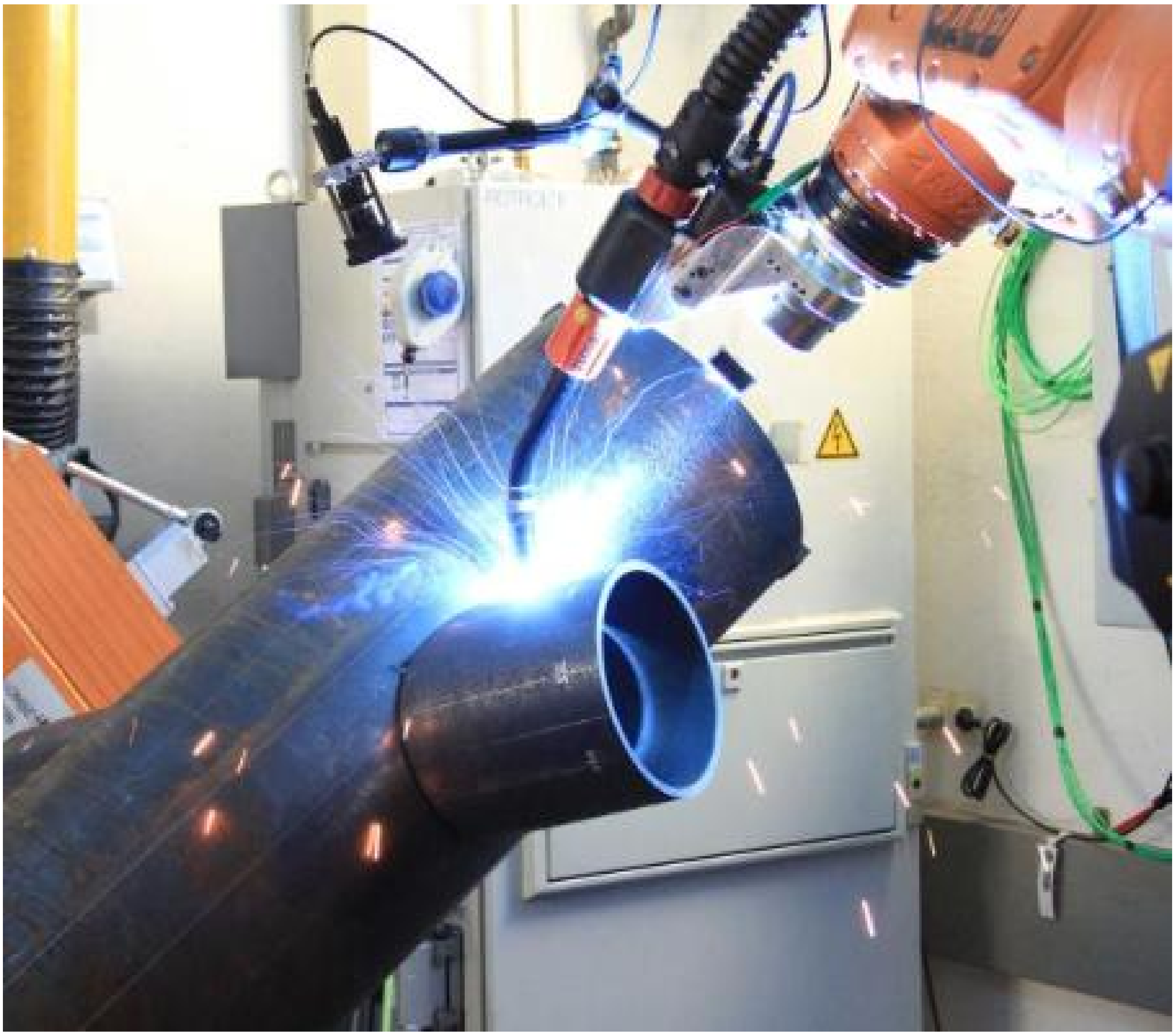
Lightweight in steel construction: end-to-end digitalised production and testing chain

About this project



SmartWeld

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Markets:

Material: Steel

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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

Offshore wind turbines stand on a huge support structure up to 60 metres high, the greater part of which remains hidden below the waterline. Today, a single steel pile, known as a monopile, is often used. Up to 2,000 tonnes of steel are welded together for this purpose - the production of which releases large quantities of CO_2.

The tonnage during transport and the amount of CO_2 released during steel production is significantly lower if more delicate support structures are used instead of the monopile. However, these lightweight structures, known as jacket foundations, pose a challenge in terms of production technology, meaning that potential CO_2 savings have not yet been realised on an industrial scale.

This is mainly due to the very complex weld seams: Today, the jacket foundations are usually welded together manually and later transported to their place of use using special ships. Tolerances in manual production and high safety requirements necessitate a conservative design, i.e. thick-walled components are used.

Purpose

The aim of SmartWeld is to make the use of lightweight construction techniques possible with an end-to-end digitalised production and testing chain in the construction of foundations. To achieve this, the welding process for the complex seams on the supporting structures is to be adapted so that it can be better automated. If this is successful, the seams will also be more durable. The structures could also be manufactured with thinner walls. They would therefore use less steel and thus save CO_2.

With an average 12-megawatt system, around 20 percent of the weight and therefore 400 tonnes of steel could be saved compared to a monopile. This corresponds to around 800 tonnes of CO_2. By optimising the design of the weld seams and making savings in the energy-intensive welding process itself, the proportion of CO_2 in production could be reduced even further. For a wind farm with 100 turbines by a total of more than 100,000 tonnes.

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Procedure

In order to utilise the new production technologies in industry as quickly as possible, the researchers are working as practically as possible. The industrial partners in the research project are developing demonstration systems suitable for series production under real manufacturing conditions. In this way, the research results can be transferred like a "blueprint" to other areas of steel construction in which large-format structures such as bridge constructions are manufactured.

Several demonstrator nodes are already being produced as part of the project, which will then be subjected to various fatigue tests - accompanied by simulations of crack development and crack progression. Tests that have already been carried out to automate the welding processes have significantly increased the production speed.

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Funding duration:

Funding sign:	03LB2022	**Funding amount:**	EUR 3.2 million

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2022A - SmartWeld in the federal funding catalogue

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Project coordination

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Lightweighting classification

	Realisation
Offer	
Products Parts and components	✓
Services & consulting	

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Others	✓
Functional integration	
Measuring and testing technology Component and part analysis	✓
Modelling and simulation Loads & stress	✓
Plant construction & automation Automation technology, Robotics	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining Welding	✓
Material property alteration	
Primary forming	
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites	
Fibres	
Functional materials	
Metals Steel	✓
Plastics	
Structural ceramics	
(Technical) textiles	