# Broadband winding technology: production of fiber composite pressure vessels

## About this project

### VeWin

### Broadband winding technology: production of fiber composite pressure vessels

**Markets:**

**Material:** Other biogenic materials, Basalt fibres, Other functional materials, Thermoplastics, Other metals, Other structural ceramics, Other (technical) textiles, Glass-fiber reinforced plastics (GFRP), Laminates, Other cellular materials (foam materials)

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## About this project

This project is funded by the Technology Transfer Programme Leichtbau (TTP LB) of the Federal Ministry of Economics and Energy.

Technology Transfer Program Leichtbau

## Context

Compact compressed air storage systems are required in many mobile applications, such as for level control in vehicles. In crash situations, such systems can lift the vehicle, thereby protecting the underbody with the battery. At the same time, the requirements in terms of weight and installation space are increasing, especially in electric vehicles. Metal containers made of steel or aluminum are robust, but result in higher weight and energy-intensive manufacturing steps.

Fiber-reinforced plastic composites offer a lighter alternative. However, there is currently no manufacturing process suitable for large-scale production of cylindrical, heavy-duty components. Conventional winding processes lay fibers or tapes narrowly and sequentially. This results in material accumulations at reversal points, increased scrap, and limited cycle times. In addition, the compaction of the composite is often uneven in complex winding patterns, which limits component quality. This is where the VeWin project comes in.

## Purpose

The participants are developing and testing a near-series thermoplastic winding technology for high volumes. At its core is a wide-band winding technique that processes pre-assembled, multi-layer fiber semi-finished products in large widths, enabling short cycle times and consistent component quality.

At the same time, the project partners are developing a joining step that reliably and reproducibly connects component interfaces and closures of a pressure vessel. As a use case, the project team is manufacturing a scalable compressed air storage tank for vehicles and demonstrating its function under realistic conditions – including the requirements for burst pressure and fatigue strength. In addition, the researchers are evaluating ecological and economic effects throughout the life cycle, such as lower mass, less waste, and reduced energy consumption in production.

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### Procedure

The project team is starting with the design of a scalable compressed air storage tank and deriving requirements for material structure, winding angle, and interfaces. Based on this, the participants are developing broadband-capable semi-finished fiber products and coordinating heating, contact pressure, cooling, and feed rate in such a way that a dense and load-bearing composite is created.

In the next step, the researchers design systems and tools that process the semi-finished product in large widths and cover different diameters. At the same time, they develop a stable joining step for the container ends and the intended joining surfaces.

The project partners then manufacture container shells and complete pressure vessels and test them in several development steps, for example for tightness, pressure load, load cycling, and behavior under practical conditions. Finally, the project team compares costs and CO# emissions with conventional metal containers and shows how the technology can be transferred to other cylindrical lightweight components.

**Funding duration:**

| | | | |
|---|---|---|---|
| **Funding sign:** | 03LB3090 | **Funding amount:** | EUR 1.4 million |

**Final report**

**Further websites** foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3090A - VeWin in the federal funding catalogue

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## Project coordination

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## English (EN){{ Projektpartner }}

## Lightweighting classification

| | Realisation |
|---|---|
| **Offer** | |
| **Products**<br>Parts and components, Systems and end products | ✓ |
| **Services & consulting**<br>Engineering, Prototyping, Validation | ✓ |

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## Lightweighting classification

| | Realisation |
|---|---|
| **Field of technology** | |
| **Design & layout**<br>Lightweight manufacturing | ✓ |
| **Functional integration**<br>Others | ✓ |
| **Measuring and testing technology**<br>Component and part analysis | ✓ |
| **Modelling and simulation**<br>Loads & stress, Life-cycle analysis, Materials | ✓ |
| **Plant construction & automation**<br>Plant construction | ✓ |
| **Recycling technologies**<br>Recycling | ✓ |

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## Lightweighting classification

| | Realisation |
|---|---|
| **Manufacturing process** | |
| **Additive manufacturing**<br>Others | ✓ |
| **Coating (surface engineering)**<br>Others | ✓ |
| **Fibre composite technology**<br>Filament winding | ✓ |
| **Forming**<br>Others | ✓ |
| **Joining**<br>Welding | ✓ |
| **Material property alteration**<br>Others | ✓ |
| **Primary forming**<br>Injection moulding , Others | ✓ |
| **Processing and separating**<br>Others | ✓ |
| **Textile technology**<br>Others | ✓ |

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## Lightweighting classification

| | Realisation |
|---|---|
| **Material** | |
| **Biogenic materials**<br>Others | ✓ |
| **Cellular materials (foam materials)**<br>Others | ✓ |
| **Composites**<br>Glass-fiber reinforced plastics (GFRP), Laminates | ✓ |
| **Fibres**<br>Basalt fibres | ✓ |
| **Functional materials**<br>Others | ✓ |
| **Metals**<br>Others | ✓ |
| **Plastics**<br>Thermoplastics | ✓ |
| **Structural ceramics**<br>Others | ✓ |
| **(Technical) textiles**<br>Others | ✓ |