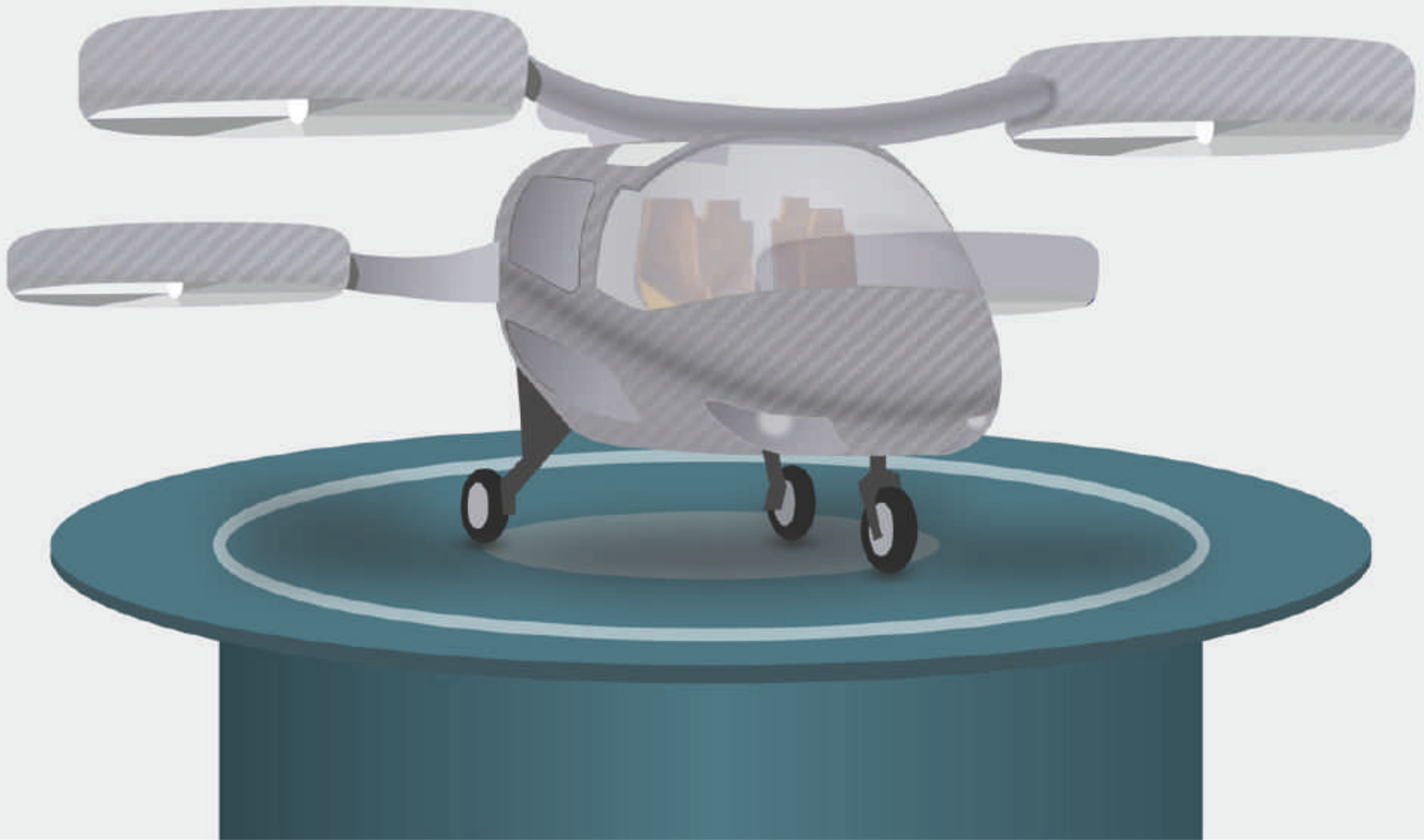
COMPOSITE MATERIALS

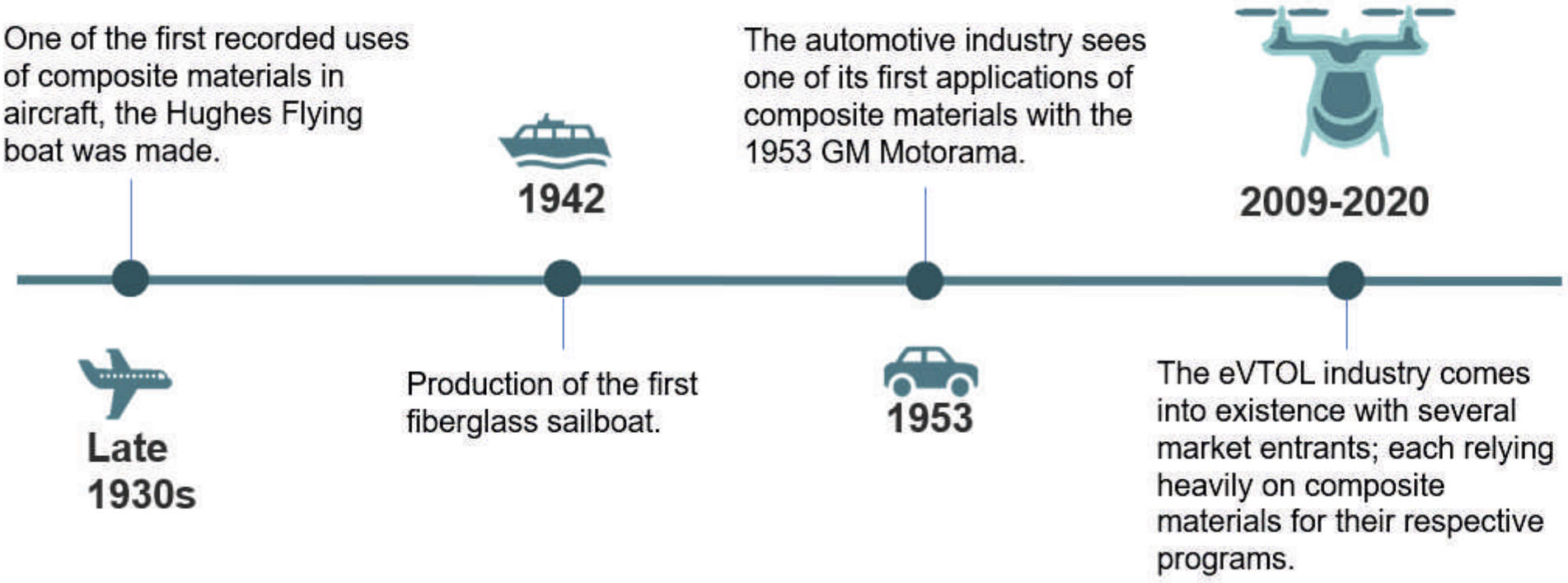
Taking Flight with the eVTOL Revolution



Stratview™ Research
Strategic Insights Delivered

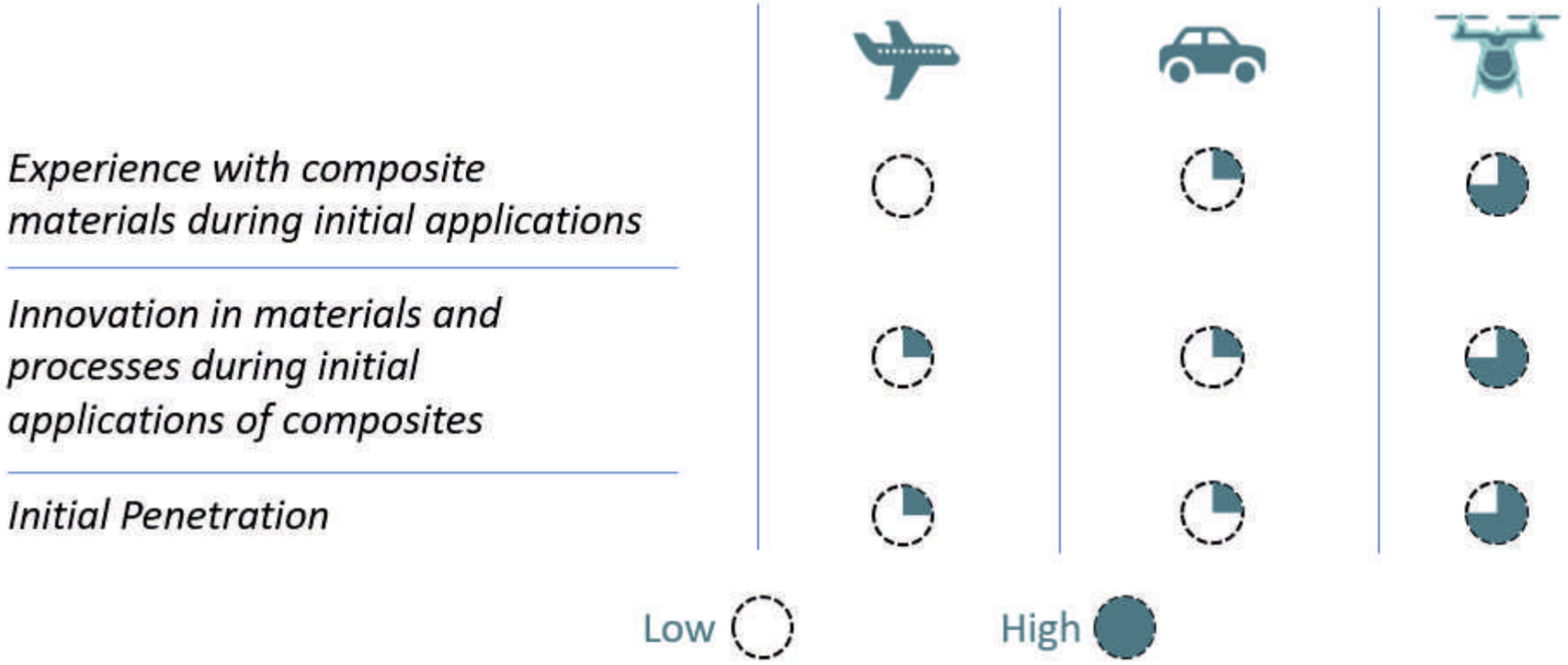
The long-established alliance between Mobility Applications and the Composites Industry

Composite Materials have long been finding applications in various domains of the mobility sector but what makes **eVTOLs** more interesting of an application is the fact that **>70% of an eVTOL** would be composite.



The industry already has sufficient experience in composites manufacturing

The eVTOL industry will readily leverage the capabilities in composite manufacturing developed by the aerospace and automotive industries over the years.



eVTOLs are entering the industry at a time when the industry is already well-versed with composite manufacturing and materials. This is one of the key enablers behind such high penetration of composites in eVTOLs.

Some eVTOL OEMs have even claimed that up to 90% of their aircraft will be made of composite materials.

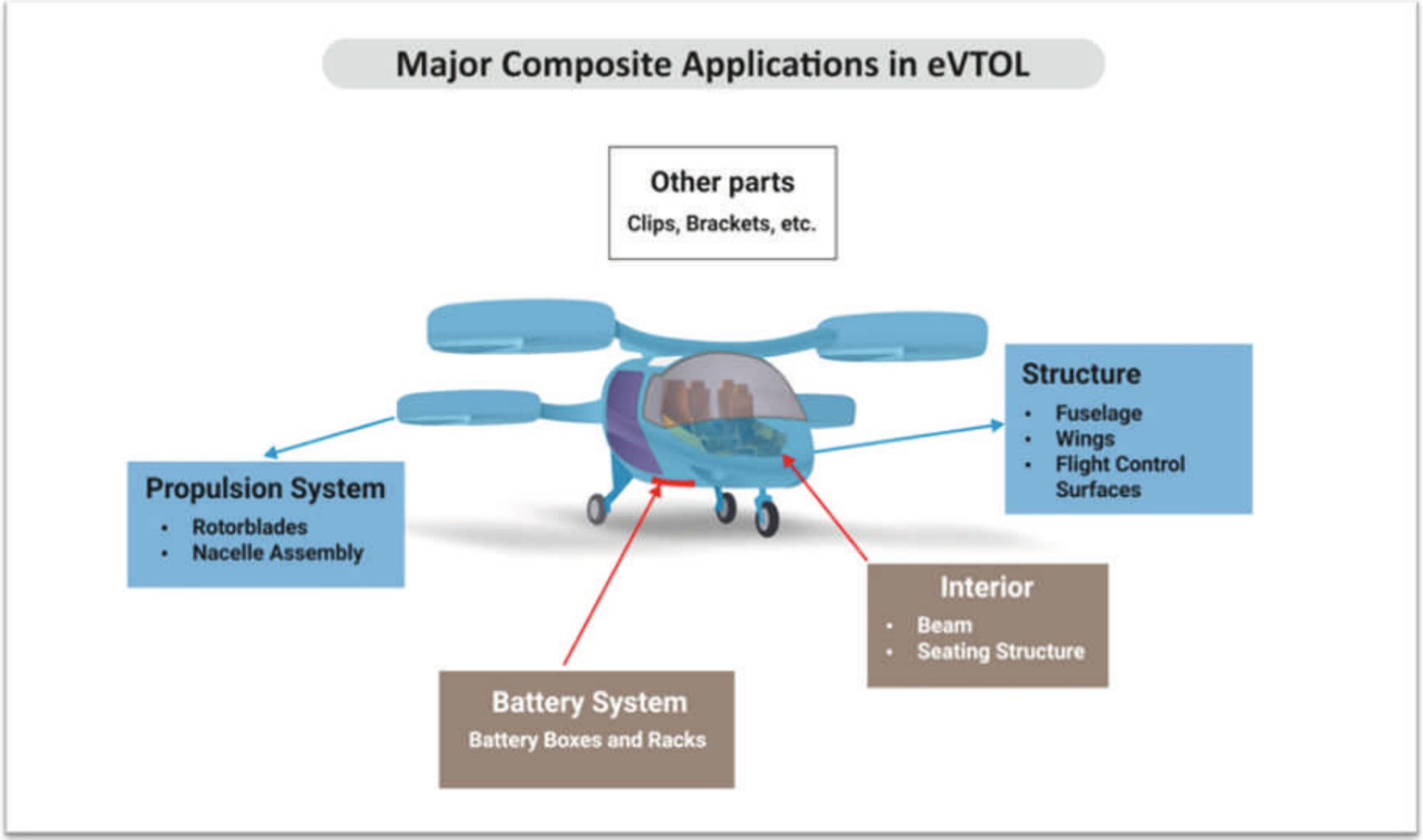


Figure: Major composite applications in eVTOL

How different is the manufacturing process going to be?

The eVTOL industry will follow on the footsteps of the aerospace industry and as a result, most of the key structural components will be made using VARTM during the low-rate production phase.

Potential fabrication processes for major composite applications in eVTOLs

Category	VARTM	HLU	AFP/ATL	3DP	PRESS MODLING
Fuselage	✓	✓	✓		✓
Wings	✓	✓	✓		✓
Nacelle Assembly	✓	✓	✓		✓
Rotorblades			✓	✓	✓
Clips, Brackets, etc.		✓		✓	
Battery Boxes and Racks					✓

HLU: Hand Layup
VARTM: Vacuum Assisted Resin Transfer Molding
3DP: 3D Printing

Process requirements for eVTOL manufacturing

In order to meet the volume targets, eVTOL manufacturing will need to adapt some high-volume manufacturing processes which are currently limited to the automotive industry.

Aerospace
(600-700 units/year)

- Hand Layup (slow)
- AFP/ATL (medium-fast)
- Vacuum Bag Only (slow)
- Bladder Molding (slow)
- Autoclave (medium)
- Press Molding (fast)
- Extrusion/Pultrusion (fast)

eVTOLs
(500-30,000 units/year)

Process Requirements:

1. For Prototypes & LRIP:
HLU/OOA

2. For high-volume production:
Automation and Molding

Automotive
(400,000+ units/year)

- Injection Molding (fast)
- Stamp Molding (fast)
- Press Molding (fast)
- Robotic "Pick & Place" (fast)
- High Pressure RTM (fast)
- Extrusion/Pultrusion (fast)
- Metal fabrication (fast)

Innovations in the industry for high-volume manufacturing

Once the yearly production volumes for eVTOLs crosses the 2,000 mark, the industry will have to switch to faster processes with lower cycle times. A joint venture, initiated by **Hengrui Corporation** and **Fraunhofer ICT**, has successfully demonstrated **High Pressure-RTM** as a viable solution for high-volume eVTOL manufacturing.

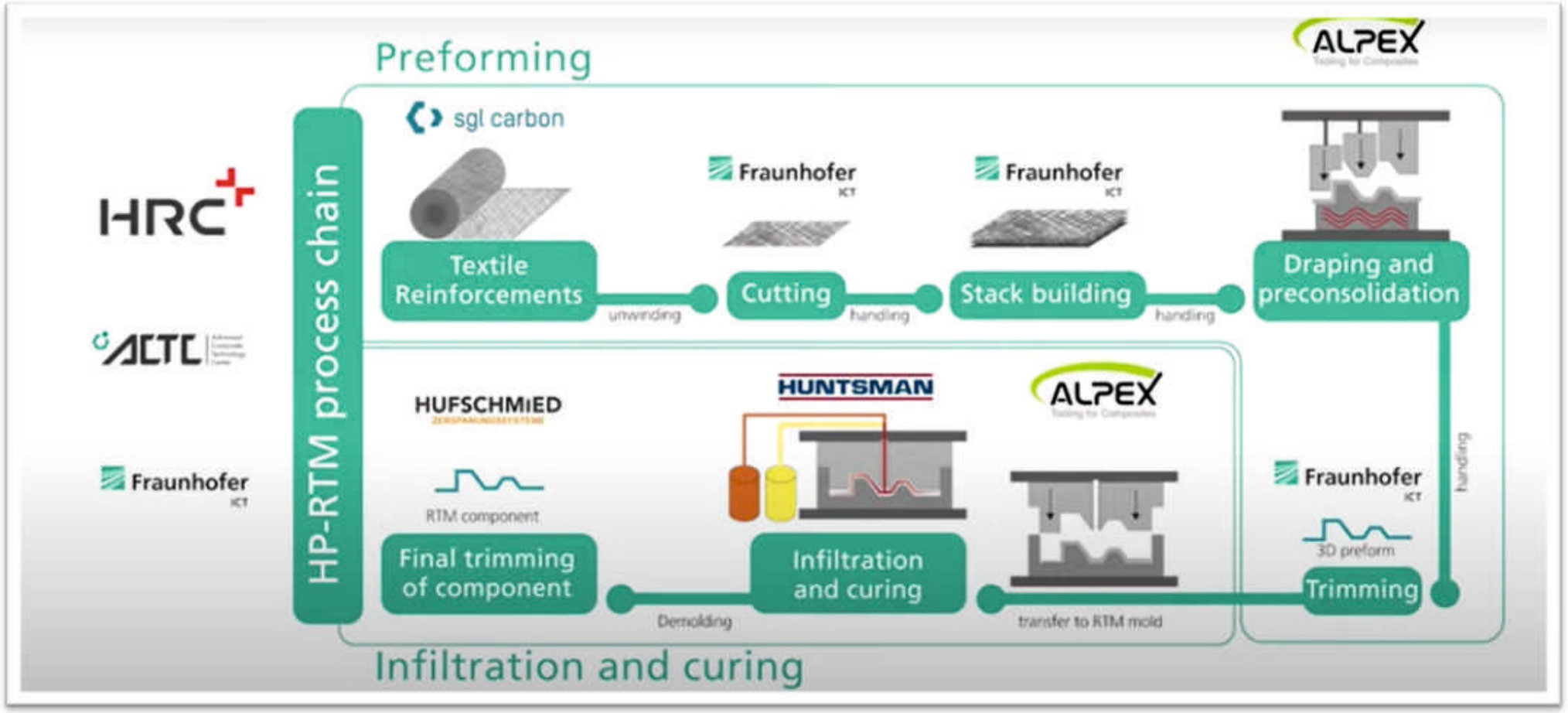


Figure: Contribution of different players at different nodes of the HP-RTM viability study.

5,000+ eVTOLs expected to be produced in 2028

As of February 2023, the eVTOL industry has ***5,000+ pre-ordered*** units in the pipeline. Once the OEMs are past the certification stage, the scaling will be rapid and the industry is expected to reach an annual production volume of 5,000+ by 2028.

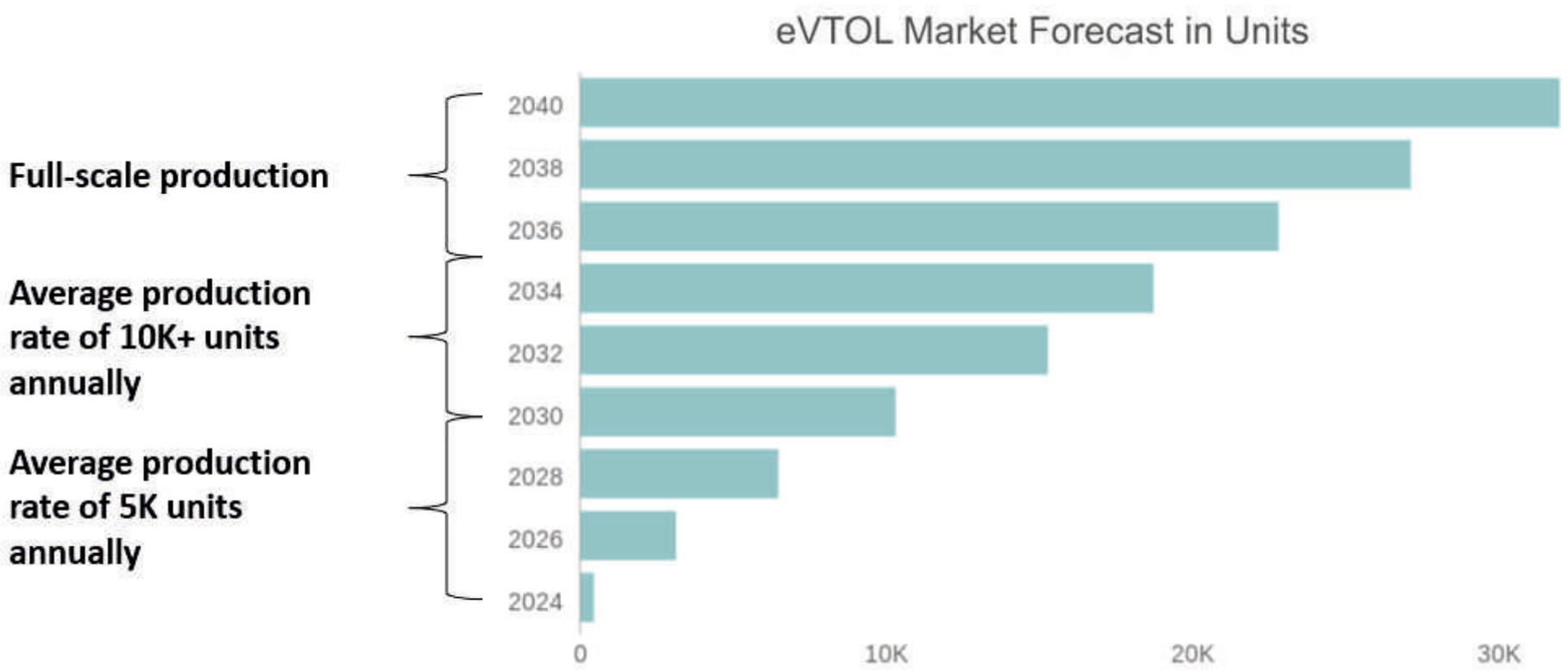
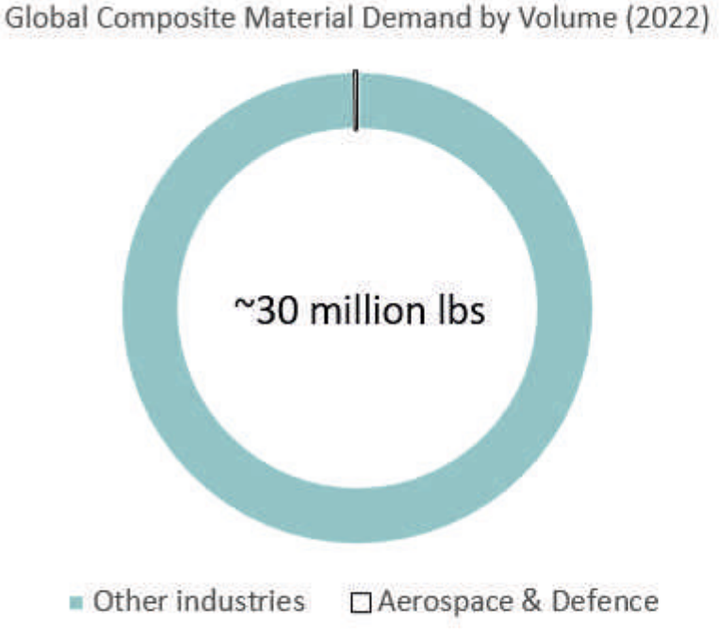


Figure: eVTOL market forecast in units (2024-2040)

The eVTOL industry will require ~77 million lbs of composite materials in 2040

A cumulative demand of **~87 million lbs** of composite materials is expected to be generated by the eVTOL industry within 5 years of commercialization i.e. during 2025-2030.



In 2022, the Aerospace & Defense industry accounted for **<1%** of the global composite materials demand by volume.

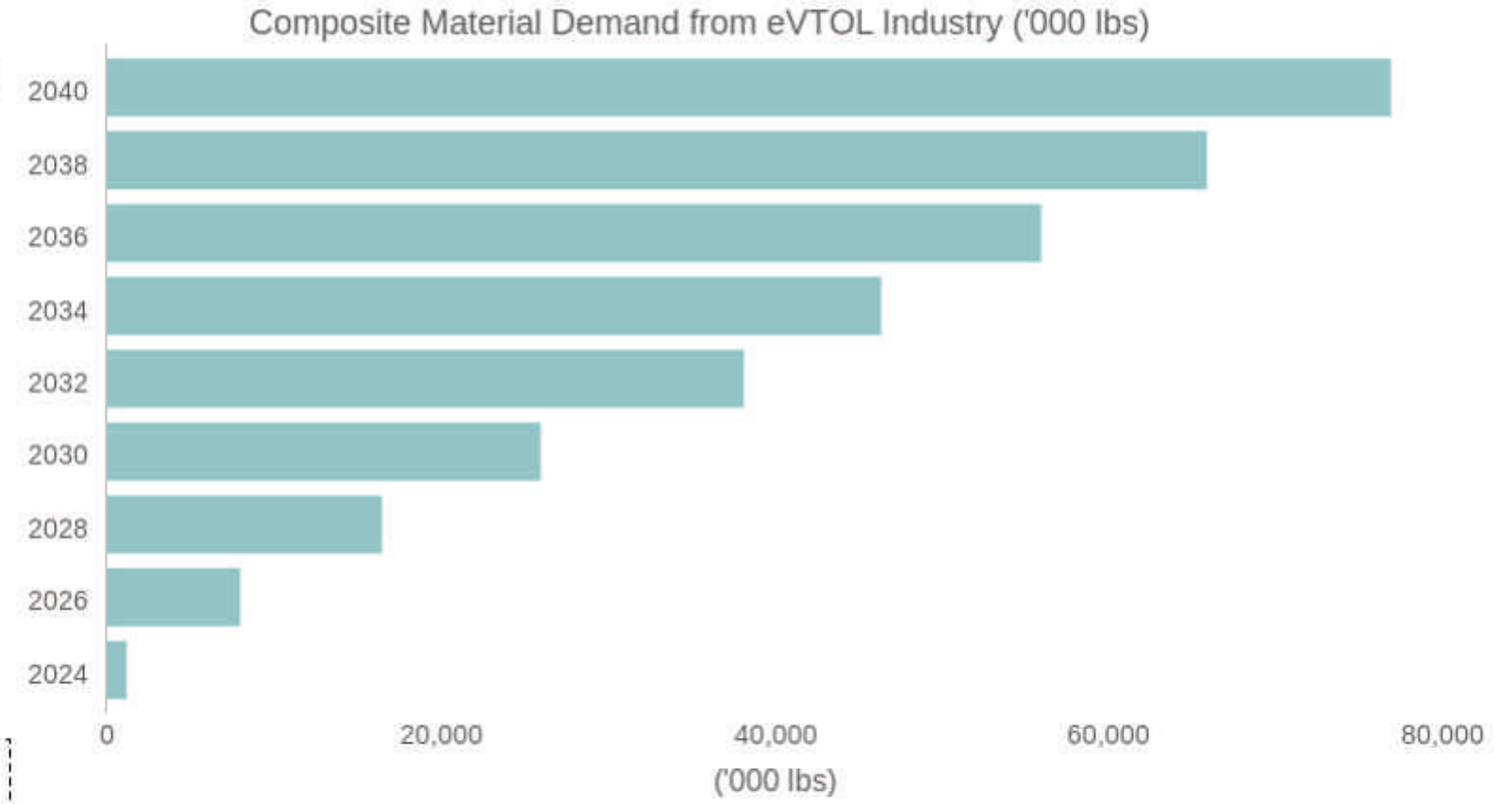


Figure: Composite material demand from eVTOL industry (2024-2040)

Easier certification vs Suitability for high-volume production

>90% of the eVTOL OEMs are choosing thermoset-rich models initially in order to get through the certification process smoothly.

OEMs with thermoset-rich models

MOBILITY REIMAGINED

wisk

VOLOCOPTER

LILIUM

Joby

OEMs with a fair amount of thermoplastic penetration

VERTICAL

JAUNT

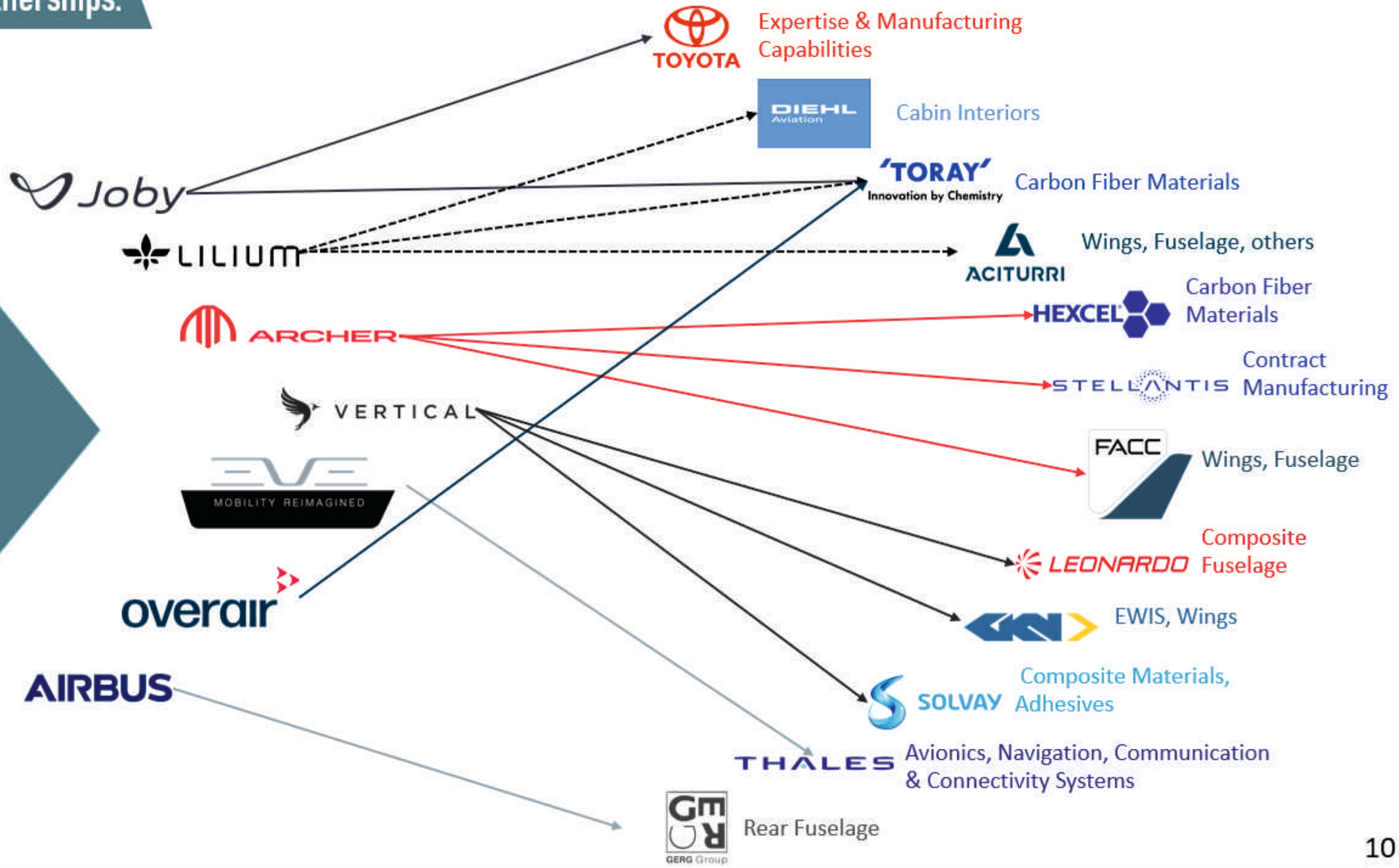
Thermoplastics are expected to have **~25% share** of the eVTOL composites market in 2040.

A higher degree of automated processing can be achieved with thermoplastics as compared to thermosets.

The average life of an eVTOL will be 15-20 years. Hence, recyclability will be a huge issue once the thermoset-rich eVTOL models complete their product-cycle.

Use of thermoplastics will also lead to reduction in cost of storing the materials and hence the overall cost of an eVTOL as well.

Alliances & Partnerships:



Certification: The ultimate challenge that every eVTOL OEM is facing

OEMs like Joby, and Lilium, which are ahead of others in the certification timeline, have both changed their commercialization targets from 2024 to 2025. Surprisingly, some OEMs which are still behind Joby and Lilium in terms of certification progress, are still targeting successful certification by 2024.

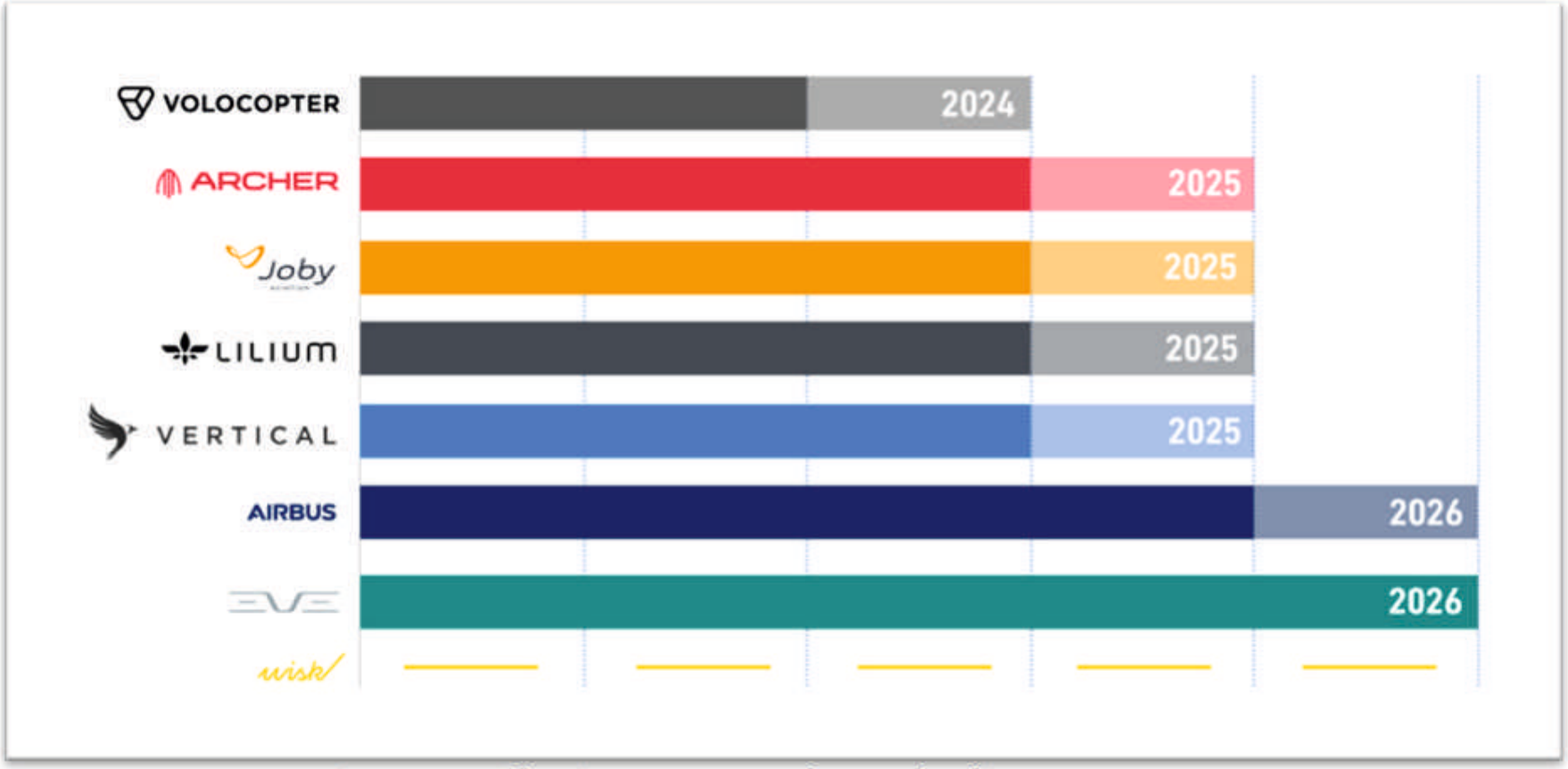


Figure: Certification progress of some leading eVTOL OEMs

Drivers

At least 35% lower CO2 emissions:
Key eVTOL OEMs are claiming at least 35% and up to 80% lower CO2 emissions as compared to ICEVs

Noise emissions lower than normal speech:
OEMs are claiming to have a noise footprint in the 45-65 dBA range

At least 3x faster:
Traveling via an eVTOL could be anywhere between 3x to up to 10x faster as compared to road taxis.

Community acceptance:
Since eVTOLs will be flying at much lower heights, it might be seen as an invasion of privacy by many.

Lack of infrastructure:
Developing a UAM-supporting infrastructure will be time taking and limited to a few cities initially.

Lack of trained pilots:
A huge no. of trained pilots will be needed for efficient operations of UAM fleets.

Challenges

The way ahead for the eVTOL-Composite alliance

2024-2030

The initial years of commercialized UAM flights with ~80% programs relying heavily on thermosets.

2030-2035

Increase in demand for composite materials that are suitable for automated production lines since majority of the production lines will be automated.

2035-2040

The industry will be at its full capacity, with sufficient development in infrastructure as well hence, the demand for materials will be at its peak.

Ahead of 2040

Use of specialized composite materials with up to 6x-7x shorter curing times as compared to the current standards.

Interested in mapping more opportunities in the eVTOL industry?

GET IN TOUCH

www.stratviewresearch.com

sales@stratviewresearch.com

/company/stratview-market-research