# From plate to power: automating foundation and tower manufacturing

As the wind industry races toward net zero and supersized turbines, Pemamek delivers the automation needed to keep up. With turnkey, intelligent manufacturing solutions for towers and foundations, it transforms production from labor intensive to high-performance, boosting throughput, quality and scalability.

Like many other manufacturing industries, the wind sector now stands on the threshold of a transformation. Net zero targets, increasingly larger turbine sizes and the need for optimized production efficiency, all amid a growing shortage of skilled labor, are accelerating change across the industry.

To meet these demands and build long-term competitiveness, manufacturers are required to evolve their processes to become more efficient, scalable, intelligent and predictable. Pemamek, a Finnish family-owned company, is leading that evolution by continuously investing in R&D and bringing innovative technologies to support manufacturers in meeting the growing demands of the industry.

For decades, the company has been known as a pioneer in advanced welding and production automation. Today, with turnkey solutions specifically tailored for wind tower and foundation production, it encourages the industry to rethink manufacturing. More than just a piece of equipment on the floor, it offers a pathway to smarter, faster and more reliable production, enabling companies to scale operations in step with the booming global wind sector.

### Winds of change: challenges and solutions

While growth brings opportunities, it also introduces new types of challenges. Wind turbines are growing taller and more powerful, with offshore installations being pushed further out to sea. Modern offshore projects demand XXL monopiles, with diameters reaching up to 15 meters, as well as massive towers and transition pieces that test the limits of today's manufacturing capabilities.

'At Pemamek, handling XXL monopiles with diameters up to 15 meters and weights over 4,000 tons is not a vision for the future, it's our present. Our turnkey solutions are backed by a solid track record, with proven technology operating around the clock across the globe,' comments Torben Blaaholm, Segment Director, Wind Energy, at Pemamek.

As dimensions increase, so does material thickness. In offshore monopile foundations, steel thickness can reach up to 180 mm. Maximum shell length can be 4.3 meters, while single shell weighs up to 150 tons. Traditional fabrication methods are too slow, labor intensive, or unpredictable to meet these new structural demands.

Pemamek's response is a modular, end-to-end manufacturing line concept that is fully customizable to each wind industry manufacturer's production needs. By combining heavy-duty welding automation, high-end welding processes, integrated material handling, digitalized production control and software, Pemamek enables manufacturers to boost throughput, improve quality, and reduce operational costs.


Backed by deep welding expertise and ongoing R&D in automation, digitalization and modularity, Pemamek is creating next generation solutions ready to meet new demands in scale, materials and production speed

At the core of this offering is the PEMA production automation line, a comprehensive solution covering every phase of tower and foundation fabrication, from plate joining and section assembly to full-section welding and final assembly welding. Similar solutions the company has delivered already to Haizea Wind Group in Spain and Sif in the Netherlands, to name a few.

**Key components of the PEMA production line**

- Plate lengthening lines with integrated edge preparation and welding
- Section assembly stations and roller beds for precise handling of XXL components
- Welding platforms and column & boom systems equipped with PEMA WeldControl for high-quality automated multi-layer welds, optimized to match varying material demands
- Heavy-duty milling and edge preparation systems tailored for thick-walled structures

Each system operates as part of a smart, connected production flow, with real-time data and intuitive interfaces enabling operators to supervise, monitor, control and optimize manufacturing performance. Critically, Pemamek's connected philosophy allows production capacity to scale step-by-step, minimizing risks and disruptions.

While Pemamek is the turnkey solution provider, the company collaborates closely with Lincoln Electric, Ficep, Microstep and Davi, to ensure each critical process step is accommodated, including cutting and bending.

## Productivity starts from understanding the details

Offshore wind is gaining momentum globally. In Europe alone, the offshore wind energy potential could reach up to 3,400 TWh by 2030. This growth is being driven by demand for larger and more powerful turbines, bigger foundations and floating wind farms. Soon, 15 meter diameter monopiles stretching up to 120 meters in length will become standard. Manufacturing these massive structures poses technical and logistical challenges, particularly around weld quality, structural accuracy and efficiency.

It addresses these challenges through advanced multi-layer welding technologies, which significantly boost productivity while ensuring precision.

'With new technology being developed, it's possible to place turbines farther offshore, but this also increases the demands on welders and equipment,' says Blaaholm. 'The foundations for floating structures are similar in complexity to those used in submarines, shipbuilding and oil rigs. By combining different PEMA welding automation solutions, it's possible to build these huge structures with the precision capacity and quality required.'

Central to this is PEMA WeldControl, a software system that automates multi-pass welding and adaptive filling. Operators become more like supervisors, as multiple welds are carried out simultaneously from a single control station.

'One of the most efficient methods for welding large structures is through the use of a triple long stick-out process in combination with PEMA WeldControl,' Blaaholm adds. 'This technology is backed by a proven track record, globally, in the industry. This, paired with robust handling systems like roller beds and assembly stations, delivers significant improvements in both performance and quality.'


The triple long stick-out process, combined with PEMA WeldControl and robust handling systems, delivers proven performance and quality gains in large, thick structure welding

Pemamek's decades in shipbuilding provide a critical foundation for floater manufacturing, where structural demands and production methods closely mirror those of ships and offshore structures

### Building it smarter

Looking ahead, the future of wind energy will demand even more innovation, not just in turbine design, but also in how critical components are manufactured. Drivers such as tighter productivity targets, labor shortages, regional investments and new floating technologies are pushing manufacturers to automate more of their operations.

Floating wind brings new structural and material challenges. Meanwhile, next generation turbines of 15 MW and beyond require thicker steel, larger diameters and longer weld paths, all of which test conventional production lines.

One of the lesser-known production inefficiencies in tower fabrication stems from joint geometry. To create the massive plates needed for tower shells, multiple smaller plates must be joined together. Traditional asymmetric X-bevels require a large cross-section, resulting in more weld passes, filler material and energy use.

The solution? Semi-narrow or narrow groove bevels, which reduce the cross-section and therefore cut down on welding time, cost and material usage, without sacrificing quality. Pemamek uses a long stick-out process in its applications, which offers high deposition rates, thanks to wire pre-heating, making it highly efficient for large and thick tubular structures like monopiles and towers.

### The road ahead

The company actively prepares its customers for the demands of tomorrow and supports their way in becoming operationally agile. With strong welding process know-how, R&D investments focused on automation, digitalization and modularity, the company is developing next generation solutions that can adapt to new scales, materials and speed requirements. Real-time data analytics are being increasingly integrated into the production process, helping operators make better and faster decisions.

Pemamek is also expanding its global presence, ensuring world class service, training and support wherever customers operate. Strategic partnerships with leading manufacturers and technology providers keep it at the forefront of industry innovation.

In a sector defined by ambition, growth and change, its message is clear: the future of wind energy demands a smarter, more sustainable and connected way of manufacturing. And Pemamek is ready to deliver it.

**About Pemamek**

Founded in 1970 and headquartered in Finland, Pemamek specializes in automated welding and production solutions for heavy industries.

With deep expertise in wind energy, shipbuilding, power generation and beyond, it delivers customer-oriented solutions that help global manufacturers meet today's toughest challenges and grasp tomorrow's biggest opportunities.

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