



The world's most efficient compressor

Enairon Gravity Compressor 400 MVSD-7

About Enairon

- Revolutionary Gravity Compressor

Enairon, a Swedish enterprise, is at the forefront of developing, producing, and delivering energy-efficient air compressors powered by its revolutionary Gravity Compressor. This groundbreaking technology is set to redefine the industry, ushering in a new era of unparalleled energy efficiency in air production. Our innovative approach utilizes water for compressing air, offering unmatched efficiency and sustainability.

Vision: Our vision is to revolutionize the industry by providing the world with the most efficient compressor technology, setting a new standard for performance and sustainability, thereby leaving the world better than we found it.

Mission: Our mission is to design, manufacture, and distribute the most efficient compressors in the world, helping businesses and industries reduce their energy consumption in the production of compressed air by 30-50%. We are committed to delivering exceptional quality, reliability, and energy efficiency, while minimizing our environmental impact and contributing to a more sustainable future.



The world's most efficient compressor

Enairon Gravity Compressor 400 MVSD-7 the next-generation compressor positioned to revolutionize air compression. Its exceptional energy efficiency, low maintenance, silent operation, long lifespan, and commitment to environmental standards make it a strong contender for businesses seeking peak efficiency, cost reduction, and a sustainable future.

Enairon Gravity Compressor 400 MVSD-7

Product data

- 400 kW motor power
- 78,43 W/Ncbm
- Efficiency >75%
- Consumes 37% less energy (range 30-50%)
- 5 100 Nm³/h in capacity at 20°C (85 Nm³/min)
- 7,5 bar in optimized output pressure
- MVSD (maximum variable speed drive)

Lifetime

>30 y

Energy savings

46 GWh

Monetary savings

3.9 m€
75 €/MWh

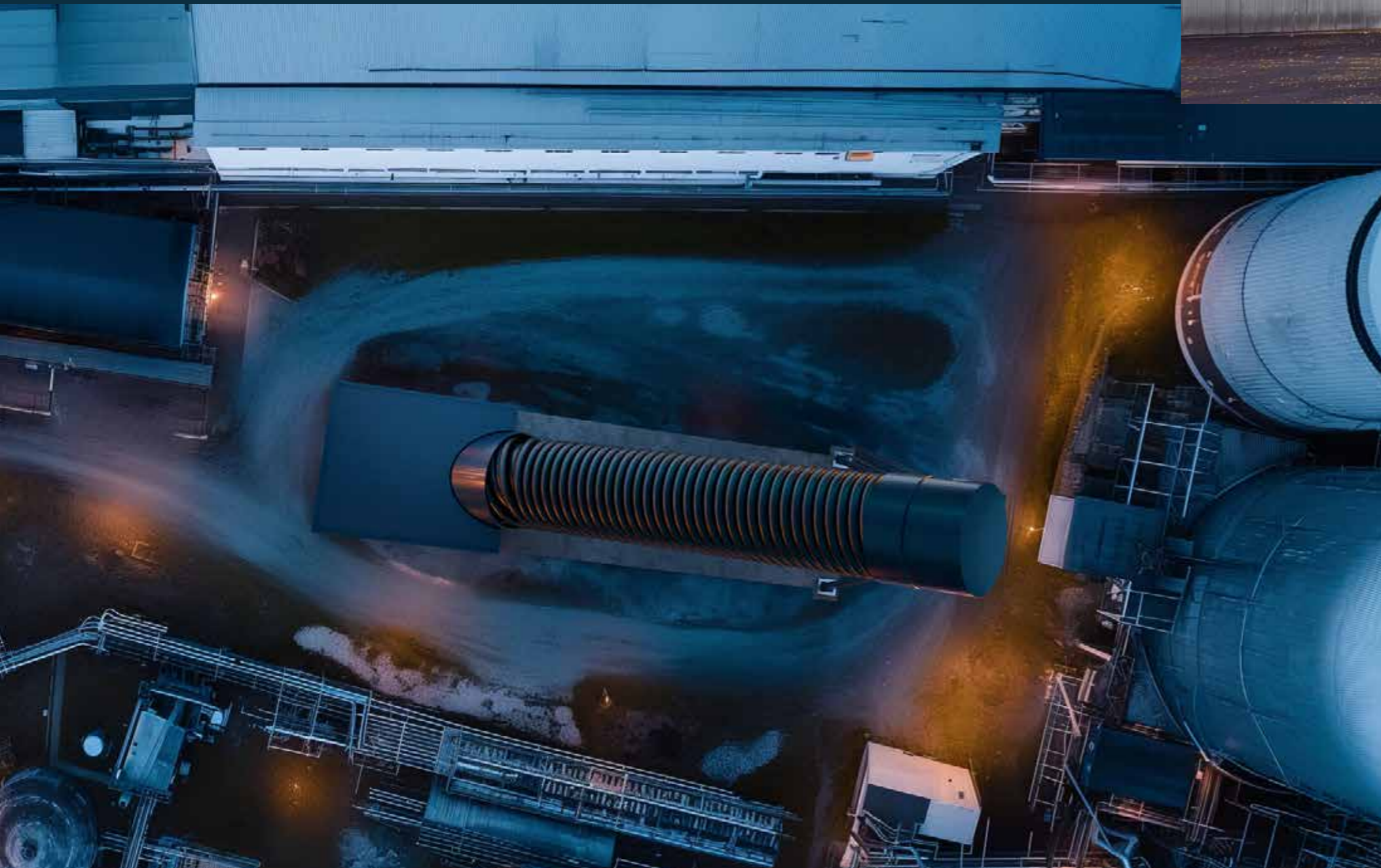
5.2 m€
100 €/MWh

7.7 m€
150 €/MWh

Gravity Compressor

– Utilizing water and gravity

Enairon's compressor is a new type of compressor, a Gravity Compressor. It is different and stands out from all existing solutions and uses water to compress the air. The design mainly consists of pipes twisted in a spiral pattern where water acts as pistons to compress the air. Utilizing water and gravity the world's most efficient process for compressing air is achieved.



Gravity Compressor Design

The compressor is constructed using PE-pipes with a continuously decreasing internal diameter, arranged in multiple spirals set at a 45-degree angle and organized in parallel. Each endpoint of every spiral is connected to two straight pipes running inside the spirals. One manages the return of water within the spiral, connecting the endpoint with the starting point of the same spiral. The other straight pipe connects the endpoint of the current spiral to the starting point of the subsequent one, exclusively facilitating the passage of air. Throughout operation, water remains within its designated spiral, while air seamlessly moves from one spiral to the next as pressure accumulates and increases in stages, ultimately reaching the endpoint of the last spiral where the air has reached the end pressure.

This thoughtfully engineered system, complemented by gravity, manages the separation of air and water, guaranteeing a seamless flow and process. Notably, the entire rotating apparatus operates passively, with only one single moving part. Once filled with water, the compressor necessitates no additional water intake; it solely requires air as the inflow and outputs only air.

How it works

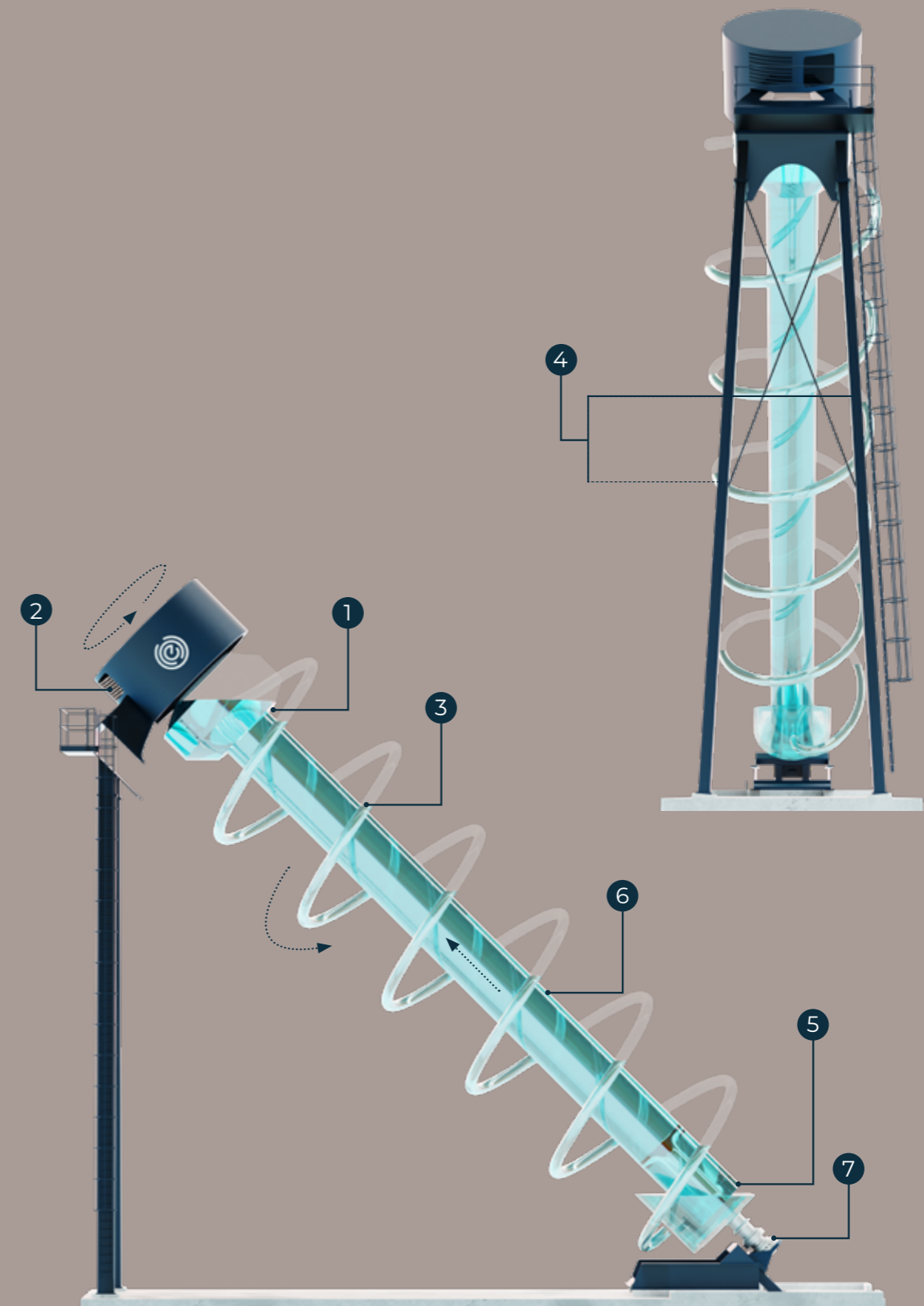
– We use water & gravity to compress air

The process starts in a top tank **(1)** which is open at the top to be able to draw in outside air through a filter **(2)**. The top tank is half-filled with water and air and alternately feeds this water and air into the spirals **(3)** that run down along the compressor.

The rotation in combination with gravity pushes the water and air down through the rotating spirals **(3)**. Gravity forces the water, that forms water pistons, to stay horizontally but the pressure from the air pushes the water pistons back out of equilibrium creating standing water pistons with height differences **(4)**. The height of the standing water columns translates to pressure differences, i.e., gravity creates the pressure difference. For each spiral revolution the air pressure is raised and accumulated to reach the end pressure. Thanks to the water pistons with high heat capacity the compression process is efficiently cooled through the entire compression process reaching an almost isothermal process with superior efficiency as a result.

The spirals end in a bottom tank **(5)**, where the water and compressed air is separated. The compressed water is recirculated utilizing that it is pressurized. The pressure is converted to potential energy when returned through the main central part **(6)** up to the higher situated top tank **(1)**.

The compressed air is taken out from the bottom tank **(5)** via an air pipe and a swivel **(7)** and is delivered to the consumer such as a factory's or industry's main piping system for compressed air.



Product Advantages

- Enairon's Gravity Compressor

The advantages of Enairon's Gravity Compressor are listed and explained in relation to most common existing comparable solutions. We begin with the fundamental advantages of the technology, which give rise to its operational advantages.

Fundamental Advantages

Superior Thermodynamics

The essence of energy conservation lies in minimizing heat generation. Unlike traditional compressors which struggle with heat due to adiabatic processes, Enairon's compression process is very cool, approaching an isothermal process without increase in temperature. The water pistons serve as multiple integrated cooling elements which stabilizes the temperature throughout the entire compression process. The air is also allowed to be pressurized slowly in multiple steps, creating a calm and stable process. While achieving absolute isothermality, or simply put 100% efficiency, is practically impossible, the Enairon Gravity Compressor comes remarkably close.

Outstanding Material Characteristics

The state of matter of the elements used to compress the air presents a distinct set of characteristics. Instead of using solid compressor elements like metal screws, pistons, or rotors, Enairon's technology employs liquid water as its compression element. Water does not deteriorate due to wear and tear, and its cost is almost negligible compared to precision machined metal parts.

Simple Construction

The patented principles upon which Enairon's Gravity compressor is built allow for a simple construction. The natural compliance of water means that the need for precision manufacturing is minimal to achieve high energy performance. The Gravity Compressor isn't constrained by extreme tolerances to prevent air leakage or excessive wear. The primary component of the compressor is the rotating spiral, representing a single large moving part. Beyond that, there are very few moving parts. This contrasts with conventional compressors, which have many more moving parts, sealings, and bearings that operate at higher speeds and temperatures.



Operational Advantages

Exceptional Energy Efficiency

This is the money maker. Enairon's Gravity Compressor achieves 75% energy efficiency, while comparable compressors, such as modern state-of-the-art "oil-free" VSD screw compressors, average efficiencies below 50%. The conventional alternatives barely manage to convert half of the supplied energy into compressed air, consuming on average 58% more electric power for the same air delivery as Enairon's compressor. As a result, Enairon's compressor significantly reduces energy consumption, achieving on average a 37% reduction in energy consumption for compressed air production, compared to state-of-the-art models.

Permanent Energy Efficiency

A part of the money maker, contributing to the a forementioned advantage. The difference in energy efficiency becomes even more pronounced as the screw compressor ages. Since conventional compressors rely on metal compression elements, which wear down and degrade over time, they struggle with increasing air leakages in the compression chamber. Independent studies, involving measurements of over 50 air compressors, suggest that traditional screw compressors experience a decline in efficiency by about 30% over a ten-year span. This implies that while the power consumption remains the same, the air capacity of the compressor diminishes.

Thus, the efficiency of today's comparable solutions fluctuates, starting at a peak of 53% (representing brand-new, laboratory condition units) and dropping to somewhere around 37%, or even below 25% in extreme cases. Enairon has conducted their own assessments in actual industrial settings, observing efficiencies ranging from 47% to 42% in moderately worn screw compressors. For a conservative estimate, Enairon compares its product to an alternative compressor which does not wear so much and sustains better performance over its lifespan, with an efficiency of 47% throughout its life. Since Enairon's Gravity Compressor uses water as pistons that don't wear out, its performance remains consistent. It preserves both its air capacity and outstanding energy efficiency throughout its operational life.



Wide Capacity Control Range

Many industries experience fluctuating compressed air consumption due to inconsistent processes and manufacturing flows. Enairon's Gravity Compressor offers an unmatched control range, allowing for exceptional modulation of power input and air output, ranging from 0 to 100%. This capability stands in contrast to competitive solutions that falter in the low power range, often unable to deliver below 30%. As a result, Enairon's technology provides enhanced control over airflow and electricity consumption. The underlying mechanics of this advantage are related to air leakage and rotational speed.

Enairon's Gravity Compressor operates at speeds below 15 rpm, which is notably lower compared to other air compressors. Screw compressors can sometimes operate at speeds of up to 25 000 rpm. Traditional compressors must operate at high rotational speed, and they always operate with leakages due to slips between solid components, such as metal screws moving within a metal chamber. The leakage ratio not only increases with wear but also with decreasing speed. By using water as pistons, Enairon's Gravity Compressor can operate at very low speeds or even come to a complete stop while maintaining air pressure without any leakage. This is possible due to the complete isolation of the air by water, ensuring a reliable seal. Thus, Enairon's compressor technology has no internal air leakage regardless of speed.

Great Reliability

The simplicity of Enairon's compressor technology translates to a reduced risk of breakdown when compared to conventional compressors. Enairon's Gravity Compressor uses a single rotating part, with water acting as pistons to compress the air. Due to its simplicity, robustness, and low number of moving components, along with the fact that Enairon's compressor undergoes no wear on its compression parts, it is potentially more reliable than other comparable technologies. While Enairon will need to validate this claim in the upcoming years, industrial maintenance technicians frequently highlight this potential advantage when evaluating the Enairon Gravity Compressor.

Low Maintenance

Building on the previous advantage, the maintenance requirements on Enairon's compressor are minimal. The components are few, simple, and durable. Those that do require maintenance are easily accessible. This results in fewer maintenance outages, enhancing customer productivity. Until Enairon collects more operating data, they opt to allocate a conservative estimate for major maintenance work and renovations to ensure caution in their calculations.

Long Lifetime of Machine

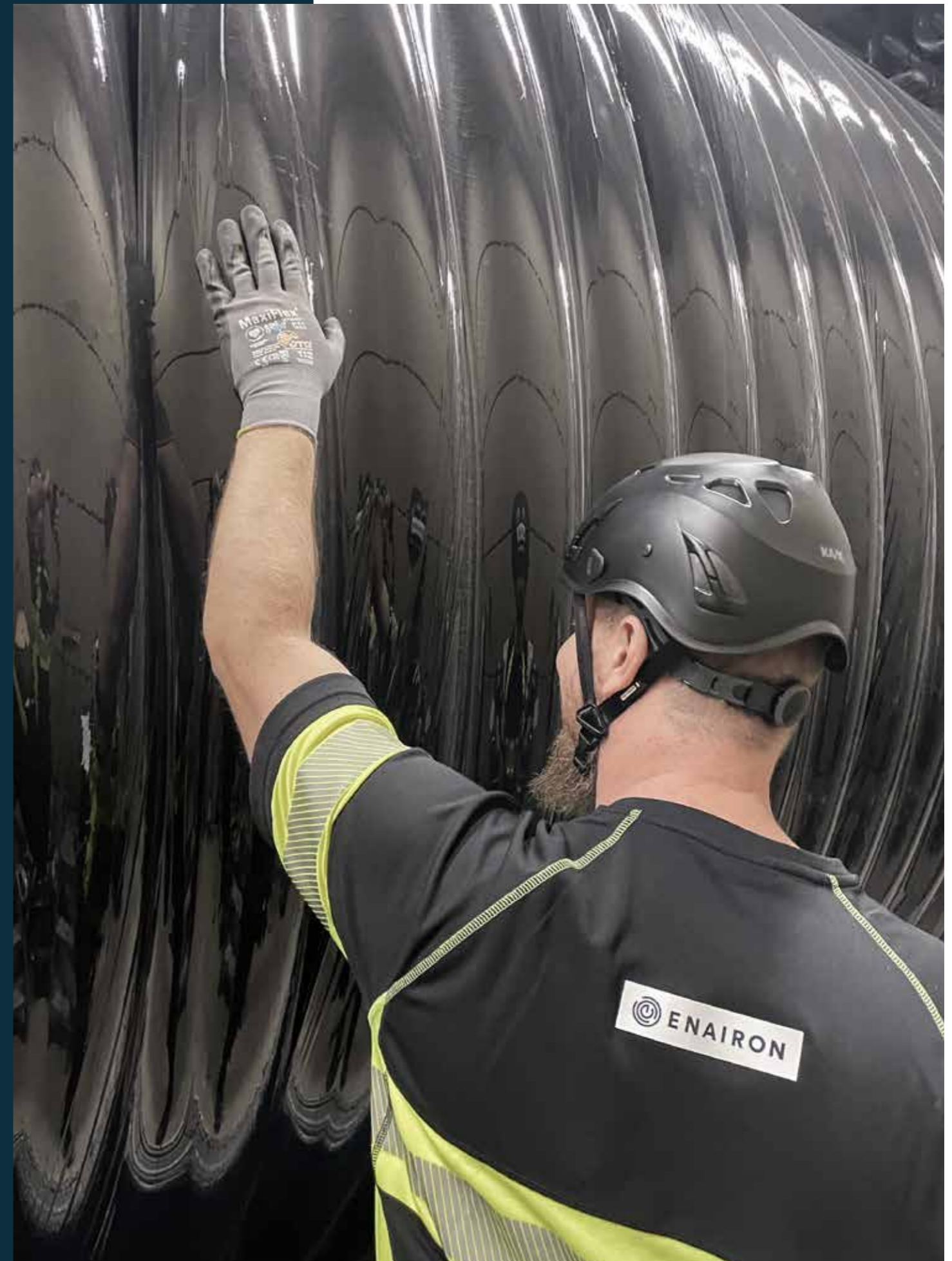
Another advantage, stemming from the previous ones, is the machine's longevity. Enairon's compressor offers a significantly longer lifespan compared to conventional technology. It is designed to be in operation for 30 years, while a conventional screw compressor is typically recommended for replacement after 15-20 years. The primary component in Enairon's compressor, the rotating spiral, is designed to last its entire 30-year lifetime. Additionally, since the pistons are made of water that doesn't wear out, the machine can achieve an exceptionally long life.

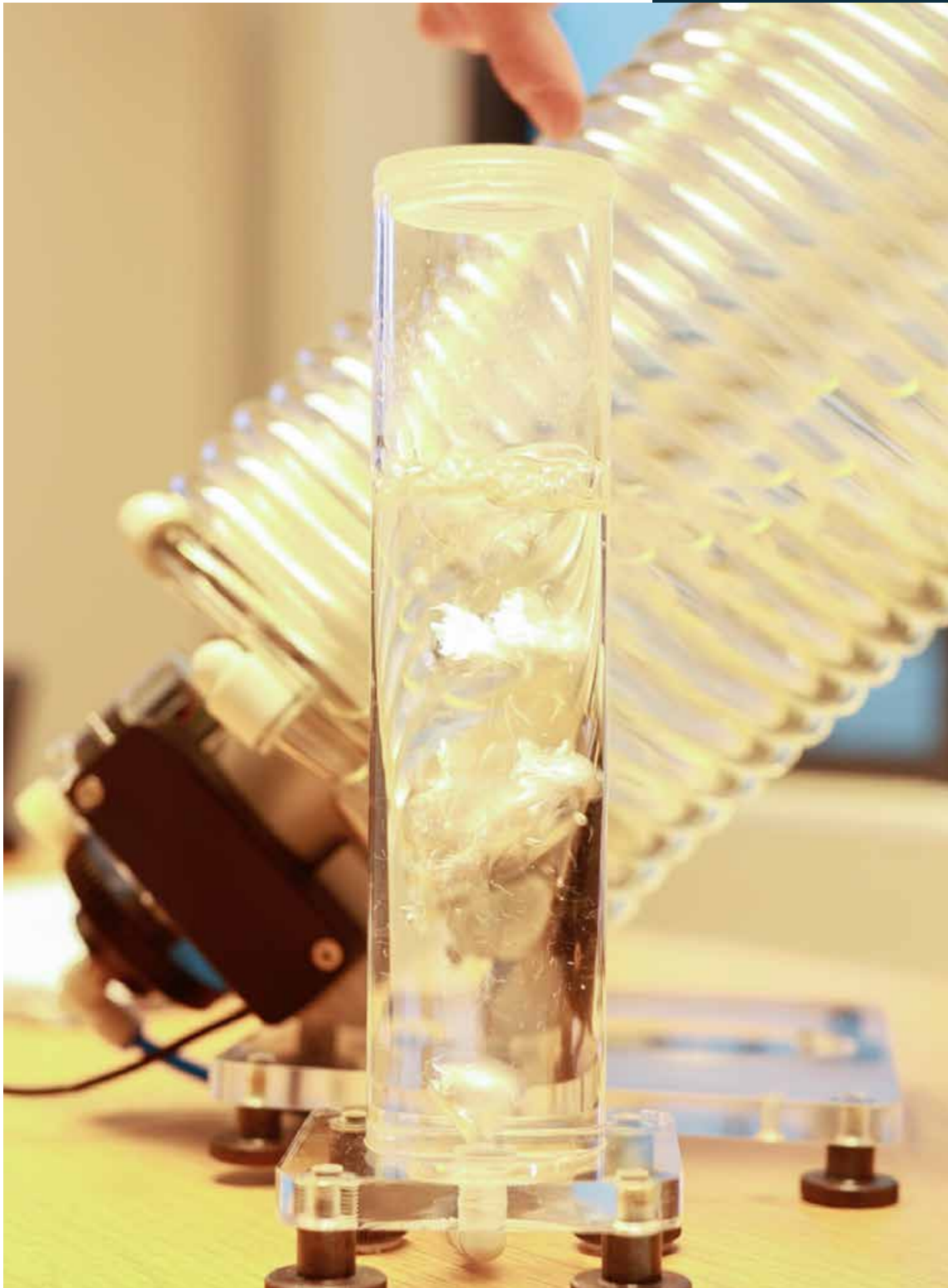
Clean, 100.0% & Oil-free Air Delivery

Enairon's compressor delivers 100% oil-free compressed air, ensuring no risk of compressed air contamination. This greatly benefits the quality of the customer's production and, and the health of industrial workers. The water pistons within the machine are self-lubricating, removes the need for oil or other lubricants in the compression process. This also eliminates the necessity for oil-removal filters. While many of today's compressor suppliers claim their machines are oil-free, they aren't truly oil-free since screws and pistons require lubrication. This, combined with inefficient air flows, results in a small amount of oil accompanying the compressed air, which then needs to be separated.

Silent Operation

Enairon's machine is almost entirely silent without vibrations, improving the working environment for industrial workers and reduces the sound profile of the industrial area.





Dry Air Delivery

Enairon's compressor delivers air with less moisture compared to conventional compressors, a direct result of the temperature difference. Enairon's Gravity Compressor operates at lower temperatures, delivering air at a cooler temperature than conventional compressors that operate at higher temperatures. Cold air holds less water than hot air. As a result, the subsequent air dryers require less power, as they don't have to work as hard to dry the air from Enairon's Gravity Compressor.

Consumes Less Cooling Water

Enairon's Gravity Compressor consumes approximately 37% less cooling water, which means that customers' cooling water systems can be downsized.

Suitable for Outdoor Positioning

A disadvantage of the Enairon compressor is its size, which requires more space than conventional technologies. As a result, the Enairon Gravity Compressor has been designed for outdoor placement. This effectively means that space can be freed up indoors where previous compressors were located. The importance of this feature varies among customers, but most have ample outdoor space and limited indoor space. This sometimes leads them to see the outdoor placement of Enairon's compressor as an advantage, especially since it often allows for positioning closer to high-consumption applications.

Reduced Lifecycle Cost

Over a 30-year timeframe, the lifecycle cost of Enairon's Gravity Compressor is approximately 34% lower when compared to the most common alternative, a modern "oil-free" VSD screw compressor. This significant reduction is due to both lower electricity costs and reduced maintenance expenses.

Reduced Carbon Footprint

Enairon's Gravity Compressors consume, on average, 2 GWh less electricity per year. This reduces the strain on society's electricity production and decreases carbon dioxide emissions. In the European Union, the carbon dioxide intensity of electricity generated is 238 g CO₂/kWh, whereas the global average is 475 g CO₂/kWh. This implies that a single Enairon compressor can save 476 tons of CO₂ emissions per year based on the EU's CO₂ equivalent, or 951 tons per year based on the global CO₂ equivalent.

Customer Testimonials

- stories from our customers

"The world's most efficient compressor was successfully installed at Stora Enso AB in a jointly financed project between Stora Enso and Enairon. The purpose of the project was to save electrical energy and pave the way for a technology that could revolutionize the compressor industry."

*Mats Marcus, Area Manager Energy Efficiency
Stora Enso AB*

StoraEnso AB

Stora Enso AB, a leader in the industry, champions sustainability and quality. Part of the global Stora Enso Group, the company emphasizes responsible practices, delivering high-quality paper solutions globally. With a focus on innovation and eco-friendly manufacturing, Stora Enso AB shapes a sustainable future for the paper industry.

Project

The project agreement between Stora Enso AB and Enairon was established in 2019 with the objective of implementing the first large-scale verification of the Enairon Gravity Compressor. Following the successful construction of prototypes, the technology underwent extensive testing, providing a continuous and substantial air supply to the paper mill in Hylte Bruk over several months. The project achieved its goals, demonstrating the Enairon compressor's success in managing fluctuating air demand within the factory. Operating at 7 bar, the 36kW compressor showcased remarkable flexibility, swiftly adjusting from 0 to 100% capacity in less than 10 seconds.





Image ownership: Höganäs AB

“At Höganäs, we are continuously striving to reduce our energy consumption and climate footprint. Our investment in the Enairon Gravity Compressor marks a significant step forward in meeting our needs for compressed air. With high energy efficiency, it will not only lower costs but also enhance sustainability. Additionally, its quiet operation will improve our workspace. We look forward to installing the Gravity Compressor on our site.”

*Magnus Pettersson, PhD
Energy Coordinator at Höganäs AB*

Höganäs AB

Höganäs AB, a leader in powder metallurgy, blends a rich legacy with cutting-edge innovation. Renowned globally, the company’s commitment to sustainable practices and precision solutions sets it apart. From automotive to industrial applications, Höganäs AB’s products redefine standards. With a global reach, efficient supply chains, and a focus on corporate responsibility, the company shapes a future where metal industries thrive sustainably.

Project

The project will introduce the next generation Gravity Compressor to Höganäs AB by 2025. The installation will take place at Höganäs headquarters in Sweden. The Enairon compressor’s capacity 5100 Ncbm is designed to efficiently manage peak airflow demands while also adapting to low-flow periods, optimizing energy consumption. The anticipated outcome includes a substantial 37% reduction in energy usage compared to Höganäs’ current air compressor solution. This compressor marks the inaugural release of Enairon’s next-generation Gravity Compressor, with plans for future mass production in the years to come.

Enairon Green Air Service Package

- Enairon's Gravity Compressor

The Enairon Gravity Compressor comes bundled with a comprehensive service package designed to provide our customers with a worry-free service solution, eliminating unexpected costs for repairs, service & maintenance. This all-inclusive package covers service & maintenance, support, software updates, technology license and API.

Our service package ensures a dependable and environmentally friendly production of compressed air. The Enairon Green Air Service Package guarantees the most energy-efficient production of compressed air globally, reducing your carbon footprint and ensuring the cleanest possible operation in terms of energy consumption.

Included in the Enairon Green Air Service Package:

Service & Maintenance: Enairon continuously monitors the status and diagnosis of the compressor through VPN, providing annual service. Service and maintenance are encompassed within the service package; however, spare parts are not covered once the warranty period expires.

Support: Free support is available during office hours (07:00-16:00). Extended support hours with customer-specific SLA can be developed upon request.

Software Updates: Annual updates of the Enairon software platform.

Technology License: The Enairon Green Air Service Package grants user rights to use the Gravity Compressor.

API: The Enairon Gravity Compressor software is designed to communicate with external software platforms.



Savings Calculator

The Enairon Gravity Compressor presents a number of distinctive advantages over current compressed air solutions, including heightened flexibility, silent operations, extended lifetime, reduced service and maintenance needs, and liberated indoor production space. However, its primary benefit lies in exceptional energy efficiency, leading to substantial cost reductions. The extent of these savings is contingent on electricity prices and average air output. Notably, the calculator focuses solely on enhanced efficiency compared to existing industrial screw compressors, omitting considerations like reduced service costs and extended lifetime.

Average Output	Electricity Price	Monetary Savings [M€]		Energy Savings [GWh]	
		1 y	30 y	1 y	30 y
5 000	75	0,13	3,86	2,1	64
5 000	100	0,17	5,15	2,1	64
5 000	150	0,26	7,73	2,1	64
4 000	75	0,10	3,09	1,7	52
4 000	100	0,14	4,12	1,7	52
4 000	150	0,21	6,18	1,7	52
3 000	75	0,08	2,32	1,3	39
3 000	100	0,10	3,09	1,3	39
3 000	150	0,15	4,64	1,3	39

The past, present and future

– How it all started in 2014

Enairon's inception marked a pivotal moment when innovation unfolded under the keen gaze of Daniel Ehrnberg in 2014. A physicist with an enthusiastic dedication to pioneering inventions for a sustainable future, Daniel's journey began with a profound study of the ancient Archimedes pump. In the simplicity of this age-old technology, his visionary mind recognized the potential to evolve and build upon this foundational technology, paving the way for a more advanced solution.

During a solitary weekend at home, Daniel, fueled by his passion, delved into experimentation. In a groundbreaking moment, he successfully engineered a model that generated pressurized air instead of merely pumping water. This initial model not only facilitated the separation of water and air but also ingeniously managed to harness and reuse the energy from the pressurized water. In this transformative moment, the world witnessed the birth of the world's most efficient compressor the "Enairon Gravity Compressor". Overwhelmed by the magnitude of his achievement, Daniel exclaimed, "Eureka," capturing the essence of a discovery that would redefine the landscape of air compression technology.

In the subsequent years, Daniel transformed his invention into a fully-fledged innovation. Through successful validation in collaboration with Chalmers University of Technology in 2015/2016, the invention garnered substantial credibility. Rigorous performance tests and the development of a theoretical model at Chalmers University, scrutinized by independent professors and researchers, further established its legitimacy. The continuous efforts from 2015 to 2016 resulted in the creation of numerous prototypes, showcasing an unparalleled level of energy efficiency that surpassed all previous benchmarks.



In 2016, Daniel initiated collaboration with Theo, the current CEO of Enairon, leading to the formulation of the business model for Enairon. Utilizing this comprehensive roadmap and fortified by outstanding data, Enairon was officially established as a company in 2017.

In the subsequent years, a robust and extensive patent portfolio was diligently established and globally approved, marking a crucial milestone for the company. This accomplishment paved the way for the initiation of the first customer contacts. In a significant milestone in 2021, Enairon achieved its first large-scale validation by delivering its technology to Stora Enso Paper AB.

Looking ahead to 2025, Enairon is gearing up for another major leap with the construction and delivery of the next generation of compressors to Höganäs Sweden AB, a prominent global player in metal powder production. This forthcoming delivery serves as a pivotal step toward the imminent global launch and scale-up of the Enairon Gravity Compressor.

Today, we stand at the forefront of the industry with a dedicated and expert team, ready to usher in the next generation of gravity compressors. Our strength lies in a robust patent portfolio, technology validated through successful reference installations, and a market clamoring for a more energy-efficient compressor solution. With our highly skilled and adept organization, Enairon is not merely challenging global compressor suppliers; we are prepared to redefine the very future of compressor technology.





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