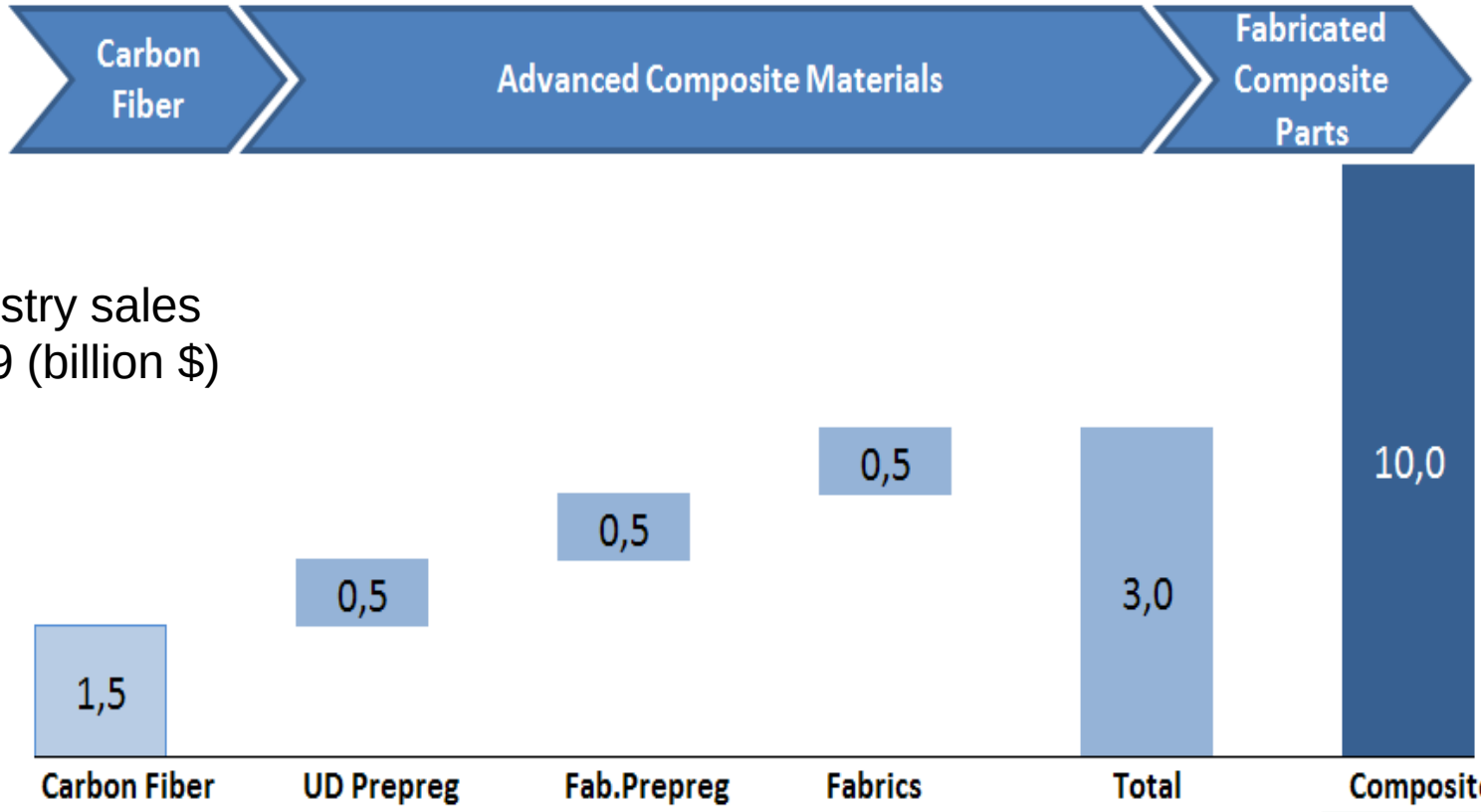
Other Applications
-Aerospace
-Defence
-Sports

AKSACA

www.aksa.com

AKKÖK

Carbon Fiber & Composites is a 10 Billion $ Industry



AKSA
Akrilik Kimya Sanayii A.Ş.

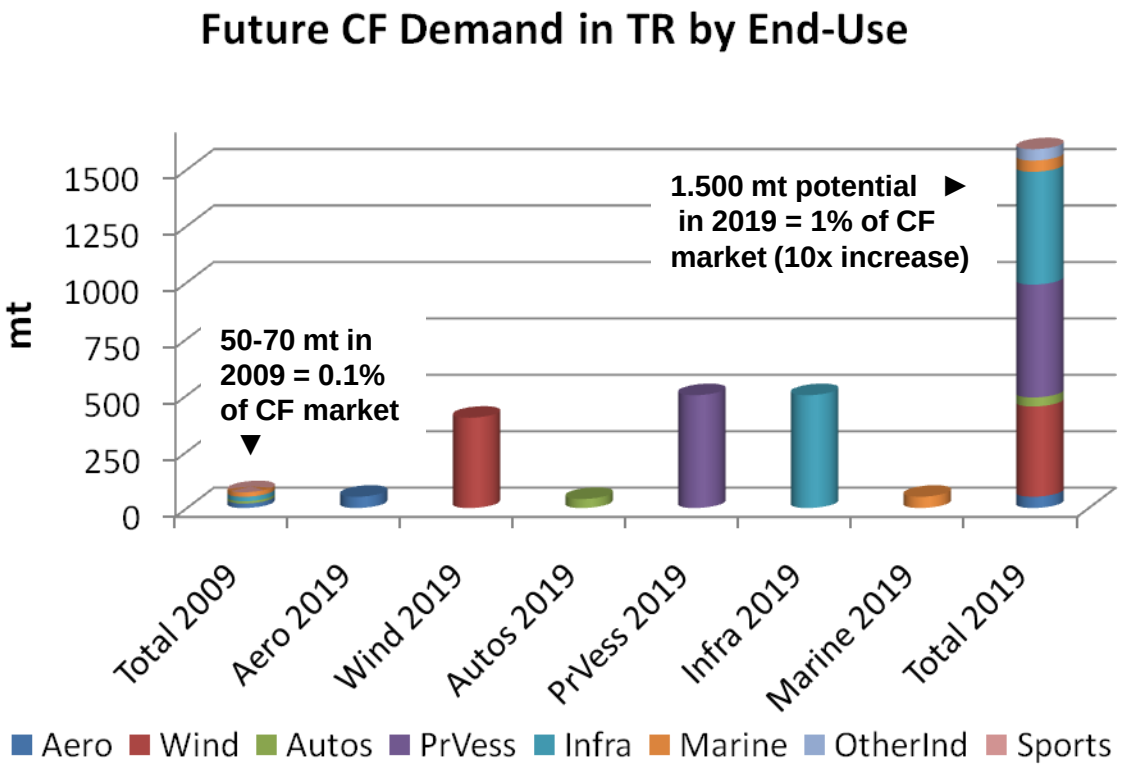
AKSACA

AKKÖK

www.aksa.com

Potential CF Use in Turkey

(AKSA synthesis of data gathered from various sources)



In 10 years… the main potential uses of CF in Turkey are likely limited to:

- Pressure Vessels,
- Wind,
- Automotive
- Marine,
- Infrastructure,

AKSA has the potential to develop between 500-1.000 mt p.a. CF busines in Turkey.

AKSA
Akrilik Kimya Sanayii A.Ş.

AKSACA

AKKÖK

www.aksa.com

Potential in NGVs

	Country	Natural Gas Vehicles	Refuelling Stations
1	**Pakistan**	2,000,000	2,600
2	**Argentina**	1,745,677	1,801
3	**Brazil**	1,588,331	1,688
4	**Iran ***	1,000,000	500
5	**India**	650,000	463
6	**Italy**	580,000	700
7	**China**	400,000	1,000
8	**Colombia**	280,340	401
9	**Bangladesh**	150,253	337
38	**Turkey**	3,056	9

Source: International Association of NGVs, Dec 2008

- * There is also a government mandate that forces local car manufacturers to produce 60% of all their new vehicles as dual fuel vehicles.

- Current Situation in the world
  - 10 Mio NGVs are in service
  - Asia and South America, accounting for 86% of the worldwide demand.
  - -3% CF Reinforced PVs,
  - 93% Heavy Steel
  - Government policies has an effect on demand.
- Potential in the world
  - CNG Composite PVs offer:
    - -Light weight,
    - -Durability
    - -Storage density
  - -By the end of 2020, 50-80 Mio NGV's worlwide

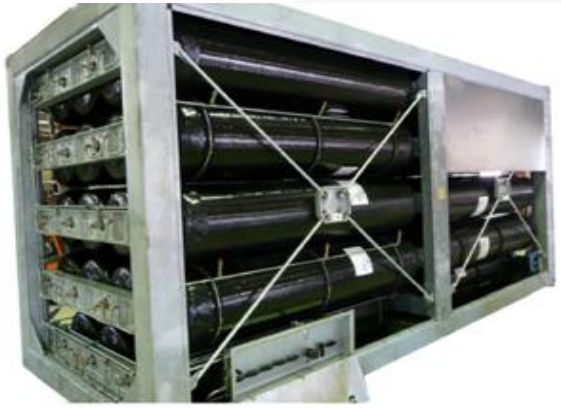
CF Reinforced CNG Tanks


Source:Xperion

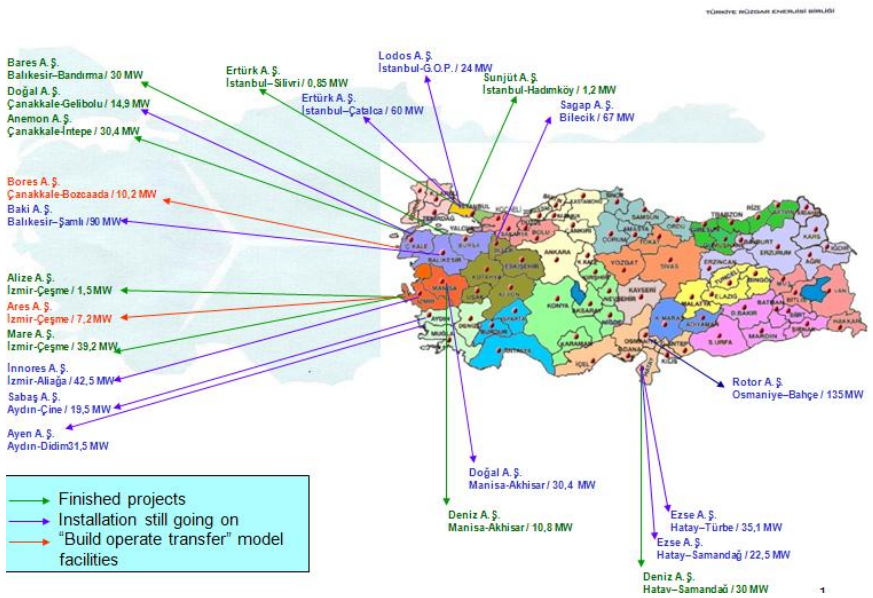
- Current Situation in Turkey
  - -1400 buses are in service in Ankara and Kayseri.
  - -Low market for private cars
- Potential in Turkey
  - -Potential demand: upto 4000 buses
  - - There is a developed market in the neighborhood countries.
  - - Government policy is crucial to develop the domestic market.
  - - Refueling Infrastructure is a challenge to develop TR market.
  - - To produce bulk storage is an option.

High Pressure of CNG fuel systems requires special PVs:

- Type 1: Full metal (Steel or Aliminium) – 1,0 kg/L
- Type 2: Metal liner fully wrapped with GF - 0,75 kg/L
- Type 3: Metal liner fully wrapped with CFRP – 0,40 kg/L
- Type 4: Plastic liner fully wrapped with CFRP – 0,35 kg/L



Wind Energy in Turkey



- Current Situation

  -Turkey almost doubled it's installed capacity, from over 450 MW in 2008 to 801 MW in 2009.

  -Enercon-Demirer is the only blade manufacturer in Turkey, producing 900-1000 blades/year.

- Potential in Turkey

  - To meet its growing electricity demand, it is estimated that Turkey has to increase its installed capacity four-fold (to over 100.000 MW) by 2020. Government has announced a plan to reach 20.000 MW by 2020.

AKSA
Akrilik Kimya Sanayii A.Ş.

AKSACA

AKKÖK

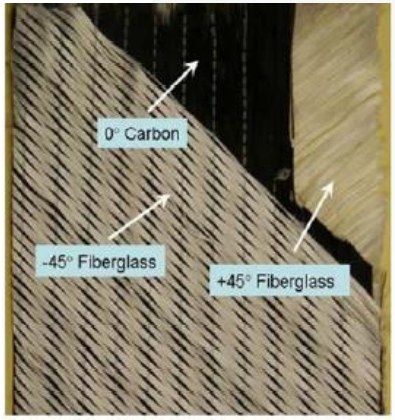
www.aksa.com

Current Trend in Wind Energy

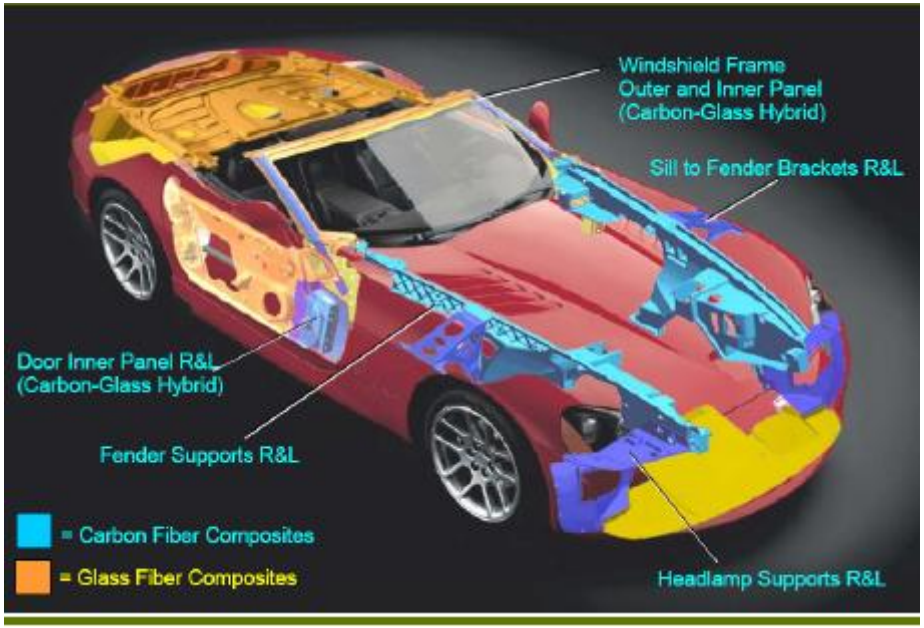
Blades are manufactured using resin infusion and pre-preg lay-up process.

- Current Situation
  - -Annual growth of 11% during last 5 years.
  - -Growth driven by China, India, and US.
  - - Europe will still dominate the market
  - -Factories located in a manner to optimize labor and transportation cost, providing copetitive advantage
  - -Custom designs, tailored to customers machine
  - -1 MW machines are rapidly becoming displaced by multi-MW wind turbines that operate with rotors exceeding 130m in diameter

- Desirable Material Properties:
  - - Light weight
  - - High Stifness : has to withstand the longer blade weight
  - - Fatigue resistance: has to withstand high number of cycles
  - - High life cycle: High initial cost is required to build a structure hence life cycle should be high



Auto Parts



- Current Situation
  - Historically, speacialty material for racing cars and luxury models (F1, Mercedes McLaren SLR, Ferrari, Lamborghini etc.).
  - More recently, incorporated into passenger safety, performance optimization and fuel efficiency.

- Why is market take is slow?
  - High price of carbon fiber (10x more expensive than steel)
  - Unreliable carbon fiber supply situation
  - Lack-of high speed production processes for CFRP parts
  - Developments in lower weight metal alloy and non-reinforcement plastic parts.

- What's needed?
  - Interest of OEM's to produce car parts by CF.
  - JVs between CF manufacturers and leading OEM's and/or parts suppliers which will
  - Increase overall capacity
  - Reduce production costs
  - Co-develop manufacturing expertise over the next years.

Auto Parts

Possible to reduce 400kg by CFRP

[CFRP effects]

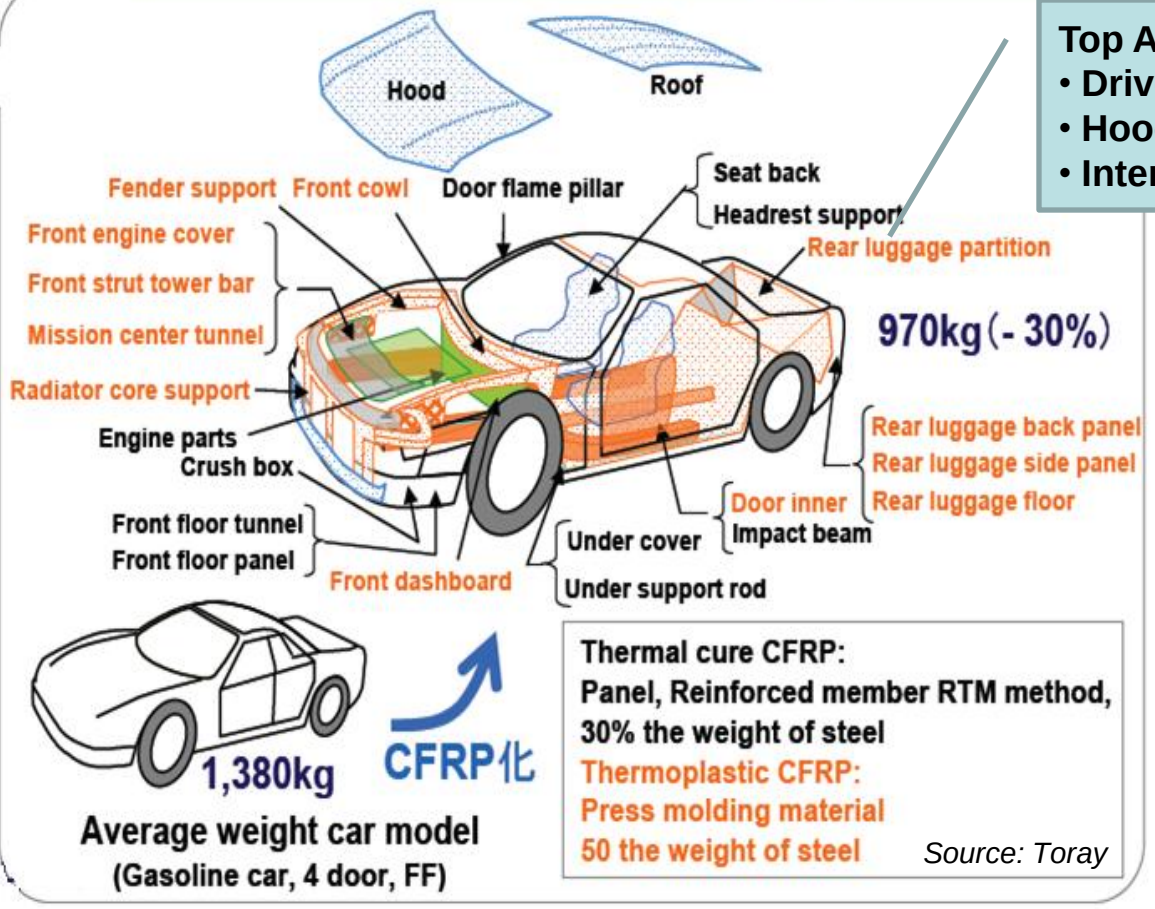
Weight saving
Good Mileage → Ecology

Better crash safety
Energy-absorbing

Lower assembly man-hour / expense
Modularized by unification

Better driving performance
Better vibration damping
Natural vibration UP

Safety improvement
Improvement of material fatigue



Top Applications
- Driveshafts
- Hood
- Interiors

- Toray invested roughly ¥2.5 billion in a dedicated Automotive Centre that it opened in 2008;
- SGL/BMW JV:

Marine

Hulls are manufactured by using Resin Infusion, RTM, Prepreg Moulding

Specific Applications:

- Hulls for large boats (America's Cup)
- Hyper yachts
- Spars and masts
- Sail battens
- Wind Surfing masts and boards

- Current Situation in the World
  - -A niche market for CF.
  - - 750 t/year of CF is used
  - -Prepreg is widely used for performing yacths.
  - -Filament Winding and prepreg tape wrapped CF structures are used in masts and spars.

- Current Situation in TR
  - -5-10 boat manufacturer use CF as multiaxial fabric or prepreg.
  - -Most of them are located in Antalya.
  - -Total CF consumption is around 10 t/yr.

Infrastructure




▪Retrofitting: UD fabrics and pultruded items (rebars, stripes etc) made of CF are being used

▪ Cement reinforcement: CF in various lengths is mixed with cement for this purpose.

▪ Bridge Rehabilitation is the top application.

▪ Column wrapping saves time over steel jacketing

▪ Pultruded bars are in the market to replace iron bars in the new construction

▪Current Situation in the World

-A developing market especially for the countries located in earthquake zones.

- In 2009 2000 t/year of CF is used

- Cement reinforcement is in the R&D phase.

▪Current Situation in Turkey

-Usually only large buildings or public facilities are being retrofitted. Not common in private houses.

-Lack of technical engineering calculations and related softwares.

-Lack of compulsory regulations to retrofit the constructions as a country policy.

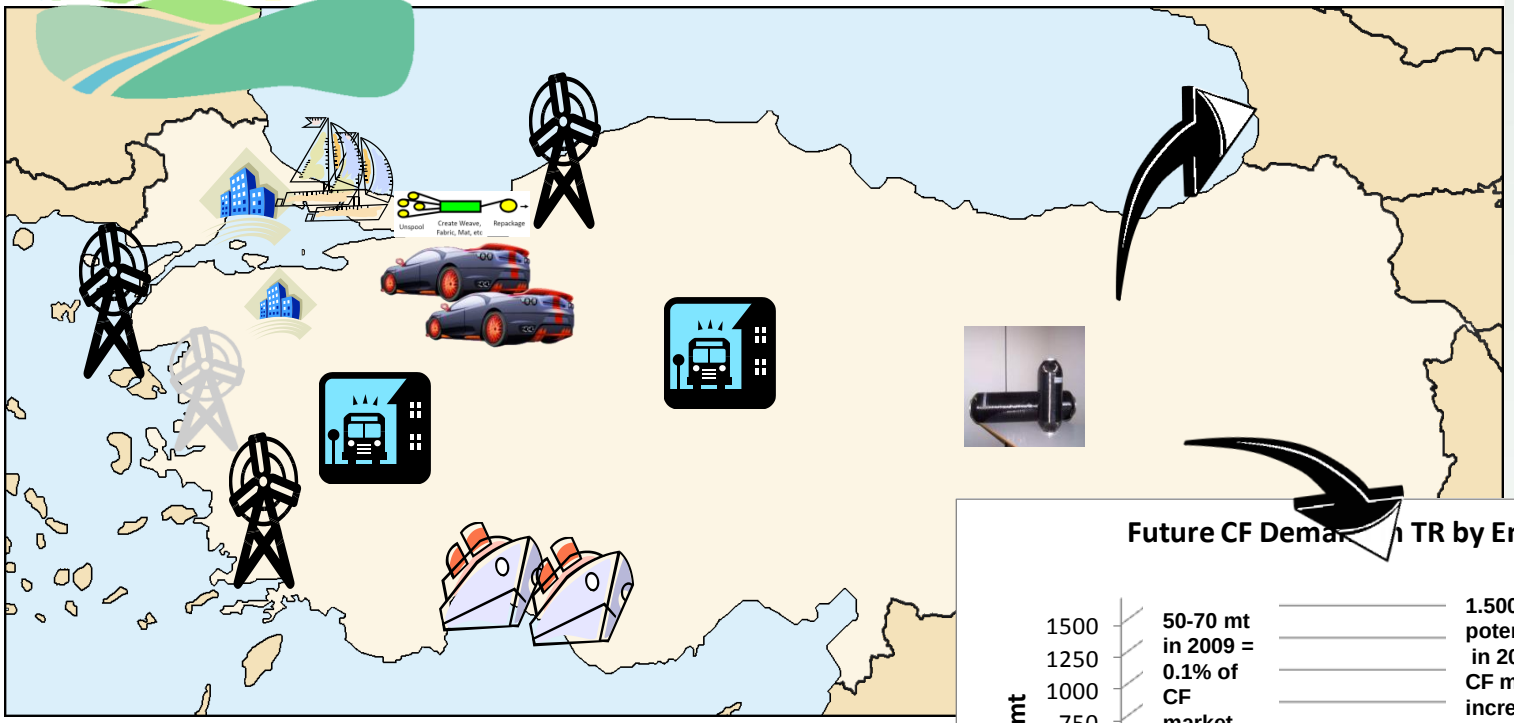
▪Potential in Turkey

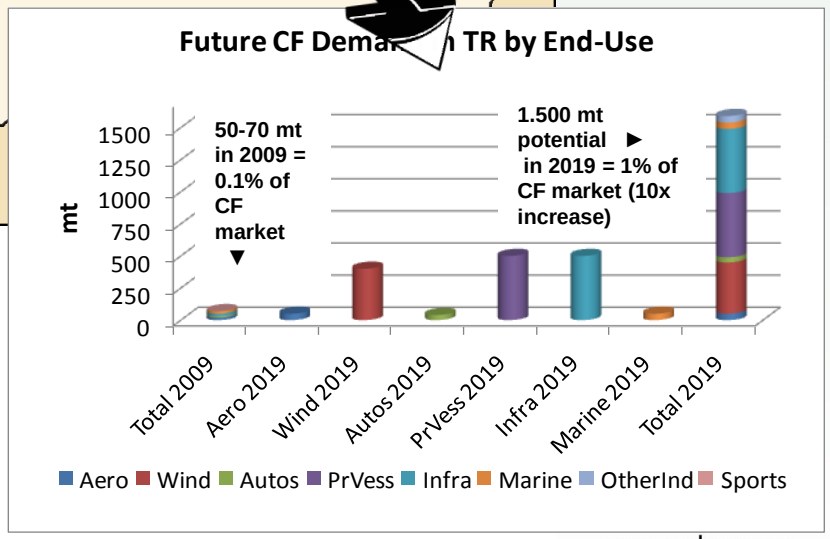
- As Turkey is in an earthquake zone, retroftting should be a number one priority.

-In İstanbul alone, it is estimated that 50.000 buildings need to be retrofitted.

Dream of AKSA

AKSA
Akrilik Kimya Sanayii A.Ş.





AKKÖK

www.aksa.com

AKSA
Akrilik Kimya Sanayii A.Ş.

Thank you for your attention

AKSACA

AKKÖK

www.aksa.com